

**DEPARTMENT OF VETERANS AFFAIRS
NCA MASTER SPECIFICATIONS**

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**SECTION 01 00 01
GENERAL REQUIREMENTS**

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SECTION 01 00 01 (MAJOR NCA PROJECTS)
GENERAL REQUIREMENTS

1.1 GENERAL INTENTION

- A. Completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for Sacramento Valley National Cemetery as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. Offices of Anderson Engineering of Minnesota, LLC, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Resident Engineer (RE) or duly authorized Contracting Officer Representative (COR).
- 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 notify the RE/COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall not be less than three working days unless otherwise designated by the RE/COR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program. Obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access. Photo ID shall be required by all personnel.
- F. Prior to commencing work, general contractor shall provide proof that an OSHA certified "competent person" (CP) as defined in 29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general contractor or subcontractors are present.
- G. Training:
 - 1. All employees of general contractor or subcontractors having supervisory responsibilities shall have the 30-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA CP.

2. All other employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and/or other relevant competency training. Relevant competency training shall be as determined acceptable by the VA CP.
3. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. CLIN 001, BASE BID: Work of the Contract includes general construction, alterations, roads, walks, grading, drainage, mechanical and electrical work, utility systems, water storage facilities, crypt installation, precast columbaria and necessary removal of existing structures and construction and certain of other items.
- B. CLIN 002, CRYPT (BASE BID - FABRICATE AND DELIVERY ONLY)
- C. CLIN 003, ADD ALTERNATE #1 COLUMBARIUM 3
- D. CLIN 004, ADD ALTERNATE #2, NEW BURIAL SECTIONS 45, 53 & 54 WITH ASSOCIATED PAVING
- E. CLIN 005, ADD ALTERNATE #2, CRYPT (ADD ALTERNATE #2 - FABRICATE AND DELIVERY ONLY)

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, five (5) full-sized drawing sets and five (5) sets of specifications will be furnished as well as an electronic set of plans and specifications.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:
 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
 2. Assure that all sub-contractors working on the project and their employees also comply with these regulations. Dismissal of violators may be directed by the Resident Engineer.
- B. Security Procedures:
 1. Contractor's employees shall not enter the project site without an appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
 2. For working outside the "regular hours" as defined in the contract, give 3 days' notice to the RE/COR so that security arrangements can

be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.

3. No photography of VA premises is allowed without written permission of the RE/COR.
4. VA reserves the right to close down or shut down the project site and order Contractor's employees off the premises in the event of a national emergency. Return to the site only with the written approval of the RE/COR.

C. Key Control:

1. Provide duplicate keys and lock combinations to the RE/COR for the purpose of security inspections of every area of project including tool boxes and parked machines and to take any emergency action(s).
2. Turn over all permanent lock cylinders to the VA locksmith for permanent installation. Coordinate the lock cylinder and key system work and shall provide the devices required to comply with the facility security system. See Section 08 71 00, DOOR HARDWARE and coordinate.

D. Document Control:

1. Perform safekeeping procedures for all drawings, project manual and other project information. This information from these shall be shared only with those with a specific need to accomplish the project.
2. 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/COR upon request.
3. These security documents shall not be removed or transmitted from the project site without the written approval of the RE/COR.
4. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
5. Notify RE/COR immediately when there is a loss or compromise of "sensitive information".
6. All electronic information shall be stored in a specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).

E. Motor Vehicle Restrictions

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

1.5 FIRE SAFETY

- A. Applicable Publications: 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.

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

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

2. 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 |
| 70-2011 | National Electrical Code |
| 241-2013 | 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 RE 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 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 RE/COR 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. Not applicable this project
- F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with RE.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to RE/COR.
- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with RE and obtain permission from RE before commencing hot work. Designate the Contractor's responsible project-site fire prevention program manager to coordinate hot work.
- L. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to RE.
- M. 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 and Construction Waste Management Plan required under Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. Remove from buildings daily.
- 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 RE/COR. 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 RE/COR 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 RE/COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the RE/COR. 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. 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.
- E. Working space and space available for storing materials shall be as shown on the drawings and may be altered/expanded as determined by the RE/COR.
- F. Workmen are subject to rules of the Cemetery regarding their conduct and dress code.
- G. 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.
 - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by the Department

of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access, for the Cemetery personnel, to areas that are required to remain in operation during the construction of the project.

3. Where 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. All such actions shall be coordinated with the Utility Company involved and the RE/COR.
- H. Phasing: To insure such executions, furnish the RE/COR with a schedule of approximate phasing and dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, notify the RE/COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive and/or concurrent phases as is mutually agreeable to the RE/COR and Contractor.
- I. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, six feet minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by RE/COR.
- J. Utilities Services: Maintain existing utility services for the Cemetery at all times. Meet with the RE and appropriate Cemetery operations staff to walk the proposed work areas and discuss any known or potential underground systems that are indicated or not shown on the construction drawings, prior to starting the work.
 1. Provide an underground utility locating service to locate any existing underground lines within the work area that are to remain in service. Any new information, not clearly indicated on the bid documents shall be passed on to the Contractor's underground locating service staff. Any new information discovered by the underground locating service staff shall be turned over to the RE/COR for resolution.

K. 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 the RE/COR.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of the RE/COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the RE/COR, and Cemetery Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
2. Submit a request to interrupt any such services to RE/COR, and Cemetery Director, in writing, 21 calendar days in advance of the outage to the RE. 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 may occur at other than Contractor's normal working hours at no additional cost to the Government.
4. Major interruptions of any system must be requested, in writing, at least 21 calendar days prior to the desired time and shall be performed as directed by the RE/COR, which may require the work to be performed off hours which shall be done at no additional cost to the Government.
5. In case of a contract construction emergency, service will be interrupted on approval of RE/COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam,

payment of such fee shall be the responsibility of the Government and not the Contractor.

- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed. Lines shall be 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 RE/COR.
- N. Coordinate the work for this contract with other construction operations as directed by RE/COR.
- O. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. Cooperation and coordination with the Cemetery Director, through the RE/COR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas, is required. Construction noise during the interment services shall not disturb the service. Coordination of work may require that equipment that is heard from the service location be shut-off, or moved out of the area prior to the service, as acceptable to the Cemetery Director through the RE/COR. Trucks and workmen shall not pass through the service area during this period:
 - 1. Discontinue work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, and clean up all areas of operation adjacent to functioning areas of the Cemetery, including existing burial sections before these dates.

2. Clean-up activities shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 1. Reserved items which are to remain property of the Government are identified by attached tags or noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by RE/COR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the National 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 and Capacitors: The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors. The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the RE/COR who will annotate the contract file and transmit the Manifest to the Cemetery 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 CRR 173 | Subpart A General |
| 49 CFR 173 | Subpart B Preparation of Hazardous Material for Transportation |
| 49 CFR 173 | Subpart J Other Regulated Material; Definitions and Preparation |
| TSCA | Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 |

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

- A. Preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work sites, which are not to be removed and which do not unreasonably interfere with the work required under this contract. Remove trees only when specifically authorized to do so, 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, then trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the RE/COR.
- B. 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. 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 RE/COR may have the necessary work performed and charge the cost to the Contractor. Paragraphs 1.10.A and 1.10.B are from (FAR 52.236-9).

- 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 apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
 - 1. Designating areas for equipment maintenance and repair;
 - 2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
 - 3. Locating equipment wash down areas on site, and providing 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.

1.9 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the RE/COR. Existing work to be altered or extended and is found to be defective in any way, shall be reported to the RE/COR before it is

disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

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

1.10 PHYSICAL DATA

- A. Data and information furnished in the bid documents 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.
- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.
- C. A copy of the soil report will be made available for inspection by bidders upon request to the Contracting Officer, 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, bidders will be permitted to make subsurface explorations of their own at site.

1.11 PROFESSIONAL SURVEYING SERVICES

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

1.12 LAYOUT OF WORK

- A. 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. 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. Execute the work to the lines and grades that may be established or indicated by the RE/COR. Maintain and preserve all stakes and other marks established by the RE/COR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the RE/COR may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor. Paragraph 1.14.A is from (FAR 52.236-17).
- B. Establish and plainly mark reference lines for all buildings, gravesite control monuments, locations for each sprinkler head within the burial section as detailed or at the point equal distance from the closest point on surrounding planned headstone locations, footings and foundations for columbarium and memorial walls and elements in their respective complexes and all 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, and all other facilities to be constructed as part of the work for this project. The surveyed layout information shall be accurate to the highest industry standards for the respective type of work, all in accordance with lines, orientation, locations 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/piers in two 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 RE/COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) are placed.
2. The forms for the concrete foundations, of the columbarium and memorial wall elements and complexes, where exposed in the final installation, require tighter construction tolerances than for general foundations (See Drawings for the allowable tolerances). For the exposed foundations of these elements provide such additional survey points and elevations as are needed so a registered land surveyor, or registered civil engineer can quickly check the work and provide the required certification(s) before concrete is poured. Contractor shall install and adjust the forms sufficiently in advance of scheduling the concrete pour(s) so they can be checked and certified prior to concrete being poured. The required certification(s) by the registered surveyor or engineer to the Contractor and/or RE/COR shall be provided before concrete is poured in the forms. The signed certification(s) shall identify the specific forms for which the certification is applicable, and shall contain language that clearly indicated that the identified foundation forms for the portions of the work that will be exposed in the final installation, and to a depth below expansion joints where the foundations abut new rigid hardscape (concrete, stone, pavers, etc.) are at the correct location, correct dimensions, and correct orientation, and that the indicated pour elevations are correct, all according to the contract drawings, within the allowable construction tolerances. Indicate the allowable construction tolerance for the dimensions, orientation, location and elevation of the forms for layout and elevation of this work. The

Certification that the form work and elevations are according to the design drawings, within allowable tolerances (which need to be indicated in the certification) should be provided to the RE/COR for review and acceptance prior to concrete for the foundations being poured.

- D. During progress of work, the Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the RE/COR before any major items of concrete work are placed. In addition, furnish to the RE/COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
1. Lines of each building and/or addition.
 2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines of grave plot documentation.
 5. Lines of elevations of all swales and interment areas.
 6. Lines and elevations of roads, streets and parking lots.
 7. Lines and elevations of top of pre-placed crypts.
 8. Lines and elevations of grade over pre-placed crypts.
 9. Northing/Easting coordinate locations 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 RE/COR 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, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. Perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

- A. 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 RE/COR's review, as often as requested.
- C. Deliver two approved completed sets of as-built drawings to the RE/COR within 15 calendar days after each completed phase and after the acceptance of the project by the RE/COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.
- E. Produce irrigation system "As-built" drawings that show the actual locations for the pipes, bends, fittings, wiring and appurtenances. The location for the underground materials as well as the depth shall be indicated, and curved pipe installations shall be so indicated, and bends and fittings shall have swing ties showing the locations, using physical features that will be visible in the winter, whenever possible. Swing ties shall be as close to perpendicular as possible. The "As-Built" drawing for the irrigation system wiring shall show the routing of the wires from controller to corresponding operational elements, and wire colors and numbers and color of spare wires shall be indicated. The wiring diagram for the irrigation system shall include the routing of the power lines to the equipment as well as the of the grounding equipment. The actual location of the installed elements on a scaled drawing shall be provided using the enlarged design drawing background to show the actual installation and not the schematic representation of the elements. All sleeves for pipes and/or wires shall be indicated with the size, type of material location and depth indicated on the "As-Built" drawings.
- F. Produce "As-Built" drawings of all subsurface infrastructure improvements, with the location and depth of the improvements being indicated on the drawings. The drawings shall have references indicated that will establish real world (State Plane) coordinates and elevations on the drawing sheets. Infrastructure improvements that are below ground shall be clearly indicated and shall be located within 100mm (4-inches) of their actual location. If underground infrastructure improvements are not being located on the "As-Built" drawings using GPS coordinates (location and elevation), then the "As-

Built" drawings shall have swing ties provided to ground surface above all infrastructure improvement locations needed to establish the route of the improvement on the ground surface immediately above the improvements, as well as the depth of the infrastructure improvement below the spot on the ground surface. All of the location and depth information shall be no greater than 100mm (4-inches) from the actual location of the respective infrastructure improvement when excavated from the indicated location to the indicated depth. Swing-tie information shall be from final project improvements, or existing improvements deemed final by the RE/COR and each location identified shall be by a minimum of two swing ties (close to 90 degrees apart).

1.14 USE OF ROADWAYS

- A. Under regulations prescribed by the RE/COR, use only established roadways, or use temporary roadways constructed by the Contractor when authorized by the RE/COR. 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.
- B. When materials are transported in prosecution of the work, use only established public roads and roads on Cemetery property and, when authorized by the RE/COR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed and maintained by the Contractor at the Contractor's expense including all necessary erosion and sediment control facilities. When necessary to cross new or existing curbing, sidewalks, or similar construction, the Contractor must furnish install, maintain and remove adequate protection by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, the Contractor may construct them immediately to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at the time set for completion of such buildings or parts thereof.

1.15 RE/COR'S FIELD OFFICE

- A. Within fifteen (15) days after receipt of "Notice to Proceed", provide, where shown on the drawings, a temporary field office, furniture, and

minimum two inch deep gravel surfaced area for use of the RE/COR.
Office and furniture shall be new.

- B. The field office shall provide not less than 134 square meters (1440 gross square feet) of floor area in one unit. Installation of the office shall meet all local codes.
- C. Provide office with two, 900 mm (three foot) wide exterior doors, including hardware and OSHA approved platform and stairs leading to grade.
- D. Enclose the entire perimeter of the office from the floor to the ground and finish to match exterior. Provide R7 insulation and seal tight to the ground with a painted 19 mm (3/4 inch) exterior grade plywood skirt.
- E. Exterior finishes shall be manufacturer's standards.
- F. Provide floor, wall, and roof with not less than R5 insulation.
- G. Interior finishes shall consist of resilient flooring, plywood paneling or painted wallboard on walls, and acoustical tile ceilings. Interior doors may be either painted or stained.
- H. Interior shall be subdivided with full height partitions to provide two offices, one sample room, one toilet, and meeting/Admin. Assistant area. Provide each space with 900 mm (three foot) wide door with master keyed locks. Section off an area with a low partition and counter for the Admin. Assistant's desk.
- I. Provide 750 mm (2-1/2 feet) wide by 900 mm (3 feet) high operable windows; two in each room (none required in sample room), except provide only one 600 mm (2 foot) high window in toilet room(s). Window openings shall be fitted with security bars to prevent any forced entry. The doors of field office shall have a hasp and padlock and also deadbolts keyed from both sides.
- J. Provide sufficient fluorescent lighting in each room to deliver 750 lux (70 foot-candles) of light at desk top height without the aid of daylight. Provide one light switch in each room.
- K. Provide one duplex receptacle in each wall of each room. If a wall is 3.0 m (10 feet) long or more, provide two receptacles for each 3.0 m (10 feet), or portion thereof, of wall. Provide two duplex receptacles in low partition at Admin. Assistant's desk.
- L. The Contractor shall provide the following:
 - 1. Electricity, hot and cold water, and necessary utility services.
Provide three cell phones with internet browser, e-mail and built in

- speaker phone for use by Resident Engineer's Office (SRE, RE and Admin. Assistant). In addition furnish one fully operational stand-alone speaker phone device that attaches to the cell phones for use in phone conferences.
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 12 network receptacles and 24 electrical receptacles located as approved by Resident Engineer upon review of the Contractor's submitted plan.
 3. Thermostatically controlled, centralized heating and air conditioning system designed to maintain the temperature between 21 and 27 degrees C (70 and 80 degrees F) 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 (1) wall mounted first aid kit that meets or exceeds current OSHA and AMSI Z.803-1 requirements.
 6. One (1) wall mounted key safe with push-button combination lock sized for 48 keys.
 7. Two (2) wall mounted 10 pound Tri-Class (ABC) dry chemical fire extinguishers.
 8. Six (6) hard hats, white, full brim with ratchet headband system.
 9. Six (6) ANSI 207 Class 2 safety vest in lime color with two pockets. Provide 3 size large and 3 size extra large.
 10. The Contractor shall install a suitable security system for the field office and provide alarm monitoring services for the duration of the RE's occupancy.
- M. For the duration of the RE/COR's occupancy, provide the following:
1. Satisfactory conditions in and around the field office 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. 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/Fax Machine (complete with installation, service, maintenance, supplies and payment of all monthly usages 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. Minimum Fax Machine requirements:
 - 1) Plain paper copies.
 - 2) Memory feature with fifty documents.
 - 3) Automatic document feeder with 50 page capacity.
 - 4) Memory storage for twenty or more numbers.
 - 5) Network capacity/connectivity.
 - d. All services, maintenance and supplies shall be same day service.
7. Provide two-way radios (2 each) Motorola DTR650 (or equal) with rechargeable batteries and charging stations. These radios will remain the property of Contractor.
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. Four (4) desk telephones, each with speaker, answering machine and long telephone cord.
 - d. One (1) 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 T-1 connection lines. Methods and material shall be per ANSI/EIA/TIA-568-1991 Standard. Install (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 block/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.
- N. The Contractor shall provide the following new items:
- The list herein below indicates office furniture for the R.E. office facility. First is indicated the item number, followed by the number of the respective items to be provided, followed by the description and size of the items, with the metric size indicated first followed by the Imperial dimensions indicated in parentheses immediately after the metric dimensions.
- 1. (1) Secretary workstation with adjustable keying desk or drawer 738 mm H x 1.5 m W x 760 mm D (size 29-1/2" H x 60" W x 30" D)
 - 2. (1) Printer stand 663 mm H x 1.5 m W x 750 mm D (size 26-1/2" H x 60" W x 30" D)
 - 3. (3) Office desks, double pedestal
 - 4. (1) Conference table 900 mm x 1.8 m (size 3' x 6')
 - 5. (1) Plan table 1.2 m x 2.1 m (4' x 7')
 - 6. (3) Work tables 750 mm x 1.8 m (folding 30" x 72")
 - 7. (1) Secretary chair
 - 8. (4) Swivel chairs with arms
 - 9. (6) Conference chairs (armless & folding)
 - 10.(2) Arm Chairs

- 11.(4) Lockable 5 drawer file cabinets, letter size
- 12.(1) Drawing rack, with 12-750 mm (12-30 inch) "Plan Hold" drawing holders, freestanding
- 13.(1) Shelves for sample room, 7 adjustable Shelves, 305 mm W x 900 mm L (12" W x 3' L)
- 14.(3) Bookcases
- 15.(1) Electric water cooler and provide a contract for water for the duration of the project.
- 16.(1) Metal storage cabinet, 900 mm x 450 mm x 1.8 m (36" x 18" x 72") with six shelves.
- O. RE/COR's field office and facilities shall be relocated once after its initial installation at the Contractor's expense. Relocation consists of moving the field office and facilities to a location within the NCA site designated by the RE/COR together with providing and maintaining utilities, parking area, sanitary facilities and janitorial service in new location until completion and final acceptance of project.
- P. At the completion of all work, including the punch list, the RE/COR's field office and facilities shall become the property of the Contractor and the Contractor shall remove same, including 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. All 5 drawer file cabinets provided shall become the property of the Government.
- Q. Furnish floor plans for approval by the RE/COR prior to furnishing the field office.
- R. Provide 4 x 4 vehicle for use by SRE comparable to Club Car XRT 1550 SE 4x4 (or approved equal), 4-seater with Kubota diesel, red exterior, tilt bed feature, safety triangle, rigid canopy, folding windshield, all terrain tires, brake lights, head lights, roll cage, seat belts, rear view mirrors and roof mounted strobe (yellow). The vehicle shall be leased by the Contractor and will be returned to the Contractor after completion of this project including project closeout. Vehicle shall be provided with front and rear rubber floor liners as manufactured by Weather Tech or approved equal. For the 4x4 type vehicle provide the following:
 - 1) Lease 6 m (20 foot) long Con-Ex, primed and painted, enclosure with ventilation and lighting for storage of the vehicle. Ensure

Con-EX's doors are double lockable doors, not roll-up type.
Install treated wood ramp for vehicle to Con-Ex if deemed necessary by RE. Provide all vehicle maintenance, and storage unit, for the duration of the project and until Contract Final Settlement.

- 2) Provide all necessary fuel and service maintenance/repairs for the duration of the project, until Contract Final Settlement. Contractor shall take vehicle off site as needed for these services.
- 3) Keep state license plate (if required by State) on the vehicle and maintain auto insurance at all times during the life of the project. Provide insurance coverage certificate to the RE office.
- 4) No stickers, name plates or decals are to be placed on vehicle by Contractor.
- 5) A suitable loner vehicle shall be provided to Resident Engineer if vehicle is out for service for more than 24 hours.

1.16 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
 1. Permission to use each unit or system must be given by RE/COR. If the equipment is not installed and maintained in accordance with the following provisions, the RE/COR will withdraw permission for use of the equipment.
 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, 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.

1.17 TEMPORARY TOILETS

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

1.18 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. At Contractor's expense and in a workmanlike manner satisfactory to the RE/COR, 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, remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

- C. Install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials by their respective manufacturers as required to prevent damage due to dampness or cold.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. 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 the contractor shall supply power via portable generators or temporary electric service from the electric utility company at own expense.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the functional Cemetery water distribution system, potable or irrigation, as applicable for the application being tested. When in doubt use potable water. Provide reduced pressure backflow preventer at each connection to the existing potable water system. Water, where available, shall be provided at no cost to the Contractor. Pressure, flow rate and volume of water shall be provided at conditions that will not disrupt the operations of the existing system, provide any facilities required to make the water source characteristics suitable for Contractor's intended use(s) without adversely impacting the existing system.
 - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes, or causing unacceptable adverse impacts on the existing system, will be cause for immediate revocation (at RE/COR's discretion) of use of water from the Cemetery's system and will require or result in the Contractor connection(s) being immediately shut-off.

1.19 NEW TELEPHONE EQUIPMENT

- A. The contractor shall coordinate with the work of installation of permanent telephone equipment by others. This work shall be completed before the building is turned over to VA.

1.20 TESTS

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

1.21 INSTRUCTIONS

- A. 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 RE/COR coincidental with the delivery of the equipment to the job site.

Manuals shall be created for the various equipment functional systems, with the O&M for the individual pieces of equipment being included in the appropriate functional systems. Prepare an outline of the organization and structure of all of the O&M manuals to the RE/COR for review and approval, prior to creation of the manuals. This shall be done through the submittal process, and once approved the Contractor may proceed with the creation of the O&M manuals. Manuals shall be complete, well organized and easy to use, 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 copies of the approved submittals for the equipment, in an Appendix for the manual, with a TOC listing the items and where the corresponding submittal materials are included. All pages in the Appendix shall be numbered and the TOC shall refer to the submittal locations based upon the page numbers. The TOC for the Appendix shall also refer each individual submittal item to the appropriate location in the functional diagram for the functional system for the respective O&M Manual. 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. In addition to the diagrams and illustrations (which often do not actually reflect the specific installation for the project), the Manuals shall include digital photographs of the actual equipment as installed, with digital annotations added using software like Adobe Pro where pdf images (photographs) can be annotated with text, arrows, lines, etc. To achieve this end result, the Contractor shall take photographs of the equipment as installed, BEFORE it is covered up, for the specific purpose of creating clear annotated photographs of the installation for the O&M Manuals. 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: 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. Use an integrated, progressive method of providing instructions for different items of equipment that are component parts of a complete system. 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 RE/COR and shall be considered concluded only when the RE/COR is satisfied in regard to complete and thorough coverage. All instruction periods where structured "training" of the use of the equipment is being provided to the Cemetery operations staff shall be videotaped and made into a DVD that can be used by the Cemetery staff as a refresher for the use of the specific equipment, or for training new personnel that are not familiar with the operation of the specific equipment. The Contractor shall be responsible for the creation of these "training videos" subject to the review and approval of the RE/COR. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the RE/COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.22 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown in the contract documents.
- B. Equipment furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.
- C. Be prepared to receive this equipment from the Government and store or place such equipment not less than 90 days before Completion Date of project.
- D. Notify RE/COR in writing, 90 days in advance, of date on which Contractor will be prepared to receive equipment furnished by

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

1. Immediately upon delivery of equipment, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 2. The Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled condition in accordance with existing standard commercial practices. Contractor shall provide all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances necessary to make the connection between the Government furnished equipment item and the final location 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.

1.23 RELOCATED EQUIPMENT

- A. Disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment as indicated in contract documents.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the RE/COR.
- 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.

1.24 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the RE/COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the RE/COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is shown on the drawings.

1.25 SAFETY SIGN

- A. Provide a Safety Sign where directed by RE/COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.
- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- C. Maintain sign and remove it when directed by RE/COR.
- D. Detail Drawing Number 45 of safety sign showing required legend and other characteristics of sign is shown on the drawings./
- E. Post the number of accident free days on a daily basis.

1.26 CONSTRUCTION DIGITAL IMAGES

- A. During the construction period through completion, furnish Department of Veterans Affairs with 100 views of digital images, including one color print of each view and one Compact Disc (CD) per visit containing those views taken on that visit. Digital views shall be taken of

exterior and/or interior and aerial photographs as selected and directed by RE/COR (RE). Each view shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) and the images will be a minimum of 2272 x 1704 pixels for the 200x250mm (8x 10 inch) prints and 2592 x 1944 pixels for the 400x500 mm (16 x 20 inch) prints, as per these specifications:

1. Normally such images including aerial photographs of the site will be taken at monthly intervals. However, the RE/COR may also direct the taking of special digital images at any time prior to completion and acceptance of contract. If the number of trips to the site exceeds an average of one per month of the contract performance period then an adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 00 72 00, GENERAL CONDITIONS.
 2. In event a greater or lesser number of images than specified above are required by the RE/COR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- B. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.
- C. Prints shall be made on 200 x 250 mm (8 by 10 inch) regular-weight matte archival grade photographic paper and produced by a process with a minimum of 300 pixels per inch (PPI). Prints must be printed using the commercial RA4 process (inkjet prints will not be acceptable). Photographs shall have 200 x 200 mm (8 by 8 inch) full picture print with no margin on three sides and a 50 mm (2 inches) margin on the bottom for pre-typed self-adhesive identity label to be added by RE/COR. It is required that the prints are professionally processed so the quality will meet or exceed that of the same size print made with a film camera. Prints must be shipped flat to the RE/COR.
- D. 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% or the original with no loss of information. File names shall contain the date the image was taken, the Project number and a unique sequential identifier. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

- E. In case any set of prints are not submitted within five days of date established by RE/COR for taking thereof, the RE/COR may have such images/photographs taken and cost of same will be deducted from any money due to the Contractor.
- F. Interior Final Photos: After completion of all work in an area final interior photos will be taken. The camera must allow the colors to be as close as possible to the actual colors. For number and location of views, see Section 09 06 00, SCHEDULE FOR FINISHES. View shall be taken after final completion of work. The images shall also be provided on a CD to the RE Office.
- G. Aerial Photographs: Submit aerial photographs at one-month intervals during the entire construction period. The first aerial photo shall be taken just prior to the start of construction and then at one-month intervals. The final aerial photograph shall be taken at full project completion during a growing season when lawns are green and not dormant.
- H. Take digital photos of the daily work in progress, including close-ups. The photographs shall be of the actual work progress, intended to convey to the A/E team members the actual work in progress. The images shall be of both close-up in nature as well as panoramic in nature to get the feel for the entire work in progress, especially when there is site work in progress. In addition, work of product installations of materials that are going to be covered up, especially if before the A/E team member responsible for the design of the element if not going to be making a site visit before the work is covered up. The purpose of these photos is to allow another set of eyes on the work as it is in progress, as this will provide additional potential for catching things that aren't correct before they are buried or cast in concrete. It is better to make things correct before they are poured in concrete. Having photos done on a daily basis, and posting them to one of more sites, to which the A/E team can be provided with easy access is also required. These daily photographs will allow the A/E team members to make note of anything that just doesn't look right, and discuss with the RE or to ask the Contractor to take more specific photos to facilitate discussion. The frequency and type of these photos shall be acceptable to the RE/COR following discussion with the respective A/E team members.

1.27 FINAL ELEVATION DIGITAL IMAGES

- A. A minimum of four (4) images of each elevation shall be taken with a minimum 12 MP camera, by a professional photographer with different settings to allow the RE/COR to select the image to be printed. All images are provided to the RE on a CD.
- B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on a label affixed to back of the photograph without damage to the photograph and shall be similar to that provided for final construction photographs.
- C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the All Cemetery buildings constructed under this project (elevations as selected by the RE from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be place in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the SRE will select one style to frame all six prints. Photographs with frames shall be delivered to the RE/COR in boxes suitable for shipping.
 - 1. Entrance sign & wall/fence feature.
 - 2. Rest room building.
 - 3. Committal Service Shelter No. 1.
 - 4. Columbarium Plaza

1.28 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 RE/COR verbally, and then with a written follow up.

1.29 PROJECT HEALTH AND SAFETY PLAN

- A. Prior to commencing any construction, 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. Medical Surveillance
6. PPE
7. Exposure Monitoring
8. Heat Stress
9. Spill Containment
10. Decontamination
11. Emergency Response
12. Confined Spaces
13. Hosting Operations
14. Trench Safety
15. Lockout/Tagout

1.30 PROJECT SUSTAINABILITY GOALS

- A. Develop and distribute copies of the work plan to each subcontractor and the RE/COR. The overall goal for the work plan is to provide a project that meets the functional program needs and incorporates the requirements and principles of sustainability as defined by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- B. The project goal generally:
 1. Preserve and restore the site ecosystem and biodiversity; avoid site degradation and erosion; minimize offsite environmental impact.
 2. Use the minimum amount of energy, water, and materials feasible to meet the design intent.
 3. Use environmentally preferable products and decrease toxicity level of materials used.
 4. Use renewable energy and material resources.
 5. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of building systems.
 6. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the building.
 7. Reduce construction waste through reuse, recycling, and supplier take-back.

C. Sustainability is the balance of environmental, economic, and societal considerations.

1.31 TRIRIGA PROJECT MANAGEMENT SOFTWARE

A. Contractor is required to use IBM TRIRIGA for submission, tracking, execution and resolution of submittals, RFIs, PCOs, reports, meeting minutes and other correspondence as typical for a project of this type. A TRIRIGA license will be provided by VA for use by the Contractor. The application is cloud based and accessible from any computer with Wi-Fi. The contractor shall designate one individual to use TRIRIGA and allow for training to be scheduled by VA soon after contract award.

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**SECTION 01 32 16.13
NETWORK ANALYSIS SCHEDULES - MAJOR PROJECTS**

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) Network Analysis System (NAS) plan and computer generated schedule demonstrating fulfillment of the entire contract requirements, shall keep the plan and computer generated schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating, mitigating delays and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The Contractor's initial NAS Diagram submission will be the basis for their initial project schedule and will be designated as a Day 1 submission. 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 NAS diagram and the 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 of 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 a subsidiary company of 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 PDM network diagram 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 Day 1 diagram and 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 NAS schedule is a condition precedent to:
 - 1. Processing of contractor's pay request(s) for any construction activities/items of work.
 - 2. Review of any schedule updates.
- C. Government review comments on the contractor's schedule 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 punchlist, Demobilization, O&M draft and final submittals, as-built drawings, and as-built NAS.
- 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 date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the network diagram 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 Day 1 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 facility earlier at no additional cost to the government.

I. The Baseline Schedule Critical Path of the project shall be limited to:

1. No more than 20% of the activities shall be on the critical and near-critical path(s). Critical path is defined as activities with zero (0) day total float. Near-Critical path(s) is defined as activities with one (1) to twenty (20) days of total float.
2. Multiple Critical paths will not be allowed.

J. The Contractor shall show activities/events for:

1. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work. At minimum, separate procurement activities will be provided for critical items, long lead items, items requiring Government approval, and material/equipment procurement for which payment will be requested in advance of installation. These activities shall be tied to the related construction activity/activities.
2. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules samples, template, or similar items with time duration of **no less than 20 workdays**.
3. Shutdowns or Interruption of VA utilities, delivery of Government furnished equipment (GFE), and rough-in drawings, project phasing and any other specification requirements.
4. 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.
5. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
6. **Commissioning (Cx)Activities** - Based upon the project specific Commissioning plan and project specification section 01 91 00, the contractor shall include in the **Day 1 NAS Diagram 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 as required in the earlier paragraphs. 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 Day 1 NAS diagram and 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. Elapsed Time Duration of Each Activity
 - IV. Documentation Associated with Each Task/Document Responsibility
7. 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 VA NAS 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 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.

- L. Work activities/events for the asbestos abatement bid item shall have a trade code of ASB.
- M. Bid items other than the Base Bid (ITEM 1) and Asbestos Abatement item 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 into 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. The network diagram 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."
- 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 Government Acceptance 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 AND TRADE RESOURCE 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 DAY ONE 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.

- E. Work activities/events for Contractor bond shall have a trade code and area code of BOND.
- F. Manpower loading - In accordance with Article PERFORMANCE OF WORK BY THE CONTRACTOR in FAR 52.236 - 1 and VAAR 852.236 - 72, the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work. This shall be the basis for the "Resource loading" of the schedule and the contractor shall provide "Manpower loading" reports by trades and the overall Trade manpower requirements, when requested by the Contracting Officer or his/her representatives.

2.4 CONSTRUCTION SCHEDULE RISK ANALYSIS / MITIGATION PLAN

- A. Schedule Risk Analysis - The contractor shall conduct the statistical schedule risk analysis based on the above detailed construction activities in the Day 1 approved diagram, identifying major schedule risk areas and recommended risk mitigation plans as outlined below.
- B. The risk analysis shall be conducted by a person or firm skilled in the statistical method of schedule risk analysis based on the (PDM) network techniques for major construction projects, preferably in the major health care related projects. The cost of this service shall be included in the Contractor's proposal.
- C. The Contracting Officer has the right to approve or disapprove the Person or firm designated to perform the risk analysis.

2.5 RISK ANALYSIS FORMAT / DATA REQUIREMENTS

- A. **Conduct Risk Analysis - Based on the approved software / format, the consultant shall** perform statistical risk analysis on the detailed approved Day 1 diagram and the baseline schedule. The contractor shall review and utilize any previous Risk analysis performed by the A/E of record based on the "semi-detailed" (yet at an overall level) construction logic and schedule to ensure the continuity of previous schedule risk analysis. The contractor's project manager and Superintendent shall identify the major schedule risk areas and possible risk mitigation strategy/plan and record it in a narrative format, with **electronic file submission** to the VA as directed by the VA Contracting officer.

- B. The submittal shall include three copies of a computer-produced risk analysis results, predicting the various meaningful probability curves of achieving the contract schedules. It shall also include a detailed narrative list of all major and minor potential and specific schedule and cost risk areas and impact of them on the overall project, and a contractor's recommendations of mitigating the identified risks which must be addressed by the VA Project and Resident engineer teams to maintain the contract schedule.
- C. The contractor shall, as a part of Risk monitoring, prepare a detailed Project Risk Register (PRR), identifying each risk items, risk assessment and its response plan. This PRR, at the discretion of VA SRE and CO, shall be discussed in a monthly risk management meeting for mitigation.

PART 3 - SUBMITTALS, DELIVERABLES, AND UPDATE PROCESS:

3.1 SUBMITTALS:

- A. The Independent CPM Consultant Submittal: Within 10 calendar days after award of the contract, 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 BASELINE SCHEDULE SUBMITTAL: Within 30 calendar days (45 calendar days on projects over \$50,000,000) after receipt of Notice to Proceed, the Contractor shall submit the baseline schedule submittal package for the Contracting Officer's review and approval. This Day 1 schedule submittal shall comply with the requirements of this specification section and shall consist of:
 - 2. Computerized Schedule
 - a. An electronic file in a compressed Primavera (P6) computerized schedule, (PDM) format.
 - 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 BASELINE SCHEDULE SUBMITTAL

Within 30 calendar days after submittal of the 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 contractor submitted NAS diagram, the corresponding computer-produced schedule(s) 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), (PDM) format. These schedule reports must be submitted **within 7 calendar days of 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 and associated compact disk(s), 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 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. 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.

H. RISK ANALYSIS PROCEDURE SUBMITTAL:

Within 45 calendar days (60 calendar days on projects over \$50,000,000) after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review and approval:

1. The qualifications of a consultant or representative who will be conducting the Risk Analysis.
2. The software to be utilized.
3. The methodology of performing the analysis.
4. The format of presenting the data.
5. A sample of the reports to be given to VA.

I. RISK ANALYSIS REPORT SUBMITTAL:

Quarterly a risk analysis exercise shall be performed and/or updated and submitted to the VA Contracting Officer. The VA Contracting Officer can request additional risk analysis.

1. The submittal shall include three copies of a computer-produced risk analysis results, predicting the various meaningful probability

curves of achieving the contract schedules. It shall also include a detailed narrative list of all major and minor potential and specific schedule and cost risk areas and impact of them on the overall project, and a contractor's recommendations of mitigating the identified risks which must be addressed by the VA Project and Resident engineer teams to maintain the contract schedule.

2. The Contractor shall, as a part of Risk Analysis Submittal, prepare a detailed Project Risk Register (PRR), identifying each risk items, risk assessment and its response plan. This PRR, at the discretion of the SRE and the CO, shall be discussed in a monthly risk management meeting for mitigation.

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. Logic, time and cost data for change orders (CO), and supplemental agreements (SA) that are to be incorporated into the network diagram and computer-produced schedule. Submit "Fragnets" for each CO and SA for VA approval prior to monthly parallel run. Changes in

- activity/event sequence and duration should be made pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications, particularly if the Day 1 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.
 6. 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.
 7. 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.
 8. 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 - After completing the monthly schedule update, the contractor's CPM consultant shall rerun all current period contract change(s) as a batch against the previous month's approved monthly project schedule with the approved "Fragnet" (Fragments of network or sub-network) logic and durations. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and the SRE for the contract change(s), and preferably shall be submitted as a part of the C.O. proposal and before any physical C.O. work is performed. Fragnet logic shall include only relevant procurement and physical C.O. work activities, and shall not include any RFI (Request for Information) or non-work activities time.

Note: If timely resolution of the RFI is potentially impacting the contract schedule, in contractor's opinion, the contractor must provide tangible proof with CPM data and immediately submit in writing to the Contracting Officer's review. When there is a disagreement on logic and/or durations, the consultant shall use the schedule logic and/or durations provided and approved by the SRE. The contractor must also allocate cost and average manpower loading to each CO or SA Fragnet activities as required by the section 2.3 - Network Diagram

Requirements above. Note: 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 proper "Fragnet" logic and durations must be used as approved by the SRE, tied to the related physical work area of the schedule. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA SRE and the CPM Analyst in accordance to 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. Before inserting the contract changes durations, care must be taken to ensure that only the original durations of the change will be used for the analysis, not the reported durations (as-built) after the progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

- F. Revised NAS Diagram - After VA acceptance and approval of the final NAS diagram and the schedule, and after each monthly update, the contractor shall submit to the Contracting Officer electronic copies of a revised complete NAS diagram showing all completed and partially completed activities/ events, contract changes and logic changes made on the intervening updates or at the first update on the final diagram. The Contracting Officer may elect to have the contractor do this on a less frequent basis, but it shall be done when the Baseline schedule is revised, or when requested by the Contracting Officer.

- G. 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.
- H. 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.
- I. 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.
- J. 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.
- K. 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.

- L. 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 execute some or all of the following remedial actions:
 - 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 - 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 - 3. Reschedule the work in conformance with the specification requirements 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 notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the contractor shall incorporate this "Recovery schedule" with all the CPM revisions 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 network diagram and schedule, the associated compact disk(s), and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events; 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 NAS diagram and 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 30-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. 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 | 7 | 5 | 3 | 2 | 1 | 0 | 0 | 1 | 3 | 4 | 7 |

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

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall

refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail or Email and shall contain the list of items, name of Cemetery, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.

2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Cemetery, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
 3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 4. Contractor shall forward a copy of transmittal letter to Resident Engineer simultaneously with submission to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to Resident Engineer for appropriate action.
 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples

shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

- E. Approved samples will be kept on file by the Resident Engineer at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 7. When work is directly related, and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

Anderson Engineering of MN LLC

13605 1st Ave N

Plymouth MN 55441

- 1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the Resident Engineer.

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SECTION 01 35 26
SAFETY REQUIREMENTS

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**SECTION 01 35 26
SAFETY REQUIREMENTS**

1.1 APPLICABLE PUBLICATIONS:

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

B. American Society of Safety Engineers (ASSE):

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

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

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

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

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

D. The Facilities Guidelines Institute (FGI):

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

E. National Fire Protection Association (NFPA):

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

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

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

70-2014.....National Electrical Code

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

70E-2015Standard for Electrical Safety in the Workplace

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

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

F. The Joint Commission (TJC)

TJC ManualComprehensive Accreditation and Certification
Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20Standards for Protection Against Radiation

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

29 CFR 1904Reporting and Recording Injuries & Illnesses

29 CFR 1910Safety and Health Regulations for General
Industry

29 CFR 1926Safety and Health Regulations for Construction
Industry

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

I. VHA Directive 2005-007

1.2 DEFINITIONS:

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

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

C. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.

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

E. Accident/Incident Criticality Categories:

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

Minor incident/impact - incidents that require first aid or result in minor equipment damage (less than \$25,000). These incidents must be investigated but are not required to be reported to the VA;

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

1. Days away from work (any time lost after day of injury/illness onset);
2. Restricted work;
3. Transfer to another job;
4. Medical treatment beyond first aid;
5. Loss of consciousness;
6. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (5) above or,
7. Any incident that leads to major equipment damage (equal to or greater than \$25,000).

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

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

contractors' activities. Or any incident which leads to major property damage (equal to or greater than \$25,000) 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.

- F. 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 a physician or registered personnel.

1.3 REGULATORY REQUIREMENTS:

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

1.4 ACCIDENT PREVENTION PLAN (APP):

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

B. The APP shall be prepared as follows:

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
2. Address both the Prime Contractors and the subcontractors work operations.
3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
4. Address all the elements/sub-elements and in order as follows:
 - a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
 - 1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
 - 2) Plan approver (company/corporate officers authorized to obligate the company);
 - 3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
 - b. **BACKGROUND INFORMATION.** List the following:
 - 1) Contractor;
 - 2) Contract number;
 - 3) Project name;
 - 4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).

- c. STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
- d. RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:
- 1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;
 - 2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
 - 3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached.;
 - 4) Requirements that no work shall be performed unless a designated competent person is present on the job site;
 - 5) Requirements for pre-task Activity Hazard Analysis (AHAs);
 - 6) Lines of authority;
 - 7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
- e. SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
- 1) Identification of subcontractors and suppliers (if known);
 - 2) Safety responsibilities of subcontractors and suppliers.

f. TRAINING.

- 1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
- 2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc...) and any requirements for periodic retraining/recertification are required.
- 3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
- 4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

g. SAFETY AND HEALTH INSPECTIONS.

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

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

- 1) Exposure data (man-hours worked);

- 2) Accident investigation reports;
- 3) Project site injury and illness logs.

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

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

- 18) Crane Critical lift;
- 19) Respiratory protection;
- 20) Health hazard control program;
- 21) Radiation Safety Program;
- 22) Abrasive blasting;
- 23) Heat/Cold Stress Monitoring;
- 24) Crystalline Silica Monitoring (Assessment);
- 25) Demolition plan (to include engineering survey);
- 26) Formwork and shoring erection and removal;
- 27) PreCast Concrete;
- 28) Public (Mandatory compliance with ANSI/ASSE A10.34-2012).

- C. Submit the APP to the Resident 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 Government Designated Authority, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer in accordance with FAR Clause 52.236-13, *Accident Prevention*, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Resident Engineer or Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and

maintain safe working conditions in order to safeguard onsite personnel, visitors, the public and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS):

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)
- B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.
- C. Work shall not begin until the AHA for the work activity has been accepted by the Resident Engineer or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
 - 1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
 - 2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
 - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.

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

1.6 PRECONSTRUCTION CONFERENCE:

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.
- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting

Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

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

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.
- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations). 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).

1.8 TRAINING:

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.
- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.
- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the Resident Engineer or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall

include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Resident Engineer that individuals have undergone contractor's safety briefing.

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

1.9 INSPECTIONS:

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

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

- A. The prime contractor shall establish and maintain an accident reporting, recordkeeping, and analysis system to track and analyze all injuries and illnesses, high visibility incidents, and accidental property damage (both government and contractor) that occur on site. Notify the Resident Engineer or Government Designated Authority as soon as practical, but no more than four hours after any accident meeting the definition of a Moderate or Major incident, High Visibility Incidents, or any weight handling and hoisting equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Resident Engineer or Government Designated Authority determine whether a government investigation will be conducted.
- B. Conduct an accident investigation for all Minor, Moderate and Major incidents as defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$25,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162 (or equivalent), and provide the report to the Resident Engineer or Government Designated Authority within 5 calendar days of the accident. The Resident Engineer or Government Designated Authority will provide copies of any required or special forms.
- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Resident Engineer or Government Designated Authority monthly.
- D. A summation of all Minor, Moderate, and Major incidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Resident Engineer or Government Designated Authority monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Resident Engineer or Government Designated Authority as requested.

- E. Notify the Senior Resident Engineer as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, Contractor property damage equal to or greater than \$25,000, Government property damage equal to or greater than \$2,500, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Senior Resident Engineer determines whether a separate government investigation will be conducted.
- F. Conduct an accident investigation for all OSHA recordable injuries and illnesses, Contractor property damage accidents resulting in at least \$25,000 in damages and Government property damage equal to or greater than \$2,500 to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the Senior Resident Engineer within five [5] calendar days of the accident. The Senior Resident Engineer will provide copies of any required or special forms.
- G. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Senior Resident Engineer on a monthly basis by the 10th of the month for the previous month using the form provided by the Senior Resident Engineer.
- H. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Senior Resident Engineer on a monthly basis by the 10th of the month for the previous month using the form provided by the Senior Resident Engineer. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Senior Resident Engineer as requested.

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):

- A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on

electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.

B. Mandatory PPE includes:

1. Hard Hats - unless written authorization is given by the Resident Engineer or Government Designated Authority in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
2. Safety glasses - unless written authorization is given by the Resident Engineer or Government Designated Authority in circumstances of no eye hazards, appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
3. Appropriate Safety Shoes - based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Resident Engineer or Government Designated Authority in circumstances of no foot hazards.
4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

1.12 INFECTION CONTROL (NOT USED THIS CONTRACT)

1.13 TUBERCULOSIS SCREENING (NOT USED THIS CONTRACT)

1.14 FIRE SAFETY

- A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Resident Engineer 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: (NOT USED THIS CONTRACT)
- 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 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 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. Standpipes: (NOT USED THIS CONTRACT)
- K. Sprinklers: (NOT USED THIS CONTRACT)
- L. Existing Fire Protection: (NOT USED THIS CONTRACT)
- M. Smoke Detectors: (NOT USED THIS CONTRACT)
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer at least 4 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Resident Engineer or Government Designated Authority.
- P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from site and buildings daily.
- R. If required, submit documentation to the Resident Engineer or other Government Designated Authority that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.15 ELECTRICAL

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

or Government Designated Authority 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 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 or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E.** Ground-fault circuit interrupters. GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by

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

1.16 FALL PROTECTION

- A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.
 - 1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
 - 2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
 - 3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
 - 4. Fall protection while using a ladder will be governed by the OSHA requirements.

1.17 SCAFFOLDS AND OTHER WORK PLATFORMS

- A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
- B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.
- C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.

1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
 2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
 3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
 4. Emergency descent devices shall not be used as working platforms.
- D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:
1. The Competent Person's name and signature;
 2. Dates of initial and last inspections.
- E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

1.18 EXCAVATION AND TRENCHES

- A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P. Excavations less than 5 feet in depth require evaluation by the contractor's "Competent Person" (CP) for determination of the necessity of an excavation protective system where 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 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 or other Government Designated Authority. The permit shall be maintained onsite and the first section of the permit shall include the following:

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

1.19 CRANES

- A. All crane work shall comply with 29 CFR 1926 Subpart CC.
- B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no "Phase In" date.
- C. A detailed lift plan for all lifts shall be submitted to the Resident Engineer or other Government Designated Authority 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing and all other elements of a critical lift plan where the lift meets the definition of a critical lift. Critical lifts require a more comprehensive lift plan to minimize the potential of crane failure and/or catastrophic loss. The plan must be reviewed and accepted by the General Contractor before being submitted to the VA for review. The lift will not be allowed to proceed without prior acceptance of this document.
- D. Crane operators shall not carry loads
 - 1. over the general public or VAMC personnel
 - 2. over any occupied building unless
 - a. the top two floors are vacated
 - b. or overhead protection with a design live load of 300 psf is provided

1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

- A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with

Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

1.21 CONFINED SPACE ENTRY

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

1.22 WELDING AND CUTTING

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer or other Government Designated Authority at least 4 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.23 LADDERS

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
- B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
- C. Manufacturer safety labels shall be in place on ladders
- D. Step Ladders shall not be used in the closed position
- E. Top steps or cap of step ladders shall not be used as a step
- F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
 - 1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
 - 2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

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

1.24 FLOOR & WALL OPENINGS

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. Skylights located in floors or roofs are considered floor or roof hole/openings.
- C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with 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.
 - 3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
 - 4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
 - 5. Workers are prohibited from standing/walking on skylights.

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**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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| 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 |
| DASMA | Door and Access Systems Manufacturers Association http://www.dasma.com/ |

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| 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 |
| GANA | 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 |

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| 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 |
| NFRC | National Fenestration Rating Council http://www.nfrc.org/ |
| NHLA | National Hardwood Lumber Association http://www.natlhardwood.org |

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| 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 |
| PEI | Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com |
| PTI | Post-Tensioning Institute http://www.post-tensioning.org |

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| 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/ |
| 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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**SECTION 01 43 39
MOCKUP REQUIREMENTS**

PART 1 - GENERAL**1.1 DESCRIPTION**

This section covers MOCKUP REQUIREMENTS - see also individual specification sections for additional requirements.

1.2 RELATED WORK

- A. Submittals: Section 01 33 23 SHOP DRAWINGS, PRODUCT DAT, AND SAMPLES
- B. Individual SPECIFICATION SECTIONS from all SPECIFICATION DIVISIONS pertaining to Columbaria and Committal Service Shelter.
- C. Section 03 30 53 CAST-IN-PLACE CONCRETE
- E. Section 03 48 24 PRE-CAST CONCRETE COLUMBARIUM UNITS
- F. Section 04 05 13 MASONRY MORTARING
- G. Section 04 20 00 UNIT MASONRY
- H. Section 04 43 00 NATURAL STONE VENEER
- I. Section 04 73 01 COLUMBARIA NICHE COVERS - MARBLE
- M. Section 07 13 00 SHEET WATERPROOFING
- O. Section 07 60 00 FLASHING AND SHEET METAL
- P. Section 07 92 00 JOINT SEALANTS

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES all required submittals. Submittals must be approved prior to constructing the mockup.
- B. Provide shop drawings for proposed Mockup plans.

1.4 DEFINITIONS

- A. Mockups (General): Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances.
 - 1. Mockups are not provided in lieu of submittals (See Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES and individual specification sections associated with the mockup).
 - 2. Unless otherwise indicated, all approved mockups establish the standard by which the WORK will be judged.
- B. Mockups of the Columbaria Wall complete with all materials including but not limited: footings, structural wall elements, finishes, stone veneer, flashings, type of formwork, formwork details, pre-cast columbaria

units, waterproofing, marble niche covers, niche unit hardware, and stone cap.

1.5 QUALITY ASSURANCE

- A. Mockup Plan: Detailed, dimensioned plans and elevations showing mockup size, and items and materials that will be included in proposed mockup. Provide for each mockup.
- B. Pre-Construction Conference: Prior to the construction of the mockup, a conference shall be schedule by the contractor for the purpose of reviewing the requirements and intent of mockup.
- C. Mock-up to be constructed independently from the all final construction and is not to be utilized in actual finished construction. After all construction is complete the mock-up shall be removed as indicated by RE.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish as directed.
 - 1. Build mockups in location and of full size and profile indicated or, as directed by the RE.
 - 2. Notify the RE a minimum of 14 calendar days in advance of dates and times when mockups will be completed and able to be inspected.
 - 3. Employ supervisory personnel to oversee mockup construction. Employ same workers that will be employed during the construction of Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Commence ordering of materials after mockup has been inspected and approved in writing by RE.
 - 6. The mockup will establish the standard of quality of workmanship by which the Work will be judged.
 - 7. Commence work and finish mockups with final approval prior to beginning construction of the Columbarium and Committal Service Shelter.
 - 8. Mockup to remain up during construction and removed after punch listing of construction and after approval by RE.
- B. Mockup Type: Construct mockup in accordance with approved shop drawings, project manual, and Contract Drawings, using exact materials and methods approved for the Project, including required accessories.

- See also drawings and individual material specification sections for additional Mock-up requirements.

C. Mock-up approval: The construction of several mock ups are required for A/E and RE review and approval as part of this contract.

1. Mock-ups will be used to make final material selection, evaluate installation techniques, and evaluate compatibility of selected components. The completed mock ups will serve as a mutual understanding of the workmanship and methods to be used on actual installation. As such, some re-work may be required at no additional cost to the government.
2. Mock-ups shall be constructed on site to allow visual inspection in conditions similar to the final location.
3. Mock-ups shall include architectural elements and geometry similar to the final product.
4. Mock-ups shall be constructed with full size materials.
5. Mock-ups shall be completed to allow sufficient time for evaluation prior to ordering of materials.

D. Mock-ups

1. COLUMBARIA WALL

Columbaria Wall - include end and divider walls - Provide stemwall and masonry ledge for stone mock-up, five high columbaria unit (40 niche units) with cap stones, connection to stem wall, and show conditions at end and divider walls (including but not limited to):

03 30 00 - Cast-in-Place Concrete
 03 48 24 - Precast Concrete Columbaria Unit
 04 05 13 - Masonry Mortaring
 04 05 16 - Masonry Grouting
 04 43 00 - Natural Stone Veneer
 04 73 00 - Columbarium Niche Covers Marble
 07 13 00 - Sheet Waterproofing
 07 60 00 - Flashing & Sheet Metal
 07 92 00 - Joint Sealants

2. COMMITTAL SERVICE SHELTER

Roof, Ceiling and Wall Mock Up (included but not limited to):

03 30 53 CAST-IN-PLACE CONCRETE
 04 05 13 MASONRY MORTARING
 04 20 00 UNIT MASONRY
 04 43 00 NATURAL STONE VENEER
 05 31 00 STEEL DECK
 07 41 13 STANDING SEAM METAL ROOFING

07 60 00 FLASHING AND SHEET METAL

07 92 00 JOINT SEALANTS

07 42 33 PHENOLIC CEILING PANELS

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SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 52.2 (2007; Addenda B 2008; Errata 2009, Errata 2010; INT 2010; Errata 2011) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ASTM INTERNATIONAL (ASTM)

ASTM D6245 (2007) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation

ASTM D6345 (2010) Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

ANSI/SMACNA 008 (2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

1.2 SUBMITTALS

Government approval by the SRE/CO is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval; the Government reserves the right to review and comment on submittals not having a "G" designation; and submittals with an "L" are for LEED review. LEED review shall be performed by the Contractor's LEED Coordinator and the LEED Administrator. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 01 33 29 LEED(TM) DOCUMENTATION as applicable:

SD-01 Preconstruction Submittals

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 (SRE/CO)

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the SRE/CO. 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) 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 Commissioning. 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 keyed to 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) 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) 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). The (SRE/CO) 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), 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).

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. 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) 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 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), 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. 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 in the list of DFOWs, but not be limited to, all critical path activities on the NAS. 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) 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) 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.

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). 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) within two working days after the meeting. The (SRE/CO) 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).

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 DFOV.

1.11.1 Preparatory Phase

Notify the (SRE/CO) 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, the CA, and the foreman responsible for the DFOV. When the DFOV will be accomplished by a Subcontractor, that Subcontractor's foreman 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.

1.11.2 Initial Phase

Notify the (SRE/CO) 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 DFOV 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 DFOV 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 DFOV 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) 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 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) 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) 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) 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). 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) 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) 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). 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) 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), 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) 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) 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). 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. 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).

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).

1.17 NOTIFICATION ON NON-COMPLIANCE

The (SRE/CO) 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) 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). 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 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 Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 00, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 00, 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 |

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|-----------------|--|
| 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: 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 RE 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 RE 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 RE. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of RE to such failure.
- C. Written Reports: Testing laboratory to submit test reports to RE and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE 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 RE regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable

- material and recommend to RE 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 or ASTM D1557.
 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 RE before the tests are conducted.
 - a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
 - 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 RE. In each compacted fill layer below wall footings, perform one field density test for every 30 m (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 RE.

SPEC WRITER NOTES:

- 1. Verify need for topsoil testing with Landscape Architect. Additional soil testing for pesticides, fertilizers, and other chemicals should be incorporated based upon discussion with the Landscape Architect.
- 2. Soils from borrow pits will generally require testing for toxic materials; verify criteria with governing jurisdiction.

3.3 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 RE.
- 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.

3.4 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
 - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557.
 - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.

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 (AASHTO T104).
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.

3.5 SITE WORK CONCRETE

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

3.6 CONCRETE

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE.
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 a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. RE may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.

10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.

- b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the RE 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 RE. 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 RE. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.7 REINFORCEMENT

- A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- 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.

3.9 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.

3.10 MASONRY

- A. Mortar Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
 - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.
- C. Masonry Unit Tests:
 - 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (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.

3.11 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Conform to AWS D1.1 Structural Welding Code for welding.
- B. Prefabrication Inspection:
 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 2. Approve welding procedure qualifications by pre-qualification or by witnessing qualifications tests.
 3. Approve welder qualifications by certification or retesting.
 4. Approve procedure for control of distortion and shrinkage stresses.
 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.

- 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Verify that rejected welds corrections are made in accordance with AWS D1.1.
 - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to RE.

3.12 STEEL DECKING

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

3.13 SHEAR CONNECTOR STUDS

- A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.
- B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.
- C. Submit inspection reports, certification, and instances of noncompliance to RE.

3.14 TYPE OF TEST

| | Approximate Number of Tests Required |
|---|---|
| A. Earthwork: | |
| Laboratory Compaction Test, Soils: | |
| (ASTM D1557)(ASTM D698) | <u>1</u> |
| Field Density, Soils (ASTM D2922) (ASTM D1556) (ASTM D2167) | <u>100</u> |
| Penetration Test, Soils | <u>0</u> |
| B. Landscaping: | |
| Topsoil Test | <u>20</u> |
| C. Aggregate Base: | |
| Laboratory Compaction, (ASTM D1557) | <u>4</u> |
| Field Density, (ASTM D1556) | <u>300</u> |
| Aggregate, Base Course Gradation (AASHTO T27) | <u>4</u> |
| Wear (AASHTO T96) | <u>3</u> |
| Soundness (AASHTO T104) | <u>3</u> |
| D. Asphalt Concrete: | |
| Field Density, (ASTM D1188) | <u>80</u> |

| | |
|---|------------------------------|
| Aggregate, Asphalt Concrete Gradation (AASHTO T27) | <u>2</u> |
| Wear (AASHTO T96) | <u>2</u> |
| Soundness (AASHTO T104) | <u>2</u> |
| E. Concrete: | |
| Making and Curing Concrete Test Cylinders (ASTM C31) | <u>230</u> |
| Compressive Strength, Test Cylinders (ASTM C39) | <u>155</u> |
| Concrete Slump Test (ASTM C143) | <u>115</u> |
| Concrete Air Content Test (ASTM C173) | <u>230</u> |
| Unit Weight, Lightweight Concrete (ASTM C567) | <u>115</u> |
| Aggregate, Normal Weight: | |
| Gradation (ASTM C33) | <u>58</u> |
| Deleterious Substances (ASTM C33) | <u>58</u> |
| Soundness (ASTM C33) | <u>58</u> |
| Abrasion (ASTM C33) | <u>58</u> |
| Aggregate, Lightweight | |
| Gradation (ASTM C330) | <u>0</u> |
| Deleterious Substances (ASTM C330) | <u>0</u> |
| Unit Weight (ASTM C330) | <u>0</u> |
| Flatness and Levelness Readings (ASTM E1155) (number of days) | <u>3</u> |
| F. Reinforcing Steel: | |
| Tensile Test (ASTM A370) | <u>0</u> |
| Bend Test (ASTM A370) | <u>0</u> |
| Mechanical Splice (ASTM A370) | <u>0</u> |
| Welded Splice Test (ASTM A370) | <u>0</u> |
| H. Masonry: | |
| Making and Curing Test Cubes (ASTM C109) | <u>12</u> |
| Compressive Strength, Test Cubes (ASTM C109) | <u>12</u> |
| Sampling and Testing Mortar, Comp. Strength (ASTM C780) | <u>12</u> |
| Sampling and Testing Grout, Comp. Strength (ASTM C1019) | <u>1</u> |
| Masonry Unit, Compressive Strength (ASTM C140) | <u>3</u> |
| Prism Tests (ASTM C1314) | <u>1</u> |
| I. Structural Steel: | |
| Ultrasonic Testing of Welds (ASTM E164) | <u>0</u> |
| Magnetic Particle Testing of Welds (ASTM E709) | <u>0</u> |
| Radiographic Testing of Welds (ASTM E94) | <u>0</u> |
| K. Inspection: | |
| Technical Personnel (Man-days) | <u>Min two days per week</u> |

L. Technical Personnel: Minimum 14 months or the whole construction

1. Technicians to perform tests and inspection listed above. Laboratory will be equipped with concrete cylinder storage facilities, compression machine, cube molds, proctor molds, balances, scales, moisture ovens, slump cones, air meter, and all necessary equipment for compaction control.

- - - E N D - - -

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, 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/>
5. California Environmental Protection Agency state Water Resources
Control Board: <https://www.waterboards.ca.gov/>

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, 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>.

1.6 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 Resident Engineer/Contracting Officer's Representative (RE/COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, prepare and submit to the RE/COR 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 by the 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.
2. Notice of Intent (NOI) and Stormwater Pollution Prevention Plan (SWPPP)

- a. The contractor shall obtain National Pollution Discharge Elimination System (NPDES) coverage through the State Water Resources Control Board (SWRCB) by applying for a Construction General Permit Notice of Intent (NOI). The contractor shall utilize the Draft SWPPP developed by the engineering consultant as the basis for creating a final SWPPP to be submitted to the SWRCB in support of the NOI application. The contractor shall furnish their own Qualified SWPPP Developers (QSD) to finalize the SWPPP. At project completion, the contractor shall file and have an approved Notice of Termination (NOT) with the SWRCB.
- B. Within 20 days after the date of its submittal, the RE/COR 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 RE/COR. 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. See Section 02 41 19.
 - 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 material allowable by local and state agencies.
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 10 year 6-hour 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 RE/COR. 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 Environmental Protection 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 and off 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 RE/COR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
 3. Monitor water areas, 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 California Air Resources Board 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 from asphaltic batch plants if onsite, or other onsite material processing operations at all times, including weekends, holidays, and hours when work is not in progress.
2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, 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 Resident Engineer/COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only before 9:00AM and after 3:00PM unless otherwise permitted by local ordinance or the RE/COR. 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 Resident Engineer/COR noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition as approved by the RE/COR. The site shall be left meeting the requirements of the local and state environmental requirements associated with the (SWPPP) Storm Water Pollution Protection Plan as submitted. The contractor shall file and have an approved Notice of Termination (NOT) with the State Water Resources Control Board. 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.

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.
- 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.

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 COR/Resident Engineer 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.
- 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.
- C. 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 COR/Resident Engineer 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. 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).
- H. Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260).
- I. ASHRAE Standard 52.2-2007.

PART 2 – PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Construction waste diversion from landfill disposal must comprise at least 50 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal.
- B. Low Pollutant-Emitting Materials:
1. Adhesives, sealants and sealant primers applied on site within the weatherproofing membrane must comply with VOC limits of SCAQMD Rule 1168:
 - a. Flooring Adhesives and Sealants:
 - 1) Indoor carpet adhesives: 50 g/L.
 - 2) Wood Flooring Adhesive: 100 g/L.
 - 3) Rubber Floor Adhesives: 60 g/L.
 - 4) Subfloor Adhesives: 50 g/L.
 - 5) Ceramic Tile Adhesives and Grout: 65 g/L.
 - 6) Cove Base Adhesives: 50 g/L.
 - 7) Multipurpose Construction Adhesives: 70 g/L.
 - 8) Porous Material (Except Wood) Substrate: 50 g/L.
 - 9) Wood Substrate: 30 g/L.
 - 10) Architectural Non-Porous Sealant Primer: 250 g/L.
 - 11) Architectural Porous Sealant Primer: 775 g/L.
 - 12) Other Sealant Primer: 750 g/L.
 - 13) Structural Wood Member Adhesive: 140 g/L.
 - 14) Sheet-Applied Rubber Lining Operations: 850 g/L.
 - 15) Top and Trim Adhesive: 250 g/L.
 - 16) Architectural Sealant: 250 g/L.
 - 17) Other Sealant: 420 g/L.
 - b. Non-Flooring Adhesives and Sealants:
 - 1) Drywall and Panel Adhesives: 50 g/L.
 - 2) Multipurpose Construction Adhesives: 70 g/L.
 - 3) Structural Glazing Adhesives: 100 g/L.
 - 4) Metal-to-Metal Substrate Adhesives: 30 g/L.
 - 5) Plastic Foam Substrate Adhesive: 50 g/L.
 - 6) Porous Material (Except Wood) Substrate Adhesive: 50 g/L.
 - 7) Wood Substrate Adhesive: 30 g/L.
 - 8) Fiberglass Substrate Adhesive: 80 g/L.
 - 9) Architectural Non-Porous Sealant Primer: 250 g/L.
 - 10) Architectural Porous Sealant Primer: 775 g/L.
 - 11) Other Sealant Primer: 750 g/L.

- 12) PVC Welding Adhesives: 510 g/L.
 - 13) CPVC Welding Adhesives: 490 g/L.
 - 14) ABS Welding Adhesives: 325 g/L.
 - 15) Plastic Cement Welding Adhesives: 250 g/L.
 - 16) Adhesive Primer for Plastic: 550 g/L.
 - 17) Contact Adhesive: 80 g/L.
 - 18) Special Purpose Contact Adhesive: 250 g/L.
 - 19) Structural Wood Member Adhesive: 140 g/L.
 - 20) Sheet Applied Rubber Lining Operations: 850 g/L.
 - 21) Top and Trim Adhesive: 250 g/L.
 - 22) Architectural Sealants: 250 g/L.
 - 23) Other Sealants: 420 g/L.
2. Aerosol adhesives applied on site within the weatherproofing membrane must comply with the following Green Seal GS-36.
 - a. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent VOCs by weight.
 - b. Aerosol Adhesive, General-Purpose Web Spray: 55 percent VOCs by weight.
 - c. Special-Purpose Aerosol Adhesive (All Types): 70 percent VOCs by weight.
 3. Paints and coatings applied on site within the weatherproofing membrane must comply with the following criteria:
 - a. VOC content limits for paints and coatings established in Green Seal Standard GS-11.
 - b. VOC content limit for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates of 250 g/L established in Green Seal GC-03.
 - c. Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed VOC content limits established in SCAQMD Rule 1113.
 - d. Comply with the following VOC content limits:
 - 1) Anti-Corrosive/Antirust Paints: 250 g/L.
 - 2) Clear Wood Finish, Lacquer: 550 g/L.
 - 3) Clear Wood Finish, Sanding Sealer: 350 g/L.
 - 4) Clear Wood Finish, Varnish: 350 g/L.
 - 5) Floor Coating: 100 g/L.
 - 6) Interior Flat Paint, Coating or Primer: 50 g/L.
 - 7) Interior Non-Flat Paint, Coating or Primer: 150 g/L.

- 8) Sealers and Undercoaters: 200 g/L.
 - 9) Shellac, Clear: 730 g/L.
 - 10) Shellac, Pigmented: 550 g/L.
 - 11) Stain: 250 g/L.
 - 12) Clear Brushing Lacquer: 680 g/L.
 - 13) Concrete Curing Compounds: 350 g/L.
 - 14) Japans/Faux Finishing Coatings: 350 g/L.
 - 15) Magnesite Cement Coatings: 450 g/L.
 - 16) Pigmented Lacquer: 550 g/L.
 - 17) Waterproofing Sealers: 250 g/L.
 - 18) Wood Preservatives: 350 g/L.
 - 19) Low-Solids Coatings: 120 g/L.
4. Carpet installed in building interior must comply with one of the following:
- a. Meet testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
 - b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at the 14 day time point.
5. Each non-carpet flooring element installed in building interior which is not inherently non-emitting (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) must comply with one of the following:
- a. Meet requirements of the FloorScore standard as shown with testing by an independent third-party.
 - b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at 14 day time point.
6. Composite wood and agrifiber products used within the weatherproofing membrane must contain no added urea-formaldehyde resins.
7. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde.
- C. Recycled Content:
- 1. Any 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] [20] 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) Cleaners.

- 3) Composite Panels.
- 4) Corrosion Preventatives.
- 5) Erosion Control Materials.
- 6) Dust Suppressants.
- 7) Fertilizers.
- 8) Floor Cleaners and Protectors.
- 9) Floor Coverings (Non-Carpet).
- 10) Glass Cleaners.
- 11) Hydraulic Fluids.
- 12) Industrial Cleaners.
- 13) Interior Paints and Coatings.
- 14) Mulch and Compost Materials.
- 15) Multipurpose Cleaners.
- 16) Multipurpose Lubricants.
- 17) Paint Removers.
- 18) Plastic Insulating Foam.
- 19) Pneumatic Equipment Lubricants.
- 20) Roof Coatings.
- 21) Wood and Concrete Sealers.
- 22) 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. Electronics and Information Technology:

- 1) Audio/Video Equipment.
- 2) Small-Scale Servers.
- 3) Data Center Storage.
- 4) Displays.
- 5) Enterprise Servers.
- 6) Set-Top and Cable Boxes.
- 7) Uninterruptible Power Supplies.

b. Other:

- 1) 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:

3. Lighting Equipment:
 - a. Exterior Lighting.
 - b. Fluorescent Ballasts.
 - c. Fluorescent Luminaires.

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. Displays.

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. Provide construction dust control to comply with SCAQMD Rule 403.

-----END-----

**SECTION 02 21 00
SITE SURVEYS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the gathering of research documents, performance of a topographic survey and preparation of a topographic survey map.

1.2 DEFINITIONS

- A. Professional Land Surveyor: One who possesses a valid state license as a "Professional Land Surveyor" from the state in which they practice.
- B. Professional Civil Engineer: One who possesses a valid state license as a "Professional Civil Engineer" from the state in which they practice. For this section, the term "surveyor" shall also include Professional Civil Engineers authorized to practice Land Surveying under the laws of the state in which they practice.

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, recycled content.

PART 2 - EXECUTION

- A. The surveyor shall research available public records for all mapping, monumentation, plats, governmental surveys etc. that may pertain to the subject property. Research all applicable public utilities for substructure data such as sewers, storm drains, water lines, electrical conduits, gas mains, telephone, etc.
- B. The survey shall be performed on the ground in accordance with the current "Accuracy Standards for Land Title Surveys" as adopted, from time to time, by the American Congress on Surveying and Mapping, the National Society of Professional Surveyors, and the American Land Title Association.
- C. The surveyor, when applicable, shall consult with the project Architect to determine scale of plat or map and size of drawings.
- D. The surveyor shall furnish two sets of prints of the plat or map of survey and an electronic CADD file. If the plat or map of survey consists of more than one sheet, the sheets shall be numbered, the total number of sheets indicated and the match lines be shown on each sheet.

- E. On the plat or map, the survey boundary shall be drawn to a convenient scale, or the scale designated by the Architect, with the scale clearly indicated. A graphic scale, shown in feet or meters or both, shall be included. A north arrow shall be shown and when practicable, the plat or map of survey shall be oriented so that north is at the top of the drawing. Symbols or abbreviations used shall be identified on the face of the plat or map by use of a legend or other means. Supplementary or exaggerated diagrams shall be presented accurately on the plat or map where dimensional data is too small to be shown clearly at full scale. The plat or map shall be 760 mm by 1060 mm (30 by 42 inches).
- F. The survey shall contain the following applicable information:
1. The name, address, telephone number, and signature of the Professional Land Surveyor who made the survey, his or her official seal and registration number, the date the survey was completed and the dates of all revisions.
 2. The survey drawing(s) submitted shall bear the following certification adjacent to the Engineer's official seal:
 1. "I hereby certify that all information indicated on this drawing was obtained or verified by actual measurements in the field and that every effort has been made to furnish complete and accurate information."
 3. Vicinity map showing the property surveyed in reference to nearby highways or major street intersections.
 4. Flood zone designation (with proper annotation based on Federal Flood Insurance Rate Maps or the state or local equivalent, by scaled map location and graphic plotting only).
 5. Land area as defined by the boundaries of the legal description of the surveyed premises.
 6. All data necessary to indicate the mathematical dimensions and relationships of the boundary represented by bearings and distances, and the length and radius of each curve, together with elements necessary to mathematically define each curve. The point of beginning of the surveyor's description and the basis of bearings shall also be shown.
 7. When record bearings or angles or distances differ from measured bearings, angles or distances, both record and measured bearings, angles, and distances shall be clearly indicated. If the record

description fails to form a mathematically closed figure, the surveyor shall so indicate.

8. Measured and record distances from corners of parcels surveyed to the nearest right-of-way lines of streets in urban or suburban areas, together with recovered lot corners and evidence of lot corners, shall be noted. The distances to the nearest intersecting street shall be indicated and verified. Names and widths of streets and highways abutting the property surveyed and widths of rights of way shall be given. Observable evidence of access (or lack thereof) to such abutting streets or highways shall be indicated. Observable evidence of private roads shall be so indicated. Streets abutting the premises, which have been described in Record Documents, but not physically opened, shall be shown and so noted.
9. The identifying titles of all recorded plats, filed maps, right of way maps, or similar documents which the survey represents, wholly or in part, with their appropriate recording data. The survey shall indicate platted setback or building restriction lines which have been recorded in subdivision plats or which appear in a Record Document which has been delivered to the surveyor. Contiguity, gores, and overlaps along the exterior boundaries of the survey premises, where ascertainable from field evidence or Record Documents, or interior to those exterior boundaries, shall be clearly indicated or noted. Where only a part of a recorded lot or parcel is included in the survey, the balance of the lot or parcel shall be indicated.
10. All evidence of found monuments shall be shown and noted. All evidence of monuments found beyond the surveyed premises on which establishment of the corners of the survey premises are dependent, and their application related to the survey shall be indicated.
11. The character of any and all evidence of possession shall be stated and the location of such evidence carefully given in relation to both the measured boundary lines and those established by the record. An absence of notation on the survey shall be presumptive of no observable evidence of possession. The term "possession" does not imply "ownership".
12. The location of all buildings upon the plot or parcel shall be shown and their locations defined by measurements perpendicular to the

- boundaries. If there are no buildings, so state. Proper street numbers shall be shown where available.
13. All easements evidenced by a Record Document which have been delivered to the surveyor shall be shown, both those burdening and those benefiting the property surveyed, indicating recording information. If such an easement cannot be located, a note to this affect shall be included. Observable evidence of easements and/or servitudes of all kinds, such as those created by roads, rights-of-ways, water courses, drains, telephone, telegraph, or electric lines, water, sewer, oil or gas pipelines on or across the surveyed property and on adjoining properties if they appear to affect the surveyed property, shall be located and noted. Surface indications, if any, or of underground easements and/or servitudes shall also be shown.
 14. The character and location of all walls, buildings, fences, and other visible improvements within five feet of each side of the boundary lines shall be noted. Without expressing a legal opinion, physical evidence of all encroaching structural appurtenances and projections, such as fire escapes, bay windows, windows and doors that open out, flue pipes, stoops, eaves, cornices, areaways, trip, etc., by or on adjoining property or on abutting streets, on any easement or over setback lines shown by Record Documents shall be indicated with the extent of such encroachment or projection.
 15. Driveways and alleys on or crossing the property must be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.
 16. Location, alignment and dimensions of all roads, curbs, walks, parking and paved areas abutting the subject land. Indicate road centerlines with true bearings and lengths by 15 m (50 foot) stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well a location of radius and vertex points. Elevations on 15 m (50') centers on centerline of roads, edges of roads and top and bottom of curbs.
 17. As accurately as the evidence permits, the location of cemeteries and burial grounds disclosed in the process of researching title to

- the premises or observed in the process of performing the field work for the survey, shall be shown.
18. Ponds, lakes, springs, or rivers bordering on or running through the premises being surveyed shall be shown. When a property surveyed contains a natural water boundary, the surveyor shall measure the location of the boundary according to appropriate surveying methods and note on the plat or map the date of the measurement and the caveat that the boundary is subject to change due to natural causes and that it may or may not represent the actual location of the limit of title. When the surveyor is aware of changes in such boundaries, the extent of those changes shall be identified.
 19. Contours at a minimum interval of (1 foot). Base vertical control on the permanent (not assumed) National Geodetic Survey (NGS). Note location, description and datum. Install a permanent National Geodetic Survey (NGS) Bench Mark within the property for use by any future surveyors for projects on the property. Furnish and install two monuments on the property, or property lines, that are tied to the State Plane Coordinate system, and indicate the respective Northing and Easting coordinates for the points in feet, with 3 decimal place accuracy. Provide notes that these two points are the basis for the coordinate system indicated on the CADD survey drawings. Unless specifically noted otherwise, provide CADD drawing of the survey, in DWG format in a version no older than two versions earlier than the most recent version of the software.
 20. Identify and show if possible, setback, height, and floor space area restrictions of record or disclosed by applicable zoning or building codes (in addition to those recorded in subdivision maps). If none, so state.
 21. Exterior dimensions of all buildings at ground level. Show square footage of exterior footprint of all buildings at ground level and gross floor area of all buildings.
 22. Measured height of all buildings above grade at a defined location. If no defined location is provided, the point of measurement shall be shown.
 23. Elevations at each entrance to buildings, service docks, building corners, steps, ramps and grade slabs.

24. Substantial, visible improvements (in addition to buildings) such as signs, parking areas, plazas, planter beds, benches, walls, swimming pools, etc.
25. Parking areas and, if striped, the striping and the type (eg. handicapped, motorcycle, regular, etc.) and number of parking spaces.
26. Indication of access to a public way such as curb cuts and driveways.
27. Location of utilities existing on or serving the surveyed property as determined by observed evidence together with plans and markings provided by utility companies, and other appropriate sources (with references as to the source of information. Locate and show all fire hydrants located within 150 m (500 feet) of the subject property.
28. Railroad tracks and sidings.
29. Manholes, catch basins, valve vaults or other surface indications of subterranean uses.
30. Wires and cables (including their function) crossing the survey premises, all poles on or within ten feet of the surveyed premises, and the dimensions of all cross-wires or overhangs affecting the surveyed premises.
31. Utility company installations on the surveyed premises.
32. Names of adjoining owners of platted lands.
33. Observable evidence of earth moving work, building construction or building additions within recent months.
34. Any changes in street right-of-way lines either completed or proposed, and available from the controlling jurisdiction. Observable evidence of recent street or sidewalk construction or repairs.
35. Observable evidence of site use as a solid waste dump, sump or sanitary landfill.
36. All trees with a minimum diameter of 150 mm (6") measured at 1200 mm (48") above the base of the tree. Perimeter outline only of thickly wooded areas with description of predominant vegetation.

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**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 buildings, portions of buildings, utilities, other structures and debris 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.
- 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.
 2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, 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 (RE). Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have RE approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 UTILITY SERVICES

- A. Demolish and remove outside utility service lines shown to be removed. Coordinate any service interruptions with the Resident Engineer (RE).
- 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 (SWPPP) and repair as directed by COR to sustain compliance with NPDES 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 2 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 15 and 16 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. Completely demolish and remove structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new utility service lines.
 - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the RE. 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. When Utility lines are encountered that are not indicated on the drawings, the RE 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. 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.

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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.

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

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project requirements.
- B. Blended Cement: It is the intent of this specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of Portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace Portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.
- C. 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

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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 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/conserve/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. 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 |
| 211.2-98(R2004) | Selecting Proportions for Structural Lightweight 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 |
| C330/C330M-09 | Lightweight Aggregates for Structural 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 RE, 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 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 and metal pan stair fill.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.

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- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. Grade 60.
- 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 Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. 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.

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: 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

| Concrete: Strength | Non-Air-Entrained | | Air-Entrained | |
|-------------------------------------|--|----------------------------|---|----------------------------|
| Min. 28 Day Comp. Str. MPa (psi) | Min. Cement kg/m ³ (lbs/c. yd) | Max. Water Cement Ratio | Min. Cement kg/m ³ (lbs/c. yd) | Max. Water Cement Ratio |
| 30 (4000) ^{1,3} | 325 (550) | 0.55 | 340 (570) | 0.50 |

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 .
 2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
 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 or ACI 211.2 for lightweight structural 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.
 3. Mixing structural lightweight concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

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, committal shelter, or memorial wall 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, committal shelter, or memorial walls, 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, 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 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 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.

3.4 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 RE 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.

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.

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 RE, 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 and committal shelter and walls in their complexes, follow the procedures identified in Paragraph FINISHES for Exterior Exposed Areas (finished).
- C. For columbarium and committal shelter, 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 receive stucco finish or painted): Fins, burrs and similar projections on surface must be knocked off flush by mechanical means approved by RE 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.

B. Slab Finishes:

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 & Shored Suspended Slabs | Unshored Suspended Slabs |
|--|----------------------------------|
| Specified overall value F_F 25/ F_L 20 | Specified overall value F_F 25 |
| Minimum local value F_F 17/ F_L 15 | Minimum local value F_F 17 |

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
- 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.

--- E N D ---

SECTION 03 48 21
PRECAST CONCRETE BURIAL CRYPTS
(DOUBLE DEPTH LAWN CRYPT)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. The work of this Section is to furnish all labor, materials, manpower, tools and equipment required to complete the manufacturing and installation of the precast concrete burial crypts as specified and/or shown, including but not limited to the work to:
1. Fabricate
 2. Transport and deliver to site
 3. Unload units on dunnage or gravel
 4. Store and/or install precast concrete burial crypts (units or crypts)
 5. Install sub base foundation and drainage
 6. Install units in the prepared crypt fields
 7. Backfill between and around the crypts
 8. Compact fill materials
 9. Topsoil
 10. Provide additional Materials:
 - a. Three (3) OSHA -approved crypt lid lifting apparatus
 - b. Five (5) extra concrete crypt lids
 - c. A device to easily retrieve and lower the inside shelf by one man without entering the crypt.
 11. Other Associated Work

1.2 DESIGN OVERVIEW

- A. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the Drawings. Design requirements shall be as follows:
1. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter.
 2. All designs will require that the manufacturer provide fabrication drawings stamped by a Professional Engineer indicating that the design meets or exceeds the structural requirements contained herein.
 3. Alternative crypt component designs may be proposed if all the following requirements are met:
 - a. Comply with the design criteria and the functional tests of this specification.

- b. All provisions of this specification shall apply to any proposed alternative design.
- c. The Government may accept or reject part or all of any proposed alternative design. The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.3 RELATED WORK

- A. Excavation and Backfill: Division 31 "EARTHWORK."
- B. Materials Testing and Inspection during Fabrication and Construction: Division 1 Section TESTING LABORATORY SERVICES.

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, low-emitting materials, recycled content, requirements.
- B. Blended Cement: It is the intent of this specification to reduce CO₂ emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.
- C. 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 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/conserve/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.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Bid documents shall include documentation that manufacturer has a minimum of three years of experience with pre-casting units of similar type. Current plant certification for the location(s) that will be producing units for this project from the National Precast Concrete Association (NPCA) shall be provided as a submittal prior to any work being performed.
- B. Provide a written stamped certification from a licensed Structural Engineer that certifies that the units being manufactured conform to the specified design and performance requirements.
- C. Installation Qualifications: Provide written documentation that verifies:
1. The installer has been regularly engaged, for at least three years, in installation of pre-cast concrete similar to this project.
- D. Fabricate crypts to the interior dimensions described below.
1. Replace or repair units that do not comply with the individual dimensions and tolerances.
- E. Prior to, or in the initial stage of crypt production, furnish at the site:
1. Proposed shelf removal tool.
 2. Two (2) perimeter crypts.
 3. One (1) interior crypt.
 - a. The three (3) crypts shall:
 - 1) Demonstrate acceptable quality of construction.
 - 2) Be used to conduct the on-site buried crypt functional load test as described herein below.

F. Functional Load Tests: Functional on-site load tests will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional tests will consist of following loading conditions:

1. Confined Loading: An interior unit between two perimeter units shall:
 - a. Be placed in a hole dug in the ground on site and covered with 600 mm (24 inches) of soil or covered to the maximum depth as shown on the plans, whichever is greater.
 - 1) The soil will be compacted to Standard Proctor (AASHTO T-99) density along the sides of 95% and reduced density over the lid, both as shown on the plans.
 - a) Impact type of equipment shall not be used on the sides of the crypts as they can cause conditions that exceed the design parameters.
 - b. An axle load of 5500 kg (12,000 lbs.) shall be passed over the covered crypts for a minimum of 10 times in repetition as follows:
 - 1) In a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts.
 - c. The crypts shall then:
 - 1) Be fully excavated, exposed and the lids removed to allow careful examination inside and outside.
 - a) The crypts must not show any signs of stress or cracking.
2. Shelf Load Testing for the intermediate shelf shall be as follows:
 - a. Apply load to individual support struts. Use one worker with a minimum weight of 90kg (200 lbs.)
 - 1) Worker shall carefully walk on individual supports to confirm structural integrity and load bearing capability.
 - a) Worker shall adhere to all safety regulations while performing test.
 - b. Upon completion of shelf load testing, the inside shelf shall be removed by the removal tool as follows:
 - 1) Without entering the crypt and by one man.
 - 2) Inspected, and lowered back into the crypt in the 2nd interment position.
 - 3) The inside shelf must not show any signs of stress, cracking or deflection.

3. Demonstrate the removal and replacement process for the inside shelf. The functioning of the shelf removal tool shall be approved by the NCA Crypt Specialist.

G. Commence production of crypts only after the written submittal(s) are approved and on-site load testing and demonstration have been scheduled for witnessing by the NCA Crypt Specialist.

1.7 DESIGN CRITERIA

A. Design Criteria (Double Depth Crypt): All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.

1. The units shall be of the following type, style, and size:

a. Type: Precast concrete.

b. Style: One-piece box with separate outer lid and the following:

- 1) A removable one-piece inside shelf
- 2) Four casket risers or two casket support bars
- 3) Drain Holes 100 mm (4-inch) diameter in the floor bottom as follows:

a) Two drain holes at opposite ends when there are casket risers.

b) Three drain holes at opposite ends and in middle, when there are two support bars.

c. Crypt interior size: Interior minimum dimensions are as follows:

- 1) 750 mm (30") minimum width at the inside bottom floor and for the full height of the crypt
- 2) 2.2 m (86") minimum length along the inside bottom floor and for the full height of the crypt
- 3) 640 mm (25") minimum clear height from the highest part of the inside shelf to the underside of the lid
- 4) 640 mm (25") minimum clear height from the lowest part of the inside shelf to the top of the casket risers
- 5) 20 mm (3/4") minimum height casket risers from the crypt floor spaced 500 mm (20") from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.

e. Crypt height and wall thickness:

- 1) Exterior maximum height dimension: 1.6 m (60") including the lid.

- 2) Crypt wall thickness: 50 mm minus 12mm (2-inches minus 1/2 inch) for inside shelf bearing.
 - 3) Perimeter crypts are allowed thicker walls where additional reinforcing is included.
 - 4) Crypt wall sections at support slots originated from the top for the inside shelf may be of lesser thickness.
- f. Layout:
- 1) Crypts shall fit in a 920 mm by 2450 mm (3-foot by 8-foot) plot or a lesser plot size as noted on the plans.
 - 2) The lesser plot size shall govern. If the proposed crypts will not fit into the designed/indicated plot size, with adequate room for the between crypt backfill, or if a different plot size is suggested, the Contractor, at no cost to the Owner, shall prepare a revised Layout/Size Plan and submit it for review and approval by the RE.
2. Load Conditions for design of units shall be as follows:
- a. A burial depth with soil cover as indicated on the plans.
 - b. A center point load of 2700 kg (6,000 lbs.) on one square foot, prior to burial.
 - c. Passage of a wheel axle load of 5500 kg (12,000 lbs.) after burial.
 - d. A 900 mm (3-foot) tall pile of excavated material on top of or adjacent to buried crypts.
3. Submit to the Resident Engineer RE for approval the following:
- a. Five sets of design documentation showing structural design of the units. **In addition, the Contractor shall provide one additional set to NCA Crypt Specialist.**
 - 1) This documentation shall include dimensions, methods of construction, and calculations.
 - b. The Structural Engineer that stamps the design calculations and drawings shall provide:
 - 1) Written recommendations indicating the extent of voids that are allowable in the produced units, without causing any degradation of loading capacity from the design load values.
 - 2) Written recommendations on the conditions where repairs will be allowed, and materials and methods to be used for repairs.

- 3) Written statement that all repairs to the units shall only be allowed if they are performed according to the written recommendations of the Structural Engineer.

B. Design Criteria (Concrete Lids):

1. To be removable and replaceable.
2. Lid lifting shall be from top positioned hot-dipped galvanized anchors (4-required per lid).
 - a. Furnish the cemetery with three (3) OSHA approved and tag certified wire rope lifting devices for removing the lid. No chain lifting devices allowed.

C. Design Criteria (Inside shelf):

1. One piece rigid construction
2. Fully conceal the lower casket with a rigid barrier
3. Weigh 18 kg (40 lbs.) or less
4. Allow for easy casket lowering belt removal
5. Capable of holding 180 kg (400 lbs.) indefinitely.
6. The entire inside shelf should be rigid, non-brittle, non-deteriorating, and have a maximum 6 mm (1/4 inch) gap from all shelf edges to the crypt wall to create a visual barrier.
7. Have one lifting hole in the middle about 50 mm (2-inches) from the edge 19 mm (3/4-inch) maximum diameter.

D. Design Criteria (Inside Shelf Removal Tool(s)):

1. Be constructed so one man can easily retrieve and install the shelf from ground level without entering the crypt.
 - a. Demonstrate the use and functionality of said tool at the crypt buried load testing, for the conditions that will occur at the cemetery during the interments at the crypt sections(s).

E. Design Criteria (Quad Crypt):

1. An alternate concrete Quad unit (one piece) may be used as an approved equal in lieu of two (2) double depth lawn crypt units. The Quad units shall conform to all other specified herein including:
 - a. The shared interior concrete wall thickness may be increased to allow for a gap between lids as deemed appropriate to meet layout requirements.

F. Design Criteria (Oversized Crypt):

1. Oversized crypts shall conform to all provisions of this section with the exception that the Interior dimensions and Wall thickness are as follows:
 - a. 1065 mm by 2335 mm (42-inches by 92-inches) inside clear span
 - b. Oversized crypt wall thickness: 65 mm - 12 mm (2-1/2 inches minus 1/2 inch) for inside shelf bearing.

G. Miscellaneous manufacturing requirements:

1. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning 12 mm (1/2 inch) down from top.
2. The design of casket risers, whether individual spots or bars crossing the bottom, shall allow the casket to rest a minimum of 19 mm (3/4 inch) above the inside floor of the crypt and above the top of the inside shelf in order to aid in casket lowering straps removal. In addition, rests location shall not exceed 530 mm (21 inches) from crypt centerline.
3. The crypt outside lifting wire shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire once crypt has been installed.

1.8 ALLOWABLE TOLERANCES

A. Tolerances of individual units shall be as follows:

1. Variation in overall crypt outside dimensions of unit (height, length and width): 3 mm (1/8") plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.
2. Variation in thickness of precast panels and elements: 1.5 mm (1/16") plus or minus.
3. Maximum height differential in final placement in the ground: 6 mm (1/4") above or below design grade.
4. Cracks greater than 0.75 mm (0.030 inches) in width are cause for crypt rejection. With evidence of fiber or steel reinforcement, any cracking 0.75 mm (0.030") or lesser width that does not extend thru wall is acceptable. Any cracking 0.4 mm (0.016 inch) or lesser that extends thru wall is acceptable. All other cracks are cause for rejecting crypts that shall be repaired or removed and replaced at no cost to VA.

1.9 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, furnish to the RE and the NCA Crypt Specialist the following:
 - 1. Samples: deliver to the site for testing and inspection:
 - a. Two perimeter crypts and one interior crypt.
- B. Submit a detailed concrete Mix Design of Self Consolidating Concrete (SCC) with a **15% minimum requirement** of a cement substitute of fly ash and/or other pozzalons.
- C. Submit Shop Drawings:
 - 1. Installation Narrative:
 - a. Method of transportation.
 - b. Method of handling and placement.
 - 2. Production Drawings:
 - a. Elevation view of each unit.
 - b. Plan view of unit.
 - c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.
 - d. Section, details and location of specialty lid lifting anchors, and lid lifting system.
 - e. Dimensions and finishes.
- D. Submit Product Design Data:
 - 1. Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.
 - 2. Loadings for Design Calculations:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads specified.
 - c. Other loads specified for units as applicable.
 - d. Deflection of precast members.
 - e. Product test reports:
 - 1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the RE immediately after the strength tests have been completed. The tests shall be as specified herein.

- 2) Prior to backfilling over crypts and at contractor expense, the RE may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.
- 3) Based on failed testing, the RE may request more frequent testing to ensure quality of the product and pozzalons content is present, again at contractor expense.

3. Manufacturer's Literature and Data:

- a. Each type of anchorage, angle, and fastener.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. Provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Transportation, storage and handling of units without damage is required. Any damage caused by accident or negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting wire system to transport crypts. On the job site, forklift handling of crypts may be approved by the RE only following:
 1. Verification that the structural design is adequate.
 2. Verification by the manufacturer and demonstration that the field procedures will cause no crypt damage.
 3. Submission of written safety procedures to be followed so the procedure is maintained as SAFE.
- B. Storage:
 1. Units may be stored within crypt fields being constructed on gravel, or at other designated locations(s) on site, as long as they are set on blocking, gravel or other approved methods to prevent damage or plugging of the bottom drainage holes.
- C. Markings and Identifications:
 1. Markings, including logos, trademarks and proprietary information are prohibited on surfaces of crypts.
 2. Date of manufacture (month, day, and year) shall be written on the box and lid with permanent ink or an equivalent marking.

1.11 COORDINATION

- A. Coordinate the manufacture, delivery, storage and installation of the units with related work.

1.12 GUARANTEE

- A. After erection, completed work will be, subject to terms of Article, GUARANTEE in Division 01, GENERAL CONDITIONS, except guarantee period is extended to five years.

1.13 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
- | | |
|---------------|---|
| T99-01(2011) | Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop. |
| T180-01(2011) | Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop. |
- C. American Concrete Institute:
- | | |
|---|--|
| ACI Manual of Concrete Practice 2011 Edition. | |
| ACI 318-05 | Building Code Requirements for Structural Concrete |
- D. American Society for Testing and Materials (ASTM):
- | | |
|-----------------|--|
| A36/A36M-12 | Standard Specification for Carbon Structural Steel. |
| A153/A153M-09 | Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware. |
| A615/A615M-13 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A1064/A1064M-13 | Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. |
| C31/C31M-12 | Standard Practice for Making and Curing Concrete Test Specimens in the Field. |
| C33/C33M-13 | Standard Specification for Concrete Aggregates |
| C39/C39M-14 | Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen |

| | |
|------------------|--|
| C78/C78M-10e1 | Standard Test Method for Flexural Strength for Concrete (Using Simple Beam with Third-Point Loading) |
| C150/C150M-12 | Standard Specification for Portland Cement. |
| C172/C172M-14 | Standard Practice for Sampling Freshly Mixed Concrete. |
| C260/C260M-10a | Standard Specification for Air-Training Admixtures for Concrete. |
| C494/C494M-13 | Standard Specification for Chemical Admixtures for Concrete |
| C595/C595-13 | Standard Specification for Blended Hydraulic Cement. |
| C1017/C1017M-13 | Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete. |
| C1116/C1116M-10a | Standard Specification for Fiber-Reinforced Concrete. |
| C1157/C1157M-11 | Standard Performance Specification for Hydraulic Cement |
| C1399/C1399M-10 | Standard Test Methods for Obtaining Residual-Strength of Fiber-Reinforced Concrete. |
| C1602/C1602M-12 | Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete. |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Precast Concrete: All crypts shall be of concrete with the following:
1. A minimum 28 days compressive strength of 35 MPa (5,000 psi)
 2. Self-Consolidating Concrete (SCC) containing structural fiber with an inverted slump between 550 mm and 700 mm (22" and 28")
 3. A minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids
 4. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
 5. Normal weight Aggregates: ASTM C 33
 6. Water: ASTM C1602
 7. Chemical Admixtures:
 - a. Water reducers, accelerating and retarding: ASTM C 494
 - b. Air Entraining: ASTM C260
 - c. Admixtures for flowing concrete: ASTM C1017

- d. Admixtures with no standard designation shall be used only with approval of VA.
- 8. Prohibited Admixtures: Calcium Chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Reinforcement:
 - 1. Welded Steel Wire Fabric: ASTM A1064.
 - 2. Steel Wire Reinforcement: ASTM A82, cold drawn.
 - 3. Steel Reinforcement: ASTM A615 Grade 60, deformed.
 - 4. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A36, zinc coated ASTM A153 hot-dipped galvanized finish G90.
 - 5. Fiber: Macrofiber complying with ASTM C1116
- C. Form Coatings:
 - 1. Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.
- D. Paint:
 - 1. Use commercial Concrete & Garage Floor Epoxy Acrylic Paint for crypt concrete lid & inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal. The use of an approved equivalent spray paint product, if approved by the NCA Crypt Specialist, shall only be for use on the interior crypt numbers.

2.2 FABRICATION

- A. General:
 - 1. Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.
- B. Finishes:
 - 1. Surface holes 6 mm (1/4") and smaller caused by air bubbles, normal color variations, normal form joint marks, small chips 6mm (1/4") and smaller and spalling no more than 0.1 square meter (one square foot) total per unit are permitted.
 - 2. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.
 - 3. The lid lifting system shall be as follows:
 - a. Top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 65 mm (2-1/2") diameter minimum recessed bowl of depth sufficient to easily connect lifting device as designated compatible by anchor manufacturer.

- b. Anchors to be installed at locations to ensure maximum lid lifting stability.
- 4. Concrete shall have no evidence of segregation of materials.
- C. Reinforcement:
 - 1. Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads.
 - 2. Reinforcing steel shall be free of dirt, mill scale, rust, oil, grease, ice, snow, water and placed within approved tolerances in accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.
- D. Concrete Placement:
 - 1. Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
 - 2. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.
- E. Curing:
 - 1. 75% of specified concrete compressive strength shall be attained before transportation of units to the cemetery or storage site.
 - 2. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally.
 - 3. Units shall be properly cured in accordance with the applicable provisions of the current ACI Manual of Concrete Practice.
- F. Surface Treatment and Corrective Work:
 - 1. Units that have minor chipping of edges and corners shall be repaired by a method approved by the RE.
 - 2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.
 - 3. Any corrective work beyond what the RE determines is minor, shall be handled according to written procedures from the Structural Engineer that stamped the design for the units. Otherwise, the units shall be removed and replaced.

2.3 TESTING AND INSPECTION

- A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including:

1. Removal of lids
2. Number painting inside crypts
3. Replacement of the lids for inspection by the RE.
 - a. The RE reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements.

PART 3 - EXECUTION

3.1 CRYPT FIELD QUALITY ASSURANCE

- A. Testing: The contractor shall procure an independent qualified testing agency to perform concrete tests during crypt production and prepare test reports.
 1. Concrete Cylinder testing for compressive strength:
 - a. Three cylinders per day of crypt production to be taken in accordance to ASTM C172 as applicable to SCC.
 - b. Strength to exceed 35 MPa (5000 psi) after 28 days curing in accordance to ASTM C31 & C39.
 - c. Test inverted slump when cylinders are made.
 2. Beam testing to confirm design flexure strength:
 - a. Once at the beginning of crypt production, a minimum of three beams with fiber shall be taken for testing of Flexural Performance of Fiber-Reinforced Concrete in accordance with ASTM C78 and C1399. All beams' flexural strength shall exceed the crypt design flexural strength requirements and residual strength of fiber reinforced concrete, and shall exceed capacity of conventionally reinforced concrete wall design as submitted by the Structural Engineer and approved by VA. Fiber Manufacturer shall verify type and dosage rate of the test beams are identical in crypt production.
 3. A single verification test of fly ash in the crypt concrete mix required at the discretion of the RE.

3.2 GENERAL LAYOUT CONTROL

- A. A professional Land Surveyor registered in the state of California shall establish sufficient lines, grades and control for the horizontal placement, slope of the base and top, and vertical alignment for the sides of units in accordance with the design drawings.

3.3 PREPARATION

- A. Before beginning installation, inspect work of other trades insofar as it affects the work of this section. Commencing installation of units will be construed as accepting as suitable the work of other trades.
- B. Verify by survey, rough grading of aggregate for first row of crypts to be installed in a field. Provide a certification by the professional surveyor to the RE that the rough grading for the base stone for the first row of crypts to be installed, as well as that the survey control points for crypt setting have been set according to the plans, prior to the Contractor starting to set crypts in the field. The Surveyor shall indicate to the RE where the control points are located and how they are protected.
- C. Verify by testing, compaction of prepared subgrade and subbase to meet Standard Proctor (AASHTO T-99).
- D. Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.4 HANDLING, INSTALLATION AND PAINTING

- A. Handling:
 - 1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, or placed on gravel until erected. Use of approved designed OEM lifting cable system that has been deemed to be safe for handling the units shall be used during the setting process, where workers are nearby.
 - 2. Lift units with suitable lifting devices at points provided by manufacturer.
 - 3. Provide temporary wood bracing to comply with manufacturer's recommendations to keep crypt bottom off ground during storage.
- B. Installation and Painting:
 - 1. Install units by competent erector crews trained and certified as competent by units manufacturer.
 - 2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids or other parts of the crypt that show damage from bouncing during transport shall be replaced by the contractor at no cost to the Owner.
 - 3. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.

4. After crypt installation and prior to backfill, remove lids with the specified lifting apparatus for crypt inspection by the RE inspector and numbering. Numbers furnished by NCA shall be painted using stencils on the outside of the crypt lids and by hand on the upper inside crypt short wall, both at the headstone end. Numbers shall be permanent paint as specified and approximately twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application within 10 seconds of surface cleaning. After completion of inspection and marking, the Contractor shall replace the lids. Any damage to lids or crypts will be the responsibility of the contractor.

3.5 PROTECTION OF WORK

- A. Use all means necessary to protect units from being damaged during and after installation.

3.6 REPLACEMENT AND REPAIR

- A. Remove and replace units that the RE has determined are damaged, cracked beyond tolerances, broken, improperly fabricated, or otherwise defective and are structurally unsound and unacceptable.
- B. Units having minor defects not affecting serviceability or appearance may be repaired when approved by NCA Inspector.
- C. Proposed repair work shall be sound, permanent, and flush with adjacent surfaces and submitted for approval by NCA Crypt Specialist.
- D. Replacements and repairs shall be done at no additional cost to the Government.

3.7 BACKFILLING AND CRYPT FIELD PROTECTION

- A. Prior to the backfill being placed between the crypts, a professional registered Land Surveyor shall:
 1. Survey the in place crypts and provide a written certification that they are, within allowable tolerances installed:
 - a. At the design locations
 - b. Properly aligned
 - c. At correct elevations and slopes
- B. The following documents shall be provided to the RE:
 1. An electronic drawing of the as-built conditions for the installed crypts.
 2. A paper copy at appropriate scale so the crypt field is fully shown on a maximum sheet size of 600 mm x 900 mm (24" x 36") with all

indications of variances in the placement from the design drawings shown.

3. A written certification that during the manufacturing, handling, setting, and or crypt numbering process that each of the lifting bowls were operated using the designed lifting device, and that any excessive concrete debris has been removed to allow free operation of the lifting bowls. A description of when in the process each of the lifting bowls were used shall also be provided.
- C. When all of the crypts in a specific field are installed as indicated in the design drawings and details, and the surveyor has so certified, the RE will approve the Contractor proceeding with the backfill between the crypts. The Contractor is responsible for insuring that the crypts do not move during the backfill operations, including but not limited to providing adequate blocking at the base of the units, if deemed necessary, to prevent them from moving during the backfill operations.
- D. Protect installed crypt units during backfill operations.
- E. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall:
 1. Contain no materials that will cause a concentrated point load.
 2. The perimeter wall backfill shall be compacted to Standard Proctor (AASHTO T-99) to 95% density to the level equal to the top of the crypts.
 3. Shall be compacted without using large vibratory equipment near crypts as impact loading may cause damage or failure of the crypt.
- F. Backfill between the crypts where gap is less than 50mm (2-inches) shall be as follows:
 1. Install approved (rounded) gravel that meets the specified gradation into gaps between crypts leaving no voids.
 2. Use rodding to assure no bridging occurs and void areas are eliminated.
 3. No sand allowed.
 4. As a resource saving measure, the use of angular stone of suitable gradation (typically the same stone used as drainage stone for below the crypts) shall be allowed in the space between the head and foot of the crypts only, if the Contractor demonstrates a successful method of placement that prevents the larger angular stone from spreading into the gaps along the long sides of side by side crypts.

| Aggregate Size No. | Grading Requirements - Amounts finer than Each Sieve (Square Openings), Mass Percent | | | | | |
|--------------------|--|------------------|--------------------|--------------------|---------------------|------------------|
| | 12.5 mm (1/2") | 9.5 mm (3/8") | 4.75 mm (No. 4) | 8.36 mm (No. 8) | 1.18 mm (No. 16) | 300 μ (No.50) |
| 8 | 100 | 85 to 100 | 10 to 30 | 0 to 10 | 0 to 5 | |
| 89 | 100 | 90 to 100 | 20 to 55 | 5 to 30 | 0 to 10 | 0 to 5 |

- G. Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of soil to specified level, 6 inches minimum of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% density (Standard Proctor (AASHTO T-99)).
- I. No equipment over the crypts should exceed crypt design loads as specified herein 5500 kg (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over or alongside crypts unless impact loads are shown not to exceed crypt design loads.
- J. Immediately during crypts install, mark the crypt field edges with temporary driven 5-foot tall lathes & signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state **"5500-kg axel load maximum. Keep 9 m away"** ("**12,000-lb axle load maximum. Keep 10 yards away**") and placed minimum 15 m (50-ft) apart.
- K. Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.
- L. Finish grading and prepare topsoil as indicated on plans.
- M. Do not store or stockpile any stone, sand, backfill, crypts or any other material over 1200 mm (4-feet) high within 9 m (10 yards) of ground on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.
- N. Do not allow any vehicle that exceeds a 5500 kg (12,000-lb) axle load, 2700 kg (6000-lb) wheel load or equivalent pressure per square inch to traverse or park within 9 m (10 yards) of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.

SPEC WRITER NOTES:

1. Delete or modify Paragraph A.2 as directed by the Project Manager.
2. Discuss at CD2 Review. Anderson CADD has this data available.

3.8 INSPECTION AND ACCEPTANCE

A. Final inspection and acceptance will be by RE following receipt of:

1. Recommendations from NCA Crypt Specialist and/or A/E team, as applicable.
2. Electronic DWG files of each individual crypt field, with coordinates of the monument markers indicated, and each burial plot being indicated with a closed polygon, and corresponding NCA burial plot identification number, along with the section markers and number for the section.

- - E N D - - -

SECTION 03 48 24
PRECAST CONCRETE COLUMBARIUM UNITS

PART 1 - GENERAL**1.1 SUMMARY**

- A. This section covers the manufacture and installation of precast concrete columbarium units, as shown on the drawings and specified herein, including but not limited to: the steel reinforcement, steel embedment plates, required sleeves, finished exposed surfaces, preparation of setting surface, adhesive, columbarium fasteners, and niche cover anchor clip assemblies.
- B. Acceptable designs of the columbarium units' components are provided as shown on the Drawings. The Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:
 - 1. Design for alternate columbarium units shall comply with the design criteria as per Articles 1.3.F and shall comply with the functional tests as per Article 1.3.G of this Specification.
 - 2. Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.
- C. The Government may accept or reject part or all of any design proposed by the Contractor.
- D. This section includes preparation, cleaning and finishing of exposed faces of the columbarium units as indicated on drawings or described herein.

1.2 RELATED DOCUMENTS

- A. Section 31 20 00, EARTH MOVING
- B. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM) for Cast-in-place concrete work.
- C. Section 04 20 00, UNIT MASONRY for stone or brick work.
- D. Section 07 92 00, JOINT SEALANTS, Materials and Workmanship for sealant application.
- E. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1.3 QUALITY ASSURANCE

- A. Manufacturer's and Installer's Qualifications: Prior to commencement of work, submit documentation regarding the experience of his precast concrete supplier and his precast concrete installer in the design, manufacture and installation of Precast Concrete structures and custom units.

- B. Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.
- C. Codes and regulations of the Federal, State and County authorities shall apply.
- D. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.
- E. Before starting production of Precast Concrete Columbarium Units, furnish at the site, two complete Precast Concrete Columbarium Units, to demonstrate quality of construction. Commence production of columbarium units only after written approval has been obtained from the Resident Engineer.
- F. Design Criteria:
 - 1. The Columbarium Units shall be of the following type, style, and size:
 - a. Type: Precast concrete, reinforced.
 - b. Size: Interior and exterior dimensions as indicated on plans.
 - 2. Columbarium top shall be capable of structurally supporting imposed service live load of no less than 240 Kgs./Square Meter (50 lb./ft²), and dead loads based on cap (coping) thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.
 - 3. Submit to the Resident Engineer for review and approval 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer.
- G. Functional Load Tests: If required by the Resident Engineer, a functional load test will be made at the Contractor's expense to insure that the columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article 1.3.F.2. The functional test will consist of the following loading conditions:
 - 1. Unconfined Loading: The columbarium will be placed on a flat surface with no support against the sides. The entire top of the columbarium will be subjected to a simulated uniform load of live

load of 240 Kgs./Square Meter (50 lb./ft²) and required dead load simulating cap, mortar, and grout as they will be installed. The load will be maintained for no less than 72 hours. At end of the loading period, the maximum deflection of the Columbarium top elements shall be no more than 3 mm (1/8"). Upon removal of the load from the unit the residual deflection shall be no more than 1.5 mm (1/16") and concrete elements shall be free of all structural distress.

1.4 MANUFACTURER AND INSTALLER QUALIFICATIONS

- A. Precast concrete columbarium units shall be product of manufacturer who has a minimum of 3 years of experience in fabrication of the precast concrete columbarium units similar in material, design, and quantity to that indicated on the drawings and specified herein.
- B. Precast concrete columbarium units installer shall have been regularly engaged for at least three years in installation of precast concrete similar to this project.
- C. Supply and Installation of fastener system shall be by product manufacturers and installers, both whom have had a minimum of 3 years of experience in installation of similar design to that indicated on the drawing.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Blended Cement: It is the intent of this specification to reduce CO₂ emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.

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/conserve/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 ALLOWABLE TOLERANCES

- A. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
1. Variation of anchors and fasteners from dimensions specified:
3 mm (1/8")
 2. Variation in overall dimensions of precast element (height and width): 3 mm (1/8")
 3. Maximum differential between adjacent units in erected position:
3 mm (1/8")
 4. Variation in thickness of precast panels and elements:
3 mm (1/8")
 5. Maximum vertical differential between adjacent columbarium units in installed position: 3 mm (1/8")

1.8 SUBMITTALS

- A. In accordance with Division 1 Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
1. Samples of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:
 - a. Stainless Steel Angle with threaded spring clip to receive the Tamper Proof Stainless Steel Bolt
 - b. Stainless Steel Bolt, Nut and Washers
 - c. Tamper Proof Stainless Steel Bolt
 - d. Stainless Steel Rosette
 - e. Stainless Steel Expansion Anchors, Bolts and pins
 - f. Stainless Steel Ferrule loop insert.
 - g. Shims
 - h. Washers
 2. Samples of two complete Precast Concrete Columbarium Units, to demonstrate quality of construction, delivered to the site to be approved prior to production..

- 3 Samples of adhesives and grouts.
4. Samples of concrete repair and/or patching materials.
5. Shop Drawings: Complete shop and erection drawings of all precast concrete columbarium units, showing:
 - a. All dimensions and details of construction.
 - b. Installation and relation to adjoining work.
 - 1) Show the individual units open ended against closed ended, where applicable and that web centerline distance is maintained across the joint between units.
 - 2) Show that the overall length of the wall, with multiple precast units is to be set with the indicated overall in place length, within the allowable tolerances (show the installation tolerances).
 - 3) For back to back precast niche units show that the web centerlines for the back to back units will align, for the locations below the cap joints, within the allowable tolerances.
 - 4) Detail where the precast niche units are to be set in the field so the centerline of niche webs will align with the centerline of cap joints above, within the allowable tolerances, when the drawings or details indicate this alignment.
 - c. Reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other trades.
 - d. Joint treatment, joint alignment coordinated with cap stone joints.
 - e. Any other work required for a complete installation.
 - f. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer.
6. Production Drawings:
 - a. Elevation view of each structural element.
 - b. Planametric view of unit.

- c. Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
 - d. Lifting and erection inserts.
 - e. Dimensions and finishes.
 - f. Method of transportation.
 - g. Method of erection and handling.
7. Erection Drawings:
- a. Elevation view of each typical wall segment of interconnected precast niche units, with the overall in place length and position of the precast niche assembly.
 - b. Section view of the precast niche units, as they are to be installed, with the critical alignment elements and field placed dimensions indicated. For double sided units, as an example, the face of niche unit to face of backed up niche unit shall be indicated with the construction tolerances for the in place units indicated. Clearly indicate how the units are going to be set in the field to achieve the intended installed conditions.
 - c. Provide setting drawing(s) that indicate how the precast niche units are to be positioned on the foundations, to meet the design drawings. The setting drawings shall be submitted based upon the field conditions for the foundations for the segments upon which the precast niche units are to be set. Any discrepancies that exist greater than 1/4" from the design drawings shall be clearly indicated as the foundations are to be constructed within this tolerance. The setting of the precast concrete niche units shall not begin until this information has been provided and approved by the RE/COR, or adjustments made to the foundations that are acceptable to the RE/COR.
 - d. Provide coordination drawings indicating the locations for the weld plates in the precast niche units as well as in the foundations, and coordinate this information so the weld plates are installed in the correct locations to align within allowable tolerances.
8. Manufacturer's Literature and Data:
- a. Each type of Concrete Fastener, including adhesive and anchor devices.

- b. Instructions for final cleaning
 - c. Concrete stain/coating, including color charts of manufacturers standard color palette (If applicable for this project.)
 - d. Written instructions of how the exposed concrete of the precast niche units is to be cleaned and prepared prior to application of the approved stain/coating indicated above.
9. Certificates: Manufacturer's qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.
10. Certificates: Installer's qualifications documenting the quality and quantity of experience of the precast concrete installer in the installation of Precast Concrete structures and custom units.
11. Certificates: Manufacturer of the precast niche units shall provide a written certification, prior to shipping the materials, that the products being shipped have been checked and that they meet the dimensional criteria as indicated, within the allowable tolerances for individual units, and that they can be assembled as part of the identified wall segments, within the allowable in place dimensions indicated, within the allowable tolerances indicated. The above manufacturing certifications shall be provided no later than immediately before the units are offloaded at the site. Units that do not meet these criteria shall either be returned or marked in such a manner that indicates they are not to be used for the project work. It is the Contractor's responsibility to ensure that all units that are installed in the project work have been certified by the manufacturer of the units. The Contractor shall be responsible for disposal of any units that are not acceptable for installation in the project work at no cost to the Government.

1.9 DELIVERY, STORAGE

- A. Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage including vandalism, injurious effects of weather and inclusion of foreign matter.
- B. Provide access to the units for field verification of the manufacturing dimensions and whether the units are within allowable tolerances.

1.10 COORDINATION

- A. Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work. See Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for details regarding the coordination of work.

1.11 GUARANTEE

- A. Guarantee precast concrete columbarium unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling, and after erection, completed work will be subject to terms of "Guarantee" article in Division 1 Specification Sections except that guarantee period is one year.
- B. Guarantee precast concrete columbarium units against rust for a period of ten (10) years.

1.12 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. Federal Specifications (Fed. Spec.):
- | | |
|-----------------|---|
| QQ-S-766C (5) | Steel Plates, Sheets, and Strip-Corrosion Resisting |
| QQ-W-423B | Wire, Steel, Corrosive-Resisting |
| TT-S-00227E (3) | Sealing Compound Elastomeric Type, Multi-Component (For Caulking, Sealing, And Glazing In Building And Other Structures) |
| TT-S-00230C (2) | Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing In Building and Other Structures) |
- C. American Concrete Institute (ACI) Publications:
- | | |
|---------------|---|
| ACI 533.3R-70 | Fabrication, Handling And Erection of Precast Concrete. |
|---------------|---|
- D. American Society for Testing Materials (ASTM) Standards:
- | | |
|-------------|------------------|
| A36/A36M-08 | Structural Steel |
|-------------|------------------|

| | |
|---|--|
| ASTM A276-13 | Stainless Steel Bars and Shapes |
| A615/A615M-12 | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. |
| A1064/A1064M-13 | Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. |
| C33/C33M-12 | Concrete Aggregates |
| C150/C150M-12 | Portland Cement |
| E. American Welding Society (AWS) Publications: | |
| AWS D1.1/D1.1M-12(e11) | Structural Welding Code |
| AWS D1.4/D1.4M-11 | Welding Reinforcing Steel |

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Manufacturers that have previously completed at least one successful NCA columbarium project are deemed to be acceptable for processing their units through the procedures according to these specifications and the drawings.
- B. Manufacturers that do not have previous successful experience for a NCA columbarium project may be selected by the Contractor for the project. Contractor is hereby notified that the submittal process for a manufacturer with no previous NCA experience with a successful columbarium project, typically takes longer to process.

2.2 COARSE AGGREGATE

- A. Hard durable aggregate carefully graded from coarse to fine in proportions required to match approved samples of precast concrete columbarium units.

2.3 AGGREGATE FOR BACK-UP MIX (FINE AND COARSE AGGREGATE LIGHTWEIGHT):

- A. ASTM C33. Limit gradation as required to produce the specified appearance and quality of concrete.

2.4 PORTLAND CEMENT

- A. ASTM C150, Type I and Type II; Color as required.

2.5 STRUCTURAL STEEL

- A. ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

- A. ASTM A1064, galvanized.

2.7 STEEL WIRE REINFORCEMENT

- A. ASTM A1064, cold drawn.

2.8 REINFORCING STEEL

- A. ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS GALVANIZED STEEL ITEMS

- A. Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by trades.

2.11 NICHE COVER ATTACHMENT HARDWARE (ROSETTES)

- A. VA National Cemetery Administration, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units are to be as shown on drawings:

1. Rosettes

- a. ASTM Type 316 stainless steel sheet goods, 2.7 mm (0.100 inch) thick.
- b. Die stamp, producing an eight-petal flower pattern as shown on drawings, 25 mm (one-inch) diameter with slight convex; center hole of 5.5 mm (0.218"), concentric to outer edge, with shoulder recess of 10 mm(0.400") in diameter and 1mm (0.035") in depth.
- c. Luster finish.

2. Interior mounting and attachment elements:

- a. ASTM Type 304 or 316 stainless steel tamper-resistant bolts, nuts, washers, anchors, mounting brackets, inserts and the like.

2.12 BACK-UP MATERIAL

- A. Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.13 BOND BREAKERS IF USED

- A. Type and material recommended by sealant manufacturer.

2.14 SEALING COMPOUND IF USED

- A. Fed. Spec. TT-S-00230 C, Type II, Class A, or ASTM C 920-11, Type S, Grade NS, Class 25.

2.15 FABRICATION

- A. Precast concrete columbarium units shall NOT be: fabricated, delivered or incorporated in the work until samples have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.

- 1. Concrete for precast columbarium units shall have minimum compressive strength of 35 MPa (5,000 psi) at 28 days.
- 2. Provide additional steel reinforcing as required for casting, handling and erection loads.
- 3. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.

4. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
 - a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - b. Fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling into precast concrete columbarium units, after fabrication, shall not be acceptable, except where pins are to be inserted through the tops of the units into the caps above, or where pins are to be inserted through the bottom of the precast niche units into the foundation below.
5. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
6. Finish: Exposed faces shall have smooth natural concrete finish with grout cleaned finish conforming to ACI 301 , unless otherwise noted. The face of the units shall be processed by the manufacturer, following removal from the forms to insure that the discoloration and blemishes on the niche faces are removed before shipping to the site.
7. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

PART 3 - EXECUTION

3.1 HANDLING AND INSTALLATION

- A. Before beginning installation, inspect work of other trades in-so-far as it affects the work of this Section. Install units by competent installation crews meeting the requirements of paragraph 1.4 B. Commencing installation of precast concrete columbarium units will be

construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improperly installed units.

1. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

3.2 SETTING

- A. Each precast element shall be set level and true to line with uniform joints as specified within the allowable tolerances, and as needed to result in the overall length of the wall assembly being the specified dimension, within the allowable construction tolerances. Joints that are required to have sealants shall be kept free of dirt and other contaminants for at least the depth to the contact points of the backer rod. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.
- B. Setting of the precast niche units is intended to meet the design drawings within the allowable construction tolerances indicated. There are certain visual relationships that are most critical in the final installation to achieve the design intent. Generally, the consistency of the cap overhang in front of the precast niches, as well as the symmetry of the overhang distance are critical. For double sided columbarium units, as an example, the distance from the face of niche unit to the face of niche units, when installed back to back, is a critical dimension when setting the units. Maintaining this dimension in setting the units, especially at the top of the precast niche units, will allow that the caps be manufactured the same width, and the placement should produce the correct overhang and be symmetrical. The distance from the center of vertical webs on adjoining units, especially across the joints between precast niche units where open and closed end units are joined, are critical as maintaining these allows the proper setting of the niche covers.

Refer to the drawings for additional information regarding the critical element relationships to be used during the creation of the foundations and setting of the precast units.

- C. Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter.

3.3 SEALING OF JOINTS

- A. Where shown and/or wherever required to make the work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.

- 1. Workmanship shall be in accordance with Division 1 Specification Sections and Section 07 92 00, JOINT SEALANTS.

3.4 CLEANING

- A. After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

- A. Precast concrete columbarium units which are damaged, cracked, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the Resident Engineer. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

- - - END - - -

**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:
 - 1. Section 04 05 16, MASONRY GROUTING.
 - 2. Section 04 20 00, UNIT MASONRY.
 - 3. Section 04 43 00 Natural Stone Veneer.
- B. Mortar Color: Section 09 06 00, SCHEDULE FOR FINISHES.

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:
 - 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. Testing laboratory's facilities and qualifications of its technical personnel.
2. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Mortar cement.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - f. Color admixture.

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):
 - C40-11.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-12.....Masonry Cement
 - C109-11.....Compressive Strength of Hydraulic Cement
Mortars (Using 2-in. or 50-MM Cube Specimens)
 - C144-04.....Aggregate for Masonry Mortar
 - C150-12.....Portland Cement
 - C207-06(2011).....Hydrated Lime for Masonry Purposes
 - C270-12.....Mortar for Unit Masonry
 - C595-13.....Blended Hydraulic Cement

C780-10.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
C979-10.....Pigments for Integrally Colored Concrete
C1329-12.....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 concrete masonry units.

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.
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 by the use of 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.

3.2 MORTAR USE LOCATION

- A.

Use Type S mortar for engineered reinforced unit masonry work.
- B. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.

- - - E N D - - -

**SECTION 04 05 16
MASONRY GROUTING**

PART 1 - GENERAL**1.1 DESCRIPTION:**

Section specifies grout materials and mixes.

1.2 RELATED WORK:

- A. Grout used in Section:
 - 1. Section 04 20 00, UNIT MASONRY.
 - 2. 04 43 00 Natural Stone Veneer.
- B. Grout Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTS:

- A. Certified test reports for grout and materials specified.
- B. Identify materials by type, brand name and manufacturer or by origin.
- C. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.
- D. Testing:
 - 1. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
 - 2. Cement:
 - a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 - b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
 - 3. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 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. Grout.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - g. Color admixture.

C. Laboratory Test Reports:

1. Grout, each type.
2. Admixtures.

D. Manufacturer's Literature and Data:

1. Cement, each kind.
2. Hydrated lime.
3. Admixtures.
4. Liquid acrylic resin.

1.5 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.

1.6 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):
 - C40-11.....Organic Impurities in Fine Aggregates for Concrete
 - C91-12.....Masonry Cement
 - C150-12.....Portland Cement
 - C207-06(2011).....Hydrated Lime for Masonry Purposes
 - C404-11.....Aggregate for Masonry Grout
 - C476-10.....Grout for Masonry
 - C595-13.....Blended Hydraulic Cement
 - C979-10.....Pigments for Integrally Colored Concrete
 - C1019-11.....Sampling and Testing Grout

PART 2 - PRODUCTS**2.1 HYDRATED LIME:**

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

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

2.5 PORTLAND CEMENT:

- A. ASTM C150, Type I.

2.6 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.

2.7 WATER:

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

2.8 GROUT:

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
 - 1. Fine Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - 2. Coarse Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

2.9 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 grout mixer.
 - 1. Mix grout for at least five minutes.
- B. Measure ingredients by volume.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.

B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).

C. Do not use grout for filling bond beam or lintel units.

- - - 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, Section 04 05 16, MASONRY GROUTING.
- B. Steel Lintels and Shelf Angles: Section 05 50 00, METAL FABRICATIONS.
- C. Natural Stone Veneer: Section 04 43 00, NATURAL STONE VENEER.
- 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: 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 requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
1. 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. Solid and load-bearing concrete masonry units.
- 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.
 - 2. Shear keys.
 - 3. Reinforcing bars.

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 reinforcing, ties, and anchors.
- B. Use sample panels approved by RE/COR 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-12 | Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A675/A675M-03 (2009) | Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties |
| A951/A951M-11 | Steel Wire for Masonry Joint Reinforcement |
| C90-12 | Load bearing Concrete Masonry Units |
| C476-10 | Grout for Masonry |
| C612-10 | Mineral Fiber Block and Board Thermal Insulation |

D1056-07 Flexible Cellular Materials - Sponge or
Expanded Rubber

C. American Welding Society (AWS):

D1.4/D1.4M-11 Structural Welding Code - Reinforcing Steel

D. Masonry Industry Council:

Hot and Cold Weather Masonry Construction Manual, 1999

E. Masonry Standards Joint Committee; Specifications for Masonry
Structures (TMS 602-11/ACI 530.1-11/ASCE 6-11) (MSJC)

F. 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 RE/COR and all parties whose work is effected or related to the work of this section.

PART 2 - PRODUCTS

2.2 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90 with net compressive strength $f'm = 1,500$ psi.

1. Unit Weight: medium weight

2. Sizes: Modular.

3. Open End Block

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.

B. Lapping of reinforcement at base of wall with dowels only.

C. Joint Reinforcement:

1. Form from wire complying with ASTM A951.

2. Galvanized after fabrication.

3. Width of joint reinforcement 40 mm (1 5/8-inches) less than nominal width of masonry wall or partition.

4. Cross wires welded to longitudinal wires.

5. Joint reinforcing at least 3000 mm (10 feet) in length.

6. Joint reinforcing in rolls is not acceptable.
7. Joint reinforcing that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.
9. Ladder Design:
 - a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
 - b. Cross wires 4 mm (0.16 inch) diameter.
10. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
 - b. Longitudinal wires deformed.

2.4 ANCHORS, TIES, AND REINFORCEMENT

- A.
 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.
- B. Rigid Anchors: Fabricate from steel bars bent to configuration indicated.

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:

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. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

E. 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.

3.4 ANCHORAGE

- A. Veneer to Concrete or Masonry Walls:
 - 1. Use adjustable veneer anchors.
 - 2. 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

A. Joint Reinforcement:

1. Use as joint reinforcement in CMU wythe of combination stone and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.

SPEC WRITER NOTES:

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.

3.6 BRICK EXPANSION AND CMU CONTROL JOINTS

A. Provide brick expansion (BEJ) and CMU control (CJ) joints where shown on drawings.

B. Keep joint free of mortar and other debris.

C. Where joints occur in masonry walls:

1. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key unless otherwise specified.
2. Install filler, backer rod, and sealant on exposed faces.

D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint.

E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.

F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.7 BUILDING EXPANSION AND SEISMIC JOINTS

A. Keep joint free of mortar. Remove mortar and other debris.

B. Install non-combustible, compressible type joint filler to fill space completely except where sealant is shown on joints in exposed finish work.

C. Where joints are on exposed faces, provide depth for backer rod and sealant as specified in Section 07 92 00, JOINT SEALANTS, unless shown otherwise.

3.9 CONCRETE MASONRY UNITS**A. Kind and Users:**

1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Provide an open joint as indicated in the drawings concrete work and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar.
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacing noted.
12. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.

3.10 GROUTING**A. Preparation:**

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts.

B. Placing:

1. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
2. Interruptions: When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.

3.11 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the RE/COR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- E. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

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. Concrete Masonry Units:

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
2. Allow mud to dry before brushing.

- - - E N D - - -

**SECTION 04 43 00
NATURAL STONE VENEER**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies requirements for construction of natural stone veneer.

1.2 RELATED WORK

- A. Cast-in-place concrete columbarium complexes: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- D. Concrete masonry units: 04 20 00 Unit Masonry
- E. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- F. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- G. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- H. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.
- I. Marble: Section 04 73 00, COLUMBARIUM NICHE COVERS
- J. Mockups: SECTION 01 43 39, MOCKUP REQUIREMENTS

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
1. Stone Veneer for columbarium and committal service shelter, sample, 8 inches by 16 inches of each stone type, showing full color range and texture of stone, bond, and proposed mortar joints. Mockup to be erected after approval of submitted samples and shop drawings. Color and texture of stone to receive final approval at mockup.
 2. Anchors, and ties, one each and joint reinforcing 48 inches long.
- C. Certificates signed by stone source, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies; indicate that the stone veneer meets specification requirements.
- D. Manufacturer's Literature and Data:
1. ASTM Stone classification, stone type, color, texture, grade and finish.

2. Anchors, ties, and reinforcement.
3. Reinforcing bars.
4. Recommended cleaning products and techniques.
- E. Submit stone suppliers installation instructions and field erection drawings.
- F. Test Reports: Prior to erection of mockup and ordering stone, submit information copies of test reports by approved independent testing laboratory as specified herein to VA in triplicate – for review and approval. Test reports of stone to be installed to indicate stone ASTM classification, stone type, color, texture, grade and finish.
- G. Cutting and setting drawings indicating unit location number.
 1. Indicate pertinent dimensioning, layout, anchorages, construction details, method of installation, adjacent construction, and jointing.
 2. Indicate large scale details of inscriptions.
- H. Sustainable Requirements: See Section 01 81 13 Sustainable Construction Requirements

1.4 MOCKUP

- A. Before starting masonry, erect mockup showing proposed range of color and texture, using materials, erection methods, jointing, and workmanship required for final work. All mockups shall not be part of the final project, but shall be constructed separately at a nearby location determined by the RE.
 1. Columbarium Mockup: See Section 01 43 39 Mockup Requirements.
 2. Committal Service Shelter Mockup: See Section 01 43 39 Mockup Requirements.
 3. Obtain VA's written acceptance of visual qualities of mockup before ordering stone and stone materials.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of listed standards and manufacturer's unless otherwise indicated. Where there is conflict between construction documents and manufacturer's requirements the most stringent shall apply.
- B. Obtain stone from a single quarry with consistent, quality, grade, color range and texture throughout work.
- C. Subcontract the fabrication of stone to a firm which has successfully fabricated stone similar to quality specified for period of not less than 5 years and is equipped to provide quantity and sizes shown.

Provide written documentation of the above, for VA approval, prior to ordering stone.

1.6 SHIPPING

- A. Do not ship stone with spacer material that will stain or mar the stone finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. At end of each working day, and also during precipitation events, cover stone work exposed to weather with waterproof coverings, securely anchored extending at least 2 feet down both sides of walls.
- B. Stone Cap joints and Wall joints: Continue to cover stone work (including stone caps) until all cap and wall joints are properly sealed and cured and are able to protect the columbaria wall from all weather and from cleaning.
- C. Maintain materials and surrounding air to minimum 40 degrees F prior to, during, and 48 hours after completion of work.
- D. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower freezing point of mortar by use of admixtures or antifreeze agents.
- E. Do not build on frozen work; remove and replace stonework damaged by frost or freezing.
- F. Do not use calcium chloride in mortar or grout.

1.8 PRODUCT DELIVERY

- A. Cover and protect stone during storage and construction against moisture, soiling, staining, and physical damage.
- B. Handle stone to prevent chipping, breakage, soiling, or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials.
- C. Store stone on wood skids or pallets. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Protect stored stone from weather with waterproof, non-staining covers or enclosures, allow air to circulate around stones. Protect stone from ground splatter and contamination with earth.
- D. Protect mortar materials and stonework accessories from weather, moisture, and contamination with earth and other foreign materials.

1.9 WARRANTY

- A. Warrant 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.

1.10 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 for Testing and Materials (ASTM):

| | |
|---------------|--|
| A82/A82M-07 | Steel Wire, Plain, for Concrete Reinforcement |
| A153/A153M-09 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| A951/A951M-11 | Steel Wire for Masonry Joint Reinforcement |
| C97/C97M-09 | Absorption and Bulk Gravity of Dimension Stone |
| C99/C99M-09 | Modulus of Rupture of Dimension Stone |
| C119-11 | Standard Terminology Relating to Dimension Stone |
| C170/C170M-09 | Compressive Strength of Dimension Stone |
| C568/C568M-10 | Limestone Dimension Stone |
| C880/C880M-09 | Flexural Strength of Dimension Stone |
| C1242-12ae1 | Selection, Design, and Installation of Dimension Stone Attachment Systems |
| C1515-11 | Cleaning of Exterior Dimension Stone, Vertical and Horizontal Surfaces, New or Existing |
| C1528-12b | Selection of Dimension Stone |
| D1056-07 | Flexible Cellular Materials - Sponge Expanded Rubber |
| D7089-06 | Determination of the Effectiveness of Anti-Graffiti Coating for Use on Concrete, Masonry, and Natural Stone Surfaces by Pressure Washing |

- C. Masonry Industry Council:

All Weather Masonry Construction Manual, 2002

- D. Indiana Limestone Institute (ILI) Publications and Drawings

1. Contractor's Handbook, 7th Edition
2. How to Avoid Small Area Stains and Blemishes, 2nd Edition
3. Indiana Limestone Handbook, 22nd Edition

- E. Marble Institute of America - Dimension Stone Design Manual, 7.2 Edition
- F. Federal Specifications (FS): FF-S-107C-00 - Screws, Tapping and Drive
- G. International Masonry Industry All Weather Council (IMIAC):
Recommended Practices and Guide Specification for Cold Weather Masonry Construction
- H. U.S. General Services Administration (GSA) Documents
 - 1. Limestone: Characteristics, Uses and Problems 0446001S
- I. Specification: Masonry Structures (ACI 530.1/ASCE 6/TMS 602), Brick Industry Associations "Technical Notes on Brick Construction" and National Concrete Masonry Association "TEK Manual for Concrete Masonry Design and Construction".
- J. ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures, (ASCE, 2010) - Seismic Design

1.11 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 RE and all parties whose work is effected or related to the work of this section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE STONE PRODUCTS

- A. Stone Type 1: Limestone Veneer and Caps for Columbarium:
 - 1. Meet ASTM C568, Classification: III High-Density with the following properties:
 - a. Maximum Absorption per ASTM C97 by Weight, % = 3.00
 - b. Density per ASTM C97, lbs/FT³, = 160
 - c. Compressive Strength per ASTM C170, PSI = 8,000
 - d. Modules of Rupture per ASTM C99, min PSI = 1,000
 - e. Flexural Strength per ASTM C880, PSI = 1,100
 - f. Abrasion Resistance Index = 500
 - 2. Veneer Sizes: As indicated on drawings.
 - 3. Cap Sizes: As indicated on drawings.
 - 4. Grade (ILI Range): Select, Monochromatic in color
 - a. Select - Fine to average-grained stone having a controlled minimum of the following characteristics:

- 1) Streaks, spots, fossil formations, pit holes, reedy formations, texture streaks, honeycomb, travertine-like formations and grain formations changes.
 5. Color: Buff; Match VA approved project color boards.
 6. Finish: Tapestry
 7. Basis-of-Design:
 - a. Buff Dolomitic Limestone
Vetter Stone Co.
23894 Third Avenue, Mankato, MN 56001
- B. Stone Type 2: Limestone Veneer for Committal Shelter 3:
1. Meet ASTM C568, Classification: II Medium-Density with the following properties:
 - a. Maximum Absorption per ASTM C97 by Weight, % = 7.50
 - b. Density per ASTM C97, lbs/FT³, = 135
 - c. Compressive Strength per ASTM C170, PSI = 4,000
 - d. Modules of Rupture per ASTM C99, min PSI = 500
 2. Veneer Sizes: As indicated on drawings.
 3. Color: Honey Tones; Match VA approved project color boards.
 5. Finish: Sandblasted
 6. Basis-of-Design:
 - a. Caramel Cappuccino Cut Stone
Buechel Stone Corp.
W3639 Highway H, Chilton, WI 53014
- C. Stone Type 3: Limestone Veneer for Committal Shelter 3:
1. Meet ASTM C568, Classification: II Medium-Density with the following properties:
 - e. Maximum Absorption per ASTM C97 by Weight, % = 7.50
 - f. Density per ASTM C97, lbs/FT³, = 135
 - g. Compressive Strength per ASTM C170, PSI = 4,000
 - h. Modules of Rupture per ASTM C99, min PSI = 500
 2. Veneer Sizes: As indicated on drawings.
 3. Color: Honey Tones; Match VA approved project color boards.
 5. Finish: Sanded
 6. Basis-of-Design:
 - a. Caramel Cappuccino Cut Stone
Buechel Stone Corp.
W3639 Highway H, Chilton, WI 53014

2.2 REINFORCEMENT AND ANCHORAGES

- A. Anchors, Dowels, Ties, Cramps, and Supports: Type 304 stainless steel of sizes and configurations required for support of stone and applicable superimposed loads, including seismic loads. All reinforcement, anchors and wall components to follow manufacturer requirements and instructions.
- B. Fasteners: Bolts, washers and nuts, Type 304 stainless steel.
- C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but at least 5/8 inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches.
 - 1. Where withes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 - 2. Wire: Fabricate from 3/16 inch diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls, unless otherwise indicated.
 - 3. Basis of Design for Acceptable Product: Heckman Building Products, Inc.; No. 262.
- F. Adjustable Masonry-Veneer Anchors:
 - 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 445 N (100 lbf) load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - 2. Split Tail Stone Anchor – for all stone
 - a. Stainless Steel – Type 304
 - b. 1/8" Thick x 1 1/2" Wide, with 1" splits
 - c. Acceptable Product: Heckmann Building Products, Inc.; No. 145.

2.3 ACCESSORIES

- A. Joint Sealant: Refer to Section 07 92 00.
- B. Weep Holes: Weep cell vent location as indicated on the drawings: typical- between stone joints at Columbarium and at base and head of wall and columbaria units). Cell vent to fill entire joint – joint size may vary.

1. Ultra-violet resistant
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Strips, full-depth of cavity prevent mesh from being clogged with mortar droppings.
- D. Mortar: Refer to Section 04 05 13.
- E. Expansion Joint Fillers: ASTM D1056 Class RE-11.
- F. Cementitious Dampproofing: Cementitious formulation nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

2.4 STONE FABRICATION

- A. Fabricate as shown and as detailed on reviewed shop drawings and in compliance with recommendations of applicable stone association.
- B. Provide holes and sinkages cut or drilled for anchors, fasteners, supports and lifting devices, as indicated and required to secure stonework in place. Shape beds to fit supports.
- C. Accurately cut, dress, drill, fit and finish stone work to shapes and sizes indicated. Cut edges square to face. Make arise straight, sharp, and true.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Verify items provided by other Sections of work are properly sized and located.
- B. Establish lines, levels, and coursing; protect from disturbance.
- C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- D. Scaffolding: Provide, erect, maintain, move, and finally remove scaffolding and staging required for masonry installation. Construct and maintain scaffolding in compliance with applicable ordinances, laws, rules and regulations. Scaffolding must be sufficiently

substantial to support workmen, and necessary materials and equipment. Provide adequate guard rails for protection of property, workmen, and passerby.

- E. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- F. Coat internal surface of stone with dampproofing to extent indicated below and as shown on the drawings:
 - 1. Stone at all masonry ledges near grade and/or courtyard and sidewalk elevations: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
 - 2. No stone to extend below grade.
 - 3. Allow dampproofing to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.

3.3 COURSING

- A. Place masonry to lines and level indicated.
- B. Arrange and trim stones for adequate fit in the pattern and course heights as indicated, random lengths, uniform joint widths with offset between vertical joints as indicated.
- C. Provide stone pattern for review and approval.

3.4 PLACING AND BONDING

- A. Lay masonry in full bed of mortar (horizontal, vertical, and collar joints), properly jointed with other work. Buttering corners of joints and deep or excessive furrowing of mortar joints is not permitted.
- B. Fully bond intersections, and external and internal corners.
- C. Do not shift, or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
- D. Remove excess mortar on surface and in cavities.
- E. Perform job site saw cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.

3.5 TOLERANCES

- A. Alignment of Columns: Maximum of 1/4 inch from true line.
- B. Variation from Unit to Adjacent Unit: 1/32 inch maximum.
- C. Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

- D. Variation from Plumb: 1/4 inch per story non-cumulative, 1/2 inch in two stories or more.
- E. Variation from Level Coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/4 inch maximum.
- F. Variation of Joint Thickness: 1/8 inch in 3 feet.
- G. Maximum variation from Cross Sectional Thickness of Walls: Plus or minus 1/4 inch.

3.6 JOINTING

- A. Joint Size:
 - 1. At stone veneer/precast niche joints, as indicated on the drawings.
 - 2. At vertical and horizontal stone veneer/stone veneer joints, as indicated on the drawings.
 - 3. At stone caps/stone veneer joints, as indicated on the drawings.
 - 4. At stone caps/precast niches joints, as indicated on the drawings.
 - 5. At stone caps/stone caps joints, as indicated on the drawings.
- B. Joint Materials:
 - 1. Mortar, Type N, ASTM C270. See Section 04 05 13 MASONRY MORTARING
 - 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, where applicable.
 - 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.

3.7 SETTING

- A. Mortar Bed Setting:
 - 1. Drench units with clean water prior to setting.
 - 2. Fill dowel holes and anchor slots completely with non-shrink grout.
 - 3. Set units in full bed of mortar containing water repellant, 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.
- B. Shim Setting:
 - 1. Set each piece on shims as indicated, minimum of two for each piece and four for each cap piece.

2. Set shims where located on the shop drawings.
 - a. Caps on Precast Niche Units:
 - 1) Place shims directly above the vertical webs below.
 - b. Install shims on cast-in-place concrete or filled CMU as indicated on the shop drawings.

3.8 REINFORCEMENT AND ANCHORAGES

- A. Anchor stone veneer to unit masonry and cast in place concrete with metal veneer anchors as follows:
 1. Secure wire anchors by inserting pintles into eyes of masonry wall reinforcement projecting from horizontal mortar joints.
 2. Embed anchors in veneer mortar joints to within 25 mm (1 inch) of face.

3.9 MASONRY FLASHINGS

- A. Extend through wall flashings to within 1/2" of exterior face of veneer, turn up interior end to termination bar and seal onto face of vertical surface - See Drawings.
- B. Lap end joints minimum 6 inches and seal watertight per manufacturer's recommendation.
- C. Use flashing manufacturer's recommended adhesive and termination sealant.
- D. Create end dams at end of cavity runs, and other vertical elements to channel water to nearest weep hole in portion of wall and items which might allow water to travel vertically.

3.10 LINTELS

- A. Install loose steel lintels as scheduled or shown. Leave space at end of lintels to expand.

3.11 WEEPS AND VENTS

- A. Install weep vents in veneer at each stone joint horizontally above through-wall flashing, above shelf angles, at bottom of walls, and at the top and bottom ends of each precast niche unit to natural stone junction as indicated on the drawings.

3.12 CONTROL/EXPANSION JOINTS

- A. Size control joints in accordance with Section 07 92 00 for sealant performance, but in no case larger than adjacent mortar joints.
- B. Provide expansion joints as indicated.

3.13 BUILT-IN WORK

- A. As work progresses, build-in metal door frames, fabricated metal frames, wood nailing strips, anchor bolts, plates, and other items to be built in the work supplied by other Sections.
- B. Build-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in mortar joints. Fill frame voids solid with mortar.
- D. Do not build-in organic materials subject to deterioration.

3.14 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Cooperate with other Sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

3.15 CLEANING

- A. All joint work is to be completed prior to beginning the cleaning and washing process of the wall and stone. All joint sealants and backer rod at walls, caps, columbaria niche units, to be in place and cured properly prior to cleaning and washing of wall and stone.
- B. Remove excess mortar and smears.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with non-acidic solution which will not harm masonry or adjacent materials. Consult stone manufacturer for acceptable cleaners. Leave surfaces thoroughly clean and free of all mortar and other soiling.
- E. Use non-metallic tools in cleaning operations.
- F. Comply with ASTM C1515 and D7089.
- G. Clean mortar with non-acidic cleaners/wash that will not harm stone – consult manufacturer prior to beginning any cleaning processes. Take care not to harm stone with cleaners and wash.

3.16 PROTECTION

- A. Maintain protective boards at exposed external corners which may be damaged by construction activities.
- B. Provide protection without damaging completed work.
- C. Keep expansion joint voids clear of mortar.

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**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 for exterior signage posts as shown in the drawings.

1.2 RELATED WORK

- A. Cast-in-place concrete: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Color and texture specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Exterior Signage: Section 10 14 00, EXTERIOR SIGNAGE.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Provide cast stone sample panel, see section 10 14 00 EXTERIOR SIGNAGE for sample submittal requirements for each color and each finish.
- C. Shop Drawings:
 - 1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes. See section 10 14 00 EXTERIOR SIGNAGE for shop drawing requirements.
- 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. Submit manufacturers test results of cast stone previously made by manufacturer, indicating compliance with ASTM C1364.
- F. Laboratory Qualifications: Description of testing laboratories facilities and qualifications of its principals and key personnel.
- G. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.

- H. Installer Qualifications: Provide documentation of requirements specified herein.

1.4 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 packaging and lifting devices from the manufacturer that are designed to permit the installer easy removal for inspection, or to handle the cast stone for installation without causing damage to the units.
- F. Provide an itemized list of product to support the bill of lading.

1.5 WARRANTY

- A. Warranty cast stone units from any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be two years.
- B. Warranty exterior cast stone masonry against rust for a period of ten (10) years.

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 Concrete Institute (ACI):
 - 318/318M-11 Building Code Requirements for Structural Concrete and Commentary
- C. Architectural Precast Association; certification program.
- D. American Society for Testing and Materials (ASTM):
 - A167-99(2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A185/A185M-07 Steel, Welded Wire Reinforcement, Plain, for Concrete
 - A240/A240M-13a Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - A276-13 Stainless Steel Bars and Shapes

| | |
|-----------------|--|
| A615/A615M-12 | Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A666 | Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar |
| C33/C33M-13 | Concrete Aggregates |
| C150/C150M-12 | Portland Cement |
| C260/C260M-10a | Air-Entraining Admixtures for Concrete |
| C426-10 | Linear Drying Shrinkage of Concrete Masonry Units |
| C494/C494M-13 | Chemical Admixtures for Concrete |
| C503/C503M-10 | Marble Dimension Stone |
| C568/C568M-10 | Limestone Dimension Stone |
| C615/C615M-11 | Granite Dimension Stone |
| C616/C616M-10 | Quartz-Based Dimension Stone |
| C618-12a | Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| C979/C979M-10 | Pigments for Integrally Colored Concrete |
| C989/C989M-13 | Slag Cement for Use in Concrete and Mortars |
| C1194-03 (2011) | Compressive Strength of Architectural Cast Stone |
| C1195-03 (2011) | Absorption of Architectural Cast Stone |
| C1364-10b | Architectural Cast Stone |
| D2244-11 | Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates |

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

1.7 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 written handling and installation procedures that will be followed for the installation of the work for cast stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the cast stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the cast stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of cast stone units that have been damaged on any edges or faces that will be visible in the final installation.
4. 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, if required.

C. Testing:

1. Follow the procedures in ASTM C1364.
2. One (1) sample from production units may be selected at random from the field for each 14 m³ (500 cubic feet) delivered to the job:
 - a. Three (3) field cut cube specimens from each of these sample to have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as specified.
 - b. Three (3) field cut cube specimens from each of these samples to have an average maximum cold-water absorption of 6 percent.
 - c. Test field specimens in accordance with ASTM C1194 and C1195.
 - d. Manufacturer to submit a written list of projects similar and at least three (3) years of age, along with owner, architect and contractor references.

- D. Pre-Installation Conference: 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 RE and all parties whose work is effected or related to the work of this section.

1.8 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.

1.9 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.

C. Job Site Testing – One (1) sample from production units may be selected at random from the field for each 14m³ (500 cubic feet) delivered to the job site:

1. Three (3) field cut cube specimens from each of these samples must have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as allowed by ACI 318.
2. Three (3) field cut cube specimens from each of these samples must have an average maximum cold-water absorption of 6 percent.
3. Test field specimens in accordance with ASTM C1194 and C1195.

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, Grade 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, if required.

2.3 COLOR AND FINISH

- A. Match the color and texture of existing signage posts on site. Provide samples for review and approval.
- 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 and 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, 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.
- F. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the RE/COR.
- 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.
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 setting requirements as indicated in section 10 14 00 EXTERIOR SIGNAGE.

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.).

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**SECTION 04 73 00
COLUMBARIUM NICHE COVERS**

PART 1 - GENERAL**1.1 GENERAL PROVISIONS**

1. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

- A. Work Included: Provide labor and materials necessary to complete the work of this Section, including but not limited to the following:
 1. The Department of Veterans Affairs (VA) shall furnish niche covers for all of the new Columbarium Niches being installed by the Contractor. This specification section is for all work necessary for the Contractor to accept, handle, store, move and install one, government approved and provided, blank columbarium niche cover for each of the new precast niches created in the new columbarium walls. The government shall also provide, as part of the niche cover products manufactured for this project, a predetermined minimum number of approved blank niche covers to act as spares. The spare niche covers are to be used to replace niche covers should any damage occur, or for re-inscription necessitated by additional interment at a specific niche location.
 2. The number of approved government provided spare columbarium niche covers for this project to be accepted, offloaded and stored at the designated location is 10 - 15% of the projects total columbarium niches.

1.3 INSTALLER QUALIFICATIONS

- A. Installation of columbarium niche covers will be performed by those companies who, through an approved certification process, have demonstrated previous experience in installation of similar design as indicated in the drawings and specified herein.

1.4 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
 1. Section 03 48 24: PRECAST CONCRETE COLUMBARIUM UNITS, the precast concrete niche units with: niche cover mounting hardware assemblies (installed); and niche cover attachment hardware assemblies (provided for use to attach the Government provided niche covers).

Four each of the niche cover mounting hardware assemblies shall be furnished and installed for each precast concrete niche opening.

Four each of the niche cover attachment hardware assemblies shall be provided for each precast niche opening, to be used to mount the approved government niche covers as indicated and on the 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 REQUIREMENTS, for project 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, please visit <http://www.biopreferred.gov/>.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 NICHE COVERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

A. Niche covers that have been inspected and accepted as being in compliance with manufacturing tolerances for size, hole size and placement, perpendicularity, finish, and product stone quality shall be furnished by the Government and delivered to the site on pallets. They shall be of size, type, manufacturing, finish and quantities required for this project. The covers shall be delivered to the site Freight on Board (FOB) and the Contractor shall be responsible to offload and secure them at the job site. The general quantity and condition shall be observed and an adequate count to cover all the installed columbarium units, plus required spares shall be verified by the Contractor prior to accepting the units and performing the offloading operations. Note any shipping damage and reject any damaged covers before the delivery truck leaves the site. Once satisfied, take ownership of the acceptable covers, as all being approved as meeting the government specifications and being suitable for installation at this project. Once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer/Contracting Officer's Representative (RE/COR).

3.2 INSPECTION

- A. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the RE/COR.

3.3 NICHE COVER ATTACHMENT HARDWARE

- A. Each of the four niche cover attachment hardware assemblies provided, for each new precast concrete niche opening, as part of Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS, consists of: the stainless steel rosette, stainless steel tamperproof screw and the white or clear washer beneath the rosette, that is to bear against the niche cover when rosette is snugged up causing the cover to stay in place against the face of the niche opening due to friction. All of the niche cover hardware (mounting and attachment assemblies) shall be as submitted and approved as part of the work in Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- B. The Contractor performing the installation of the niche covers shall maintain control of the niche cover attachment hardware assemblies from delivery to the site through acceptance of the installation of the government provided niche covers.

3.4 INSTALLATION

- A. Installation of the government provided niche covers shall include all materials, manpower, tools and equipment required to receive the approved government provided niche covers from the manufacturer, and handle them as necessary and perform whatever work is needed to result in the successful installation of one niche cover for every precast concrete niche space created for this project.
- B. The niche covers shall be installed so as to create a visual straight line along the top of the row of covers agreed to by the Resident Engineer as the primary visual vertical reference line in the installation. The covers shall be spaced achieve, as close as possible, the intended design spacing, taking into consideration the allowable fluctuations in the manufacturing tolerances for the government provided niche covers.
- C. The niche cover attachment assemblies shall be installed so that the threaded end of the tamperproof screw is inserted into the threads of the spring clip on the mounted angle bracket behind each of the mounting holes in the niche covers. This should result in the head of

the screw being parallel with the face of the niche cover. The threaded hole in the spring clip shall be fully visible when looking through the mounting hole in the niche cover to the respective spring clip behind the hole. The position of the spring clip shall be adjusted so the threaded tamperproof screw will enter the threaded hole in the spring clip and that the attachment assembly can be tightened to secure the cover in the intended position. To achieve this installation, the angle brackets shall be adjusted to be the correct height from the niche wall so the hole in the spring clip can have the respective tamper proof screw inserted and tightened. To achieve the proper positioning of the spring clips, the angle brackets shall be adjusted in their position, or the hole in the angle bracket through which the tamper proof screw passes when tightened into the spring clip, shall be enlarged as necessary to allow the adjustment of the spring clip to align with the hole in the niche cover so the tamper proof screws through the individual rosettes can each be inserted and tightened using the threaded spring clip. Only correct installations of the tamperproof screws, inserted into the threads of the spring clip and being tightened are acceptable. The head of the tamperproof screw shall be snugged up tight against the rosette, and shall be seated against the rosette, which occurs when the tamperproof screw is approximately perpendicular to the face of the niche cover.

3.5 CLEANING AND PROTECTION

- A. Columbarium niche covers shall be shop cleaned at the time of fabrication. After installation, carefully clean the markers, removing all dirt stains, and all other incident defacements.
 - 1. Stiff bristle fiber brushes may be used, but the use of wire brushes or acid-type cleaning agents and other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted regarding the use of any cleaners and must approve of them before use.
 - 2. Protection of Finished Work: All covers that are installed as part of the work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.
- B. Clean up area of excess material and debris. Clean visible portions of all covers.

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**SECTION 05 12 00
STRUCTURAL STEEL FRAMING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting: Section 09 91 00, PAINTING.
- C. Steel Decking: Section 05 31 00, STEEL DECKING.

1.3 QUALITY ASSURANCE

- A. Fabricator and erector must maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Fabricate work in an AISC certified fabrication plant.
- B. The controlling contractor must ensure that the steel erector is provided written notification required by 29 CFR 1926.752, before authorizing the commencement of steel erection; provide copy of this notification to the RE.
- C. Pre-Installation Conference: 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 RE and all parties whose work is effected or related to the work of this section.

1.4 TOLERANCES

- A. Hold fabrication tolerances for structural steel within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information (AISC Steel Construction Manual Fourteenth Edition except as follows:
 - 1. Elevation tolerance for column splice points at time member is erected is 10 mm (3/8 inch).
 - 2. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).

3. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 DESIGN

- A. Connections: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with the details shown on the Drawings, supplementing where necessary. The details shown on the Drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the RE of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the RE. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.

1.6 REGULATORY REQUIREMENTS

- A. AISC: Specification for Structural Steel Buildings
- B. AISC: Code of Standard Practice for Steel Buildings and Bridges.

1.7 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 requirements.

1.8 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings: Complete.
- C. Certificates:
 1. Structural steel.
 2. Steel for all connections.
 3. Welding materials.
 4. Shop coat primer paint.
- D. Test Reports:
 1. Welders' qualifying tests.
- E. Design Calculations and Drawings:

1. Connection calculations, if required.

F. Record Surveys.

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 Institute of Steel Construction (AISC):

AISC 303-10 Steel Buildings and Bridges

AISC 360-10 Structural Steel Buildings

C. American National Standards Institute (ANSI):

B18.22.1-03 Plain Washers

B18.22M-05 Metric Plain Washers

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

A6/A6M-13 General Requirements for Rolled Structural Steel Bars, Plates,
Shapes, and Sheet Piling

A36/A36M-12 Carbon Structural Steel

A53/A53M-12 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and
Seamless

A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A242/A242M-04(2009) High-Strength Low-Alloy Structural Steel

A283/A283M-12a Low and Intermediate Tensile Strength Carbon Steel Plates

A307-12 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

A325-10 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum
Tensile Strength

A490/A490M-12 Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile
Strength

A500/A500M-10a Cold Formed Welded and Seamless Carbon Steel Structural
Tubing in Rounds and Shapes

A501-07 Hot-Formed Welded and Seamless Carbon Steel Structural
Tubing

A572/A572M-12a High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A992/A992M-11 Structural Steel Shapes

- E. American Welding Society (AWS):
D1.1/D1.1M-10 Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
Specification for Structural Joints Using ASTM A325 or A490 Bolts (2000)
- G. Military Specifications (Mil. Spec.):
MIL-P-21035 Paint, High Zinc Dust Content, Galvanizing, Repair (2003)
- H. Occupational Safety and Health Administration (OSHA):
29 CFR Part 1926 Safety Standards for Construction

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A992.
- B. Structural Tubing: ASTM A500, Grade B.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
 - 1. High-strength bolts, including nuts and washers: ASTM A325 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
 - 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Zinc Coating: ASTM A123.
- G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

PART 3 - EXECUTION

3.1 CONNECTIONS (SHOP AND FIELD)

- A. Welding: Welding in accordance with AWS D1.1. Make welds only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than proof load given in Specification for Structural Joints Using ASTM A325 or A490 Bolts. Perform tightening with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators or the turn-of-the-nut method. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

3.2 FABRICATION

- A. Execute fabrication in accordance with AISC Steel Construction Manual – Fourteenth Edition.

3.3 SHOP PAINTING

- A. General: Shop paint steel with primer in accordance with Section 6, Code of Standard Practice for Steel Buildings and Bridges.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
 - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
 - 2. Surfaces which will be encased in concrete.
 - 3. Surfaces which will receive sprayed on fireproofing.
 - 4. Top flange of members which will have shear connector studs applied.
- D. Zinc Coated Finish (Hot Dip Galvanized): Provide per ASTM A123 (after fabrication).
- E. Touch-up (after erection): Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

3.4 ERECTION

- A. General: Erect structural steel framing in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.
- B. Temporary Supports: Provide temporary support of structural steel frames during erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

3.5 FIELD PAINTING

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.
- B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

3.6 SURVEY

- A. Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that may be supported, attached, or applied to the structural steel work, submit a certified report of survey to RE for approval. Prepare reports by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS; specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

--- E N D ---

**SECTION 05 31 00
STEEL DECKING****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section specifies material and services required for installation of steel decking as shown and specified.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Finish Painting: Section 09 91 00, PAINTING.

1.3 DESIGN REQUIREMENTS

- A. Design steel decking in accordance with AISI publication, "Specification for the Design of Cold-formed Steel Structural Members" except as otherwise shown or specified.
- B. Design all elements with the latest published version of applicable codes.

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 requirements.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Prepare shop and erection drawings showing decking unit layout, connections to supporting members, and similar information necessary for completing installation as shown and specified, including supplementary framing, sump pans, ridge and valley plates, cant strips, cut openings, special jointing or other accessories. Show welding, side lap, closure, deck reinforcing and closure reinforcing details. Show openings required for work of other trades, including openings not shown on structural drawings. Indicate where temporary shoring is required to satisfy design criteria.
- C. Manufacturer's Literature and Data: Indicate steel decking section properties and specifying structural characteristics.
- D. Certification: For each type and gauge of metal deck supporting concrete slab or fill, furnish certification of the specified fire ratings. Certify that the units supplied are U.L. listed as a "Steel Floor and Form Unit".

- E. Insurance Certification: Assist the Government in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance.

1.6 QUALITY ASSURANCE

A.

Pre-Installation Conference: 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 RE and all parties whose work is effected or related to the work of this section.

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):

| | |
|------------------|--|
| A36/A36M-12 | Carbon Structural Steel |
| A653/A653M-11 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process |
| A1008/A1008M-12a | Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable |

- C. American Iron and Steel Institute (AISI):

| | |
|--------------|--|
| AISI S100-07 | North American Specification for the Design of Cold-Formed Steel Structural Members, Specification and Commentary for the Design of Cold-Formed Steel Structural Members |
|--------------|--|

- D. American Welding Society (AWS):

| | |
|--------------|---------------------------------------|
| D1.3D1.3M-08 | Structural Welding Code - Sheet Steel |
|--------------|---------------------------------------|

- E. Factory Mutual (FM Global):

Loss Prevention Data Sheet 1-28: Design Wind Loads (2012)
Factory Mutual Research Approval Guide (2005)

- F. Military Specifications (Mil. Spec.):

| | |
|--------------|--|
| MIL-P-21035B | Paint, High Zinc Dust Content, Galvanizing Repair (2003) |
|--------------|--|

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Decking: ASTM A653, Structural Quality
- B. Galvanizing: ASTM A653, G60 .
- C. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B.
- D. Primer for Shop Painted Sheets: Manufacturer's standard primer (2 coats). When finish painting of steel decking is specified in Section 09 91 00, PAINTING, primer coating must be compatible with specified finish painting.
- E. Miscellaneous Steel Shapes: ASTM A36.
- F. Welding Electrode: E60XX minimum.
- G. Sheet Metal Accessories: ASTM A653, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:
 - 1. Metal Cover Plates: Provide for end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings; same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.
 - 2. Continuous Sheet Metal Edging: Provide at openings, concrete slab edges and roof deck edges; same quality as deck units but not less than 1.3 mm (18 gauge) steel. Manufacture to design side and end closures supporting concrete and their attachment to supporting steel, to safely support the wet weight of concrete and construction loads. Limit deflection of cantilever closures to 3 mm (1/8 inch) maximum.
 - 3. Metal Closure Strips: Provide for openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.
 - 4. Ridge and Valley Plates: Provide 1.3 mm (18 gauge), minimum 100 mm (4 inch) wide ridge and valley plates where roof slope exceeds 40 mm per meter (1/2 inch per foot).
 - 5. Cant Strips: Provide bent metal 45 degree leg cant strips where indicated on the Drawings. Fabricate cant strips from 1 mm (20 gauge) metal with a minimum 125 mm (5 inch) face width.
 - 6. Seat Angles for Deck: Provide where a beam does not frame into a column.

7. Sump Pans for Roof Drains: Fabricate from single piece of minimum 1.9 mm (14 gauge) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 75 mm (3 inches) wide. Recess pans not less than 38 mm (1 1/2 inches) below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

2.2 REQUIREMENTS

- A. Provide steel decking of the type, depth, gauge, and section properties as shown.
- B. Metal Roof Deck: Single pan fluted units with flat horizontal top surfaces utilized to act as a permanent support for all superimposed loads. Comply with the depth and minimum gage requirements as shown on the Contract Documents.
 1. Wide Rib (Type B) deck.
 5. Finish: Galvanized G-60.
 7. Finish: Prime painted. Apply finished coat of paint to underside of deck after installation. Color as selected by Architect.
- C. Do not use steel deck for hanging supports for any type or kind of building components including suspended ceilings, electrical light fixtures, plumbing, heating, or air conditioning pipes or ducts or electrical conduits.

PART 3 - EXECUTION

3.1 ERECTION

- A. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Remove any oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.
- B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
- C. Do not use floor deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace any deck units that become damaged after erection and prior to casting concrete at no cost to the Government.
- D. Provide steel decking in sufficient lengths to extend over 3 or more spans.
- E. Place steel decking units at right angles to supporting members. End lap sheets of roof deck a minimum of 50 mm (2 inches) and over supports.

F. Fastening Deck Units:

1. Fasten floor deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. with a minimum of two welds per unit at each support. Where two units abut, fasten each unit individually to the supporting steel framework.
2. Tack weld or use self-tapping No. 8 or larger machine screws at 915 mm (3 feet) o.c. for fastening end closures. Only use welds to attach longitudinal end closures.
3. Weld side laps of adjacent floor deck units that span more than 1524 mm (5 feet). Fasten at mid-span or 915 mm (3 feet) o.c., whichever is smaller.
4. Fasten roof deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. at every support, and at closer spacing where required for lateral force resistance by diaphragm action. Attach split or partial panels to the structure in every valley. In addition, secure deck to each supporting member in ribs where side laps occur. Power driven fasteners may be used instead of welding for roof deck if strength equivalent to the welding specified above is provided. Submit test data and design calculations verifying equivalent design strength.
5. Mechanically fasten side laps of adjacent roof deck units with spans greater than 1524 mm (5 feet) between supports, at intervals not exceeding 915 mm (3 feet) o.c., or mid-span, whichever is closer, using self-tapping No. 8 or larger machine screws.
6. Provide any additional fastening necessary to comply with the requirements of Underwriters Laboratories and/or Factory Mutual to achieve the required ratings.
7. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 2.1 kPa (45 psf) at eave overhang and 1.4 kPa (30 psf) for other roof areas.

G. Cutting and Fitting:

1. Cut all metal deck units to proper length in the shop prior to shipping.
2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the Structural Drawings.
3. Other penetrations shown on the approved metal deck shop drawings but not shown on the Structural Drawings are to be located, cut and reinforced by the trade requiring the opening.

4. Make all cuts neat and trim using a metal saw, drill or punchout device; cutting with torches is expressly prohibited.
5. Do not make any cuts in the metal deck that are not shown on the approved metal deck drawings. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and any other openings and supports in the immediate area. Do not cut the opening until the sketch has been reviewed and accepted by the RE/COTR. Provide any additional reinforcing or framing required for the opening at no cost to the Government. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected metal deck.
6. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

3.2 WELDING

- A. Make welds only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.3.

3.3 FIELD REPAIR

- A. Areas scarred during erection.
- B. Welds to be thoroughly cleaned and touched-up. Touch-up paint for zinc-coated units must be zinc rich galvanizing repair paint. Touch-up paint for shop painted units of same type used for shop painting.

--- 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.
 - 2. Loose Lintels.
 - 3. Shelf Angles.

1.2 RELATED WORK

- A. B. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- Prime and finish painting: Section 09 91 00, PAINTING.

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 requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS AND PRODUCT DATA.
- B. Shop Drawings:
 - 1. Indicate 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. Submit Design Calculations for specified live loads including dead loads prepared by professional engineer licensed in the location of their practice.
- 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.

1.5 QUALITY ASSURANCE

- A. Each manufactured product must meet or exceed the requirements specified, and be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type to 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.

1.6 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 Society of Mechanical Engineers (ASME):
 - B18.6.1-81(R2008) Wood Screws
 - B18.2.2-10 Nuts for General Applications
- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-12 Carbon Structural Steel
 - A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A307-12 Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - A500/A500M-10a Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - A653/A653M-11 Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
 - C1107/C1107M-13 Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - E488-10 Strength of Anchors in Concrete Elements
 - F436-11 Hardened Steel Washers
- D. American Welding Society (AWS):
 - D1.1/D1.1M:2010 Structural Welding Code Steel
 - D1.2/D1.2M:2008 Structural Welding Code Aluminum
 - D1.3/D1.3M:2008 Structural Welding Code Sheet Steel

METAL FABRICATIONS

05 50 00 - 2

E. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06-2006 Metal Finishes Manual

F. Structural Steel Painting Council (SSPC):

SSPC-SP 1 Solvent Cleaning

SSPC-SP 2 Hand Tool Cleaning

SSPC-SP 3 Power Tool Cleaning

PART 2 - PRODUCTS**2.1 MATERIALS**

A. Structural Steel: ASTM A992.

B. Structural Tubing: ASTM A500.

C. Primer Paint: As specified in Section 09 91 00, PAINTING.

D. 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 with in-turned pyramid shaped clamping ridges on each side.
3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A653, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.

E. Grout: ASTM C1107, pourable type.

2.2 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 is used.

B. Anchor Bolts: ASTM A307; same material, color, and finish as the metal to which applied when exposed.

C. Mechanical Post-Installed Anchors: Design values listed must be as tested according to ASTM E488 and in accordance with the product's ICC-ER Report.

- D. Lag Screws and Bolts: ASME B18.2.1, type and grade best suited for the purpose.
- E. Toggle Bolts: ASME B18.2.1.
- F. Bolts, Nuts, Studs and Rivets: ASME B18.2.2 or ASTM A307.
- G. Washers: ASTM F436, type to suit material and anchorage.

2.3 FABRICATION

A. General:

1. Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames.
2. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as required to support wall loads over openings. Provide with connections and fasteners and welds as shown on the Drawings.
3. Construct to have at least 200 mm 8 inches bearing on masonry at each end.
4. Provide angles and plates, ASTM A36, for embedment as indicated.
5. Galvanize embedded items exposed to the elements according to ASTM A123.

B. 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.

C. Size:

1. Size and thickness of members as shown.

D. 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 punch or drill; 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 member's machine screws or bolts.

E. 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.

F. 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 standards as listed in article Applicable Publications.
- 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. Provide as indicated.
- 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. Fabricate fit of components and the alignment of holes to 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.
- G. Finish:
 - 1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
 - 2. 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) Provide as defined in SSPC-SP2 and SP3.

H. 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.

2.4 SUPPORTS

A. General:

1. Fabricate ASTM A992 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.

2.5 LOOSE LINTELS

- A. Furnish lintels of sizes shown.
- 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.

SPEC WRITER NOTES:

1. Coordinate with structural section for shelf angles part of steel framing this paragraph is for angles to concrete framing.

2.6 SHELF ANGLES

- A. Fabricate from steel angles of size shown.
- B. Attach shelf angle as indicated.

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.

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.
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 on shop drawings.

3.3 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.

3.4 SHELF ANGLES

- A. Anchor shelf angles with 19 mm (3/4 inch) bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.
- B. Provide expansion space at end of members.

3.5 STEEL COMPONENTS FOR MILLWORK ITEMS

- A. Coordinate and deliver to Millwork fabricator for assembly where millwork items are secured to metal fabrications.

3.6 CLEAN AND ADJUSTING

- A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.
- B. Clean after installation exposed prefinished and plated items and items fabricated from aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

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**SECTION 06 10 00
ROUGH CARPENTRY****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Section specifies wood blocking, sheathing, furring, nailers, and rough hardware.

1.2 RELATED WORK

- A. Milled Woodwork: Section 06 20 00, FINISH CARPENTRY.

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. VOC Emissions:
 - a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification.
 - b. Submit manufacturer's certification that products comply with SCAQMD Rule 1168 in areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur. In areas where freeze/thaw conditions do exist or direct exposure to moisture can occur, submit manufacturer's certification that products comply with Bay Area AQMD Reg. 8, Rule 51 for containers larger than 16 oz. and with California Air Resources Board (CARB) for containers 16 oz. or less.

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 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):

| | |
|-----------|---|
| A307-10 | Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength |
| C954-11 | 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 |
| C1002-07 | Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs |
| 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 |
| F844-07a | Washers, Steel, Plain (Flat) Unhardened for General Use |
| F1667-11a | 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):

| | |
|------------------|---|
| 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.
- 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.
direct precipitation or continuous exposure to liquid water.
- 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 AWP Standard U1 for the following Use Categories (material conforming to a higher AWP 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 fresh water contact - heavy duty above ground.
 - f. UC4B: Heavy duty soil or fresh water contact - critical or difficult to replace components.
 - g. UC4C: Extreme duty soil or fresh water contact - critical structural components.
- H. Boron-based Preservatives: Impregnate lumber with preservative treatment conforming to AWP 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 AWP Standard U1, Commodity Specification H and AWP 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.

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.
- B. Anchors in Masonry: Except where indicated otherwise, embed anchor bolts not less than 160 mm (6 inches) in masonry unit walls and provide each with a nut and a 50 mm (2 inch) diameter washer at bottom end. Fully grout bolts with mortar.
- 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.
- E. Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants: 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.
 - 3. Anchor perimeter nailers in accordance with FM 4435. Provide strips grooved as indicated
 - 4. Crickets, Cants, and Curbs: Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curbs as indicated.

- 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.
- G. Wood Grounds: Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with a 2400 mm (8 foot) straightedge.
- 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.
 3. Nail furring strips to masonry.
 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.
- B. If rough carpentry becomes wet, apply EPA-registered borate treatment complying with EPA registered label.

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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. Framing, furring and blocking: Section 06 10 00, ROUGH CARPENTRY.

B. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

C. 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. VOC Emissions:

a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification.

b. Submit manufacturer's certification that products comply with SCAQMD Rule 1168 in areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur. In areas where freeze/thaw conditions do exist or direct exposure to moisture can occur, submit manufacturer's certification that products comply with Bay Area AQMD Reg. 8, Rule 51 for containers larger than 16 oz. and with California Air Resources Board (CARB) for containers 16 oz. or less.

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 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.
- D. Samples:
1. Tongue and groove wood boards.
- 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 preservative treated materials.
- G. Manufacturer's literature and data:
1. Finish hardware.
 2. Electrical components.

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 RE. 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):
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: 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.

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.

4. Other: As specified for item.

2.3 PARTICLEBOARD - NOT USED**2.6 BUILDING BOARD (HARDBOARD) - NOT USED****2.7 ADHESIVE**

- A. Product compliant with performance requirements.

2.8 STAINLESS STEEL

- A. ASTM A167, Type 302 or 304.

2.9 ALUMINUM CAST - NOT USED**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 - NOT USED**2.14 FABRICATION**

- A. General:

1. Finish woodwork must be free from pitch pockets.
2. Plywood cannot be less than 13 mm (1/2 inch), unless otherwise shown or specified.
3. Edges of members in contact with concrete or masonry to have a square corner caulking rebate.
4. 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 21°C (70°F) 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.
 - 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. Plumb and level items unless shown otherwise.
 - 7. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.
 - 8. Exterior Work: Provide joints that are close fitted, mitered, tongue and grooved, rebated, or lapped to exclude water filled and sealed.
 - 9. 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.

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**SECTION 07 22 00
ROOF AND DECK INSULATION**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Installation of roof and deck insulation on new construction ready to receive roofing.

1.2 RELATED WORK

- A. Wood blocking and edge strips: Section 06 10 00, ROUGH CARPENTRY.
- B. Sheet metal components: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 QUALITY CONTROL

- A. Supervision of work by persons that are knowledgeable and experienced in roofing. See submittals for documentation of supervisor's qualification.
- B. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to insulation for storage, handling, and application.

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. Asphalt materials, each type
 - 2. Roofing cement, each type
 - 3. Roof insulation, each type
 - 4. Fastening requirements
 - 5. Insulation span data for flutes of metal decks
- C. Samples:
 - 1. Roof insulation, each type
 - 2. Nails and fasteners, each type
- D. Certificates:
 - 1. Indicating type, thickness and thermal conductance of insulation. (Average thickness for tapered insulation).
 - 2. Indicating materials and method of application of insulation system on metal decks meet the requirements of Factory Mutual Research Corporation for Class 1 Insulated Steel Deck Roofs.
- E. Laboratory Test Reports: Thermal values of insulation products.
- F. Layout of tapered roof system showing units required.
- G. Documentation of supervisors training and experience showing knowledge of roofing procedures.

1.5 DELIVERY, STORAGE AND MARKING

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer or seller.
- B. Keep materials dry, and store in dry, weather tight facilities or under canvas tarps. Use of polyethylene or plastic tarps to cover materials is not permitted. Store above ground or deck level on wood pallets. Cover ground under stored materials with plastic tarp.
 - 1. Store rolled materials (felts, base sheets, paper) on end. Do not store materials on top of rolled material.
 - 2. Store foam insulation away from areas where welding is being performed and where contact with open flames is possible.
- C. Protect from damage from handling, weather and construction operations before, during, and after installation.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C1289-10.....Faced Rigid Cellular Polyisocynurate Thermal Insulation Board
 - D41-11.....Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - D312-00(R2006).....Asphalt Used in Roofing
 - D2178-04.....Asphalt Glass Felt Used in Roofing and Waterproofing
 - D2822-05(R2011).....Asphalt Roof Cement
 - D4897-01(2009).....Asphalt Coated Glass Fiber Venting Base Sheet
- C. Factory Mutual Global (FM):
 - 4450-89.....Approved Standard for Class 1 Insulated Steel Deck Roofs
- D. National Roofing Contractors Association (NRCA):
 - The NRCA Roofing and Waterproofing Manual - Fifth Edition (2009).
- E. Underwriters Laboratories, Inc. (UL):
 - Fire Resistance Directory (2009)

1.7 QUALITY ASSURANCE:

- A. Roof insulation on combustible or steel decks shall have a flame spread rating not greater than 75 and a smoke developed rating not greater

than 150, exclusive of covering, when tested in accordance with ASTM E84, or shall have successfully passed FM Approvals 4450.

1. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in-lieu-of copies of test reports.
2. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the particular type used for this project and the construction is listed as fire-classified in the UL Building Materials Directory or listed as Class I roof deck construction in the FM Approvals "RoofNav."
3. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

PART 2 - PRODUCTS

2.1 ASPHALT MATERIALS

- A. Primer: ASTM D41.
- B. Asphalt: ASTM D312, Type III or IV for vapor retarders and insulation.
- C. Glass (Felt): ASTM D2178, Type IV, heavy duty ply sheet.
- D. Venting Asphalt Base Sheet: ASTM D4897, Type I or Type II.
- E. Roof Cement: ASTM D2822, Type I or Type II, asbestos free; or, D4586, Type I or Type II.

2.2 INSULATION

- A. Isocyanurate Board: ASTM C1289, Type I, Class 2 or Type III.
- B. Tapered Roof Insulation System Segments:
 1. Fabricate of isocyanurate. 2. Cut to provide high and low points with crickets and slopes as shown.
 3. Minimum thickness of tapered sections; 13 mm (1/2 inch), unless manufacturers allow taper to zero mm (inch).

2.3 FASTENERS

- A. Fasteners for securing insulation to steel decks:
 1. Conform to requirements of Factory Mutual Research Corporation for wind uplift.
 2. Self-drilling galvanized screws with 50 mm (two inch) diameter disk.
 3. Antibackout thread design.
 4. Have a pullout resistance of 14 kg (30 pounds) minimum.

2.4 RECOVERED MATERIALS

- A. Comply with following minimum content standards for recovered materials:

| Material Type | Percent by Weight |
|--|-------------------------------|
| Plastic rigid foams: Polyisocyanurate/polyurethane | |
| Rigid foam | 9 percent recovered material |
| Foam-in-place | 5 percent recovered material |
| Glass fiber reinforced | 6 percent recovered material |
| 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.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Do not apply roof insulation if deck will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon.
- B. Entire roof deck construction of any section of the building shall be completed before insulation system work is begun. Curbs, blocking, edge strips, and other components which insulation, roofing and base flashing is attached to shall be in place ready to receive insulation and roofing. Coordinate roof insulation operations with roofing and sheet metal work so that insulation is installed to permit continuous roofing operations.
- C. Insulation system materials shall be dry and damage free when applied. Do not use broken insulation or insulation with damaged facings. Remove damaged insulation from the site immediately.
- D. Dry out surfaces, including the flutes of metal deck, that become wet from any cause during progress of the work before roofing work is resumed. Apply materials only to dry substrates.
- E. Do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, fog, snow, ice) or frost is present in any amount in or on the materials when temperature is below 10 °C (50 °F). Do not apply materials to substrate having temperature of 10 °C (50 °F) or less.
- F. Phased construction is not permitted. The complete installation of all flashing, insulation, and roofing shall be completed in the same day

except for the area where temporary protection is required when work is stopped.

3.2 SURFACE PREPARATION

- A. Sweep decks to broom clean condition. Remove all dust, dirt or debris.
- B. Remove projections that might damage materials.

3.3 VAPOR RETARDER:NOT USED

3.4. INSULATION THICKNESS

- 1. Thickness of roof insulation shown on drawings is nominal.
- 2. The minimum thickness of insulation for metal decks shall not be less than recommended by the insulation manufacturer to span the rib opening (flute size) of the metal deck used.
- 3. When thickness of insulation to be used is more or less than that shown on the drawings, make adjustments in the alignment and location of roof drains, flashing, gravel stops, fascias and similar items at no additional cost to the Government.
- 4. Tapered insulation shall be preformed and fabricated to the slopes indicated.
- 5. Use not less than two layers of insulation when insulation is 25 mm (one inch) or more in thickness unless specified otherwise.

3.5 INSTALLATION OF INSULATION

- A. Lay insulating units with close joints, in regular courses and with cross joints broken. When laid in more than one layer, break joints of succeeding layers of roof insulation with those in preceding layer. Bed insulation layers in Type III or IV asphalt firmly pressed into the hot bitumen. Keep bitumen below surface of insulation to receive single ply rubber roofing.
- B. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.
- C. Cover all insulation installed on the same day by either:
 - 1. The roofing membrane as specified.
 - 2. Temporary protection as specified.
- D. Seal all cut edges at penetrations and at edges against blocking with bitumen or roof cement.
- E. Cut to fit tight against blocking or penetrations.
- F. Steel Deck:

1. Material and method of application of insulation systems used on metal decks shall meet the requirements of Underwriters laboratories for Class A or Factory Mutual Research Corporation for Class I Insulated Steel Roof Deck.
2. Mechanically anchor first layer of insulation to steel deck to conform to FM Class 1-90, Insulated Steel Roof Deck.
3. Locate the long dimension edge joints to have solid bearing on top of deck ribs; do not cantilever over deck rib openings or flutes.

- - - E N D - - -

**SECTION 07 41 13
STANDING SEAM METAL ROOFING**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies the installation of pre-formed standing seam roofing panels with snap together seam.

1.2 RELATED WORK

- A. Sealant: Section 07 92 00, JOINT SEALANTS.
B. Fascia and Trim: 07 60 00, FLASHING AND SHEET METAL.

1.3 DESIGN REQUIREMENTS

- A. Provide panels in continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets must be in continuous contact from eave to ridge.
- B. There cannot be exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel must be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes.
- C. Snap together type systems must have a capillary break and a positive side lap locking device. Include a continuous factory applied sealant within the seam.
- D. Roof panel anchor clips must be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.
- E. Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E1592.
2. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class; design and size components to withstand positive and negative wind loads, including increased loads at building corners as calculated according to local jurisdiction and ASCE 7.

3. Deflection: Provide panels capable of supporting design loads between unsupported spans with deflection of not greater than $L/180$ of the span.

F. Single Source: Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer; be the latest design by the manufacturer; and have been designed by the manufacturer to operate as a complete system for the intended use.

G. Energy Performance, Energy Star: Provide roofing finish system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" or listed on Cool Roof Rating Council (CRRC) product list.

1.4 INSTALLATION REQUIREMENTS

A. Pre-Installation Conference: 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 COR and all parties whose work is effected or related to the work of this section.

B. Install in accordance with SMACNA Architectural Sheet Metal Manual except as otherwise shown or specified.

1.5 SUBMITTALS

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

B. Shop Drawings: Show design, details of construction, flashing, and fastenings.

C. Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated.

Coordinate calculations with manufacturer's test results. Include calculations for:

1. Wind load uplift design pressure at roof locations.
2. Clip spacing and allowable load per clip.
3. Fastening of clips to structure or intermediate supports.
4. Intermediate support spacing and framing and fastening to structure when required.
5. Allowable panel span at anchorage spacing indicated.
6. Safety factor used in design loading.
7. Governing code requirements or criteria.

8. Edge and termination details.

- D. Installer Qualifications: Document installer is factory-trained, approved by the metal roofing system manufacturer to install the system, and has a minimum of three years' experience as an approved applicator with that manufacturer. The applicator must have applied five installations of similar size and scope as this project within the previous 3 years.

1.6 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 requirements.

1.7 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.

1.8 WARRANTY

- A. Roofing work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years.

1.9 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 Architectural Manufacturer Association (AAMA):
- | | |
|-------------|--|
| AAMA 621-02 | High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates |
|-------------|--|
- C. American Society for Testing and Materials (ASTM):
- | | |
|----------------|---|
| A463/A463M-09 | Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process |
| C920-11 | Elastomeric Joint Sealants |
| E1514-98(2011) | Structural Standing Seam Steel Roof Panel Systems |
| E1592 | Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference |
- D. American Society of Civil Engineers (ASCE):
- | | |
|-----------|---|
| ASCE 7-10 | Minimum Design Loads for Buildings and Other Structures |
|-----------|---|
- E. Cool Roof Rating Council (CRRRC):
- | | |
|------------|--|
| CRRRC-1-10 | Product Rating Program, www.coolroofs.org |
|------------|--|
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual 2012
- G. Underwriters Laboratory (UL):
- | | |
|----------------------|--|
| UL 580, 2006 Edition | Tests for Uplift Resistance of Roof Assemblies |
|----------------------|--|
- H. U.S. Department of Energy (DoE):
- | |
|--|
| Roof Products Qualified Product List, www.energystar.gov |
|--|

PART 2 - PRODUCTS**2.1 METAL ROOF PANEL**

- A. Aluminum-Zinc Alloy Coated Sheet Steel conforming to ASTM A463 and coated on both sides with 0.5 ounce of aluminum per square foot (0.15 Kg/sm); minimum 0.6 mm (24 gage) base metal thickness.
- B. Conform to ASTM E1514.
- C. Vertical rib, snap joint, standing seam metal roof panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation

by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels and snapping panels together.

D. Panel Coverage: 406 mm (16 inches).

E. Seam Height: Minimum 44 mm (1-3/4 inch).

2.2 SEALANTS

A. Field-applied: ASTM C920.

B. Seam Cap Sealant: Factory applied hot melt, high viscosity, pressure sensitive adhesive with high heat resistance.

C. Type, Grade, and Class as recommended in writing by the manufacturer.

2.3 SEALANT TAPE

A. Pressure sensitive, 100 percent solids, Gray Polyisobutylene compound with release-paper backing.

B. 12 mm (1/2 inch) wide x 3 mm (1/8 inch) thick.

2.4 UNDERLAYMENT

A. Self-Adhering with reinforcing scrim, High-Temperature Sheet: Minimum 50 thick minimum, consisting of slip-resisting top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.

2.5 FASTENERS

A. Self-drilling, or self-tapping zinc plated hex head carbon-steel screws with EPDM washer or stainless steel cap.

B. Concealed Standard Anchor Clips: Clips base must be minimum 1.2 mm (18 gauge) galvanized steel with 0.7 mm (22 gage) galvanized or stainless steel sliding top. Clips must be two (2) piece design; one-piece clips are not acceptable.

2.6 FINISHES

A. Factory finished complying with SMACNA's recommendations for applying and designating finishes.

B. Exterior Finish:

1. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

2. Coating system must provide nominal 0.025 mm (1.0 mil) dry film thickness, consisting of primer and color coat.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.0125 mm (0.5 mil).

C. Color: As indicated in Section 09 06 00 Schedule for Finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Install fascia and trim.

3.3 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting of metal roof panels by torch is not permitted.
 - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction; predrill panels.
 - 3. Provide metal closures at peaks, rake walls and each side of ridge and hip caps.
 - 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 6. Install ridge and hip caps as metal roof panel work proceeds.

7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

3.4 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

2. Details of installation which are not indicated must be in accordance with the SMACNA, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

B. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3 mm (1/8 inch) offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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SECTION 07 53 23
ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Ethylene Propylene Diene Monomer (EPDM) sheet roofing adhered to roof deck.

1.2 RELATED WORK

- A. Treated wood framing, blocking, and nailers: Section 06 10 00, ROUGH CARPENTRY.
- B. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.
- C. Metal cap flashings, copings, fascias, and expansion joints: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 PERFORMANCE REQUIREMENTS

- A. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- B. Roofing System Energy Performance Requirements: Provide a roofing system identical to components that that have been successfully tested by a qualified independent testing and inspecting agency to meet the following requirements:
 - 1. Energy Performance, Energy Star: Provide roofing system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- C. Wind Uplift Resistance: Provide complete roof system assembly rated and installed to resist wind loads indicated and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems except as approved by the RE. Submit licensed engineer's wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements based on a design wind speed of 110 mph in accordance with ASCE 7 and/or other applicable building code requirements.

1.4 QUALITY ASSURANCE

- A. Approved applicator by the membrane roofing system manufacturer, and certified by the manufacturer as having the necessary expertise to install the specific system.
- B. Pre-Roofing Meeting:

1. Upon completion of roof deck installation and prior to any roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers Technical Representative, Roofing Applicator, Contractor, and RE.
 2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
 3. Inspect roof deck at this time to:
 - a. Verify that work of other trades which penetrates roof deck is completed.
 - b. Determine adequacy of deck anchorage, presence of foreign material, moisture and un-level surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
 - c. Examine samples and installation instructions of manufacturer.
 - d. Perform pull out test of fasteners; refer to Part 3 of this section.
- C. Energy Performance: Provide roofing system that is listed on DOE's Energy Star Roof Products Qualified Product List for "low-slope" roof products.

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, 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>.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Applicators approval certification by manufacturer.
- C. Shop Drawings:
1. Sheet membrane layout.

2. Fastener pattern, layout, and spacing requirements.
3. Termination details.
- D. Manufacturers installation instructions revised for project.
- E. Samples:
 1. Sheet membrane: One 150 mm (6 inch) square piece.
 2. Sheet flashing: One 150 mm (6 inch) square piece.
 3. Fasteners: Two, each type.
 4. Welded seam: Two 300 mm (12 inch) square samples of welded seams to represent quality of field welded seams.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials as specified by manufacturer.
- B. Store volatile materials separate from other materials with separation to prevent fire from damaging the work, or other materials.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install EPDM sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface, or when condensation develops on surfaces during application. Unless recommended otherwise by the EPDM sheet manufacturer and approved by the RE, do not install EPDM sheet when air temperature is below 4 degrees C 40 degrees F or within 3 degrees C 5 degrees F of the dew point. Follow manufacturer's printed instructions for installation during cold weather conditions.

1.9 SEQUENCING

- A. Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing must immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.10 WARRANTY

- A. Roofing work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years.

1.11 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 of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
- | | |
|---------------|---|
| ASCE/SEI-7-10 | Minimum Design Loads for Buildings and Other Structures |
|---------------|---|
- C. American Society for Testing and Materials (ASTM):
- | | |
|-----------------|--|
| A167-99(2009) | Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip |
| B209-10 | Aluminum and Aluminum-Alloy Sheet and Plate |
| C1371-04a | Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers |
| C1549-09 | Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer |
| D2103-10 | Polyethylene Film and Sheeting |
| D4637/D4637M-13 | EPDM Sheet Used in Single-Ply Roof Membrane |
| E408-71 | Total Normal Emittance of Surfaces Using Inspection-Meter Techniques |
| E1918-06 | Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field |
| E1980-11 | Calculating Solar Reflectance of Index of Horizontal and Low-Sloped Opaque Surfaces |
- D. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE):
- | | |
|------------------|---|
| ASHRAE 90.1-2010 | Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix f |
|------------------|---|
- E. Cool Roof Rating Council:
- | | |
|--------|--|
| CRRC-1 | Product Rating Program, www.coolroofs.org |
|--------|--|
- F. FM Approvals: RoofNav Approved Roofing Assemblies and Products:
- | | |
|---------|--|
| 4470-12 | Approved Standard for Class 1 Roof Coverings |
| 1-28-09 | Loss Prevention Data Sheet: Design Wind Loads. |
| 1-29-09 | Loss Prevention Data Sheet: Above-Deck Roof Components |
| 1-49-09 | Loss Prevention Data Sheet: Perimeter Flashing |

- G. National Roofing Contractors Association (NRCA):
2013 Edition The NRCA Roofing and Waterproofing Manual
- H. U.S. Environmental Protection Agency (EPA):
EPA 600/R13/116-02 Method for the Determination of Asbestos in
Bulk Building Materials
- I. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog,
www.biopreferred.gov
- J. U.S. Department of Energy (DoE): Roof Products Qualified Product List,
www.energystar.gov

PART 2 - PRODUCTS

2.1 EPDM SHEET ROOFING

- A. Conform to ASTM D4637, Type I.
- B. Thickness:
 - 1. Use 2 mm (60 mil) thick sheet for adhered system.
- C. Pipe Boots:
 - 1. Molded EDPM designed for flashing of round penetrations, 200 mm (8 inch) minimum height.
 - 2. Color same as roof membrane.

2.2 EPDM FLASHING SHEET

- A. Conform to ASTM D4637, Type I, unreinforced.
- B. Partially cured or cured.

2.3 MISCELLANEOUS ROOFING MEMBRANE MATERIALS

- A. Sheet roofing manufacturers specified products.
- B. Seam Tape: Double-sided synthetic rubber tape, minimum 0.76 mm 0.03 inch thick, minimum 75 mm (3 inch) wide. The roof membrane manufacturer must supply seam tape recommended by the manufacturer's printed data for forming watertight bond of EPDM sheet materials to each other for the application specified and conditions encountered. 150 mm (6 inch) wide tape is required for seam seals along lines of mechanical attachment of membrane.
- C. Splice Adhesive: For roofing and flashing sheet; low volatile organic compound (VOC).
- D. Lap Sealant: Manufacturer's standard single component sealant.
- E. Bonding Adhesives: Manufacturer's standard bonding adhesive; low volatile organic compound (VOC).
- F. Fastener Sealer: Manufacturer's approved sealer.
- G. Primers, Splice Tapes, Cleaners, and Butyl Rubber Seals: As specified by roof membrane manufacturer.

- H. Water Cutoff Mastic/Water Block: As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.4 FASTENERS

- A. Fasteners: Factory coated steel fasteners and metal or plastic plates, complying with FM approvals 4470 and designed for fastening membrane to substrate and acceptable to roofing system manufacturer.
- B. Pipe Compression Clamp or Drawband:
1. Stainless steel or cadmium plated steel drawband.
 2. Worm drive clamp device.
- C. Surface Mounted Base Flashing Clamp Strip (Termination Bar):
1. Aluminum strip: ASTM B209 24 mm (.094-inch) thick.
 3. For exposed location, form strips with 6 mm (1/4 inch) wide top edge bent out 45 degrees (for sealant) from 40 mm (1-1/2 inch) wide material; 2400 mm (8 feet) maximum length with slotted 6 mm x 10 mm (1/4 by 3/8-inch) holes punched at 200 mm (8 inch) centers, centered between bend and bottom edges.
 4. For locations covered by cap flashings, form strips 30 mm (1-1/4 inch) wide, 2400 mm (8 feet) maximum length with slotted holes 6 mm x 10 mm (1/4 by 3/8 inch) punched at 200 mm (8 inch) centers, centered on strip width.

2.5 VAPOR RETARDER – NOT USED

2.6 FLEXIBLE TUBING

- A. Closed cell neoprene, butyl polyethylene, vinyl, or polyethylene tube or rod.
- B. Diameter approximately 1-1/2 times joint width.

2.7 WALKWAY PADS – NOT USED

PART 3 – EXECUTION

3.1 GENERAL

- A. Do not apply if deck will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected.
- B. Dry out surfaces, including the flutes of metal deck, that become wet from any cause during progress of the work before roofing work is resumed.
- C. Apply materials only to dry substrates.
- D. Do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, fog, ice, or frost) is present in any amount in or on the materials.

1. Do not apply materials to substrate having temperature of 4°C (40 degrees F) or less, or when materials applied with the roof require higher application temperature.
2. Do not apply materials when the temperature is below 4°C (40 degrees F).

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.
- B. Prevent material from entering and clogging roof drains and conductors, and from spilling or migrating onto surfaces of other construction.

3.3 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install membrane roofing over area to receive roofing according to manufacturer's written instructions. Unroll roofing membrane and allow it to relax before installing.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at a rate required by roofing manufacturer' and allow to partially dry before installing membrane. Do not apply bonding adhesive to splice area of membrane roofing.
- D. Apply roofing membrane with side laps located in the direction of the slope of the roof deck.
- E. Field form seams, or lap splices, with seam tape in accordance with membrane manufacturer's printed instructions and as specified. Clean and prime mating surfaces in the seam area. After primer has dried or set in accordance with membrane manufacturer's instructions, apply seam tape to bottom membrane and roll with a 75 mm to 100 mm (3 inch to 4 inch) wide smooth silicone or steel hand roller, or other manufacturer approved rolling device, to ensure full contact and adhesion of tape to bottom membrane. Tape end laps must be minimum 25 mm (1 inch). Roll top membrane into position to check for proper overlap and alignment. Remove release paper from top of seam tape and form seam splice. Ensure top membrane contact with seam tape as release paper is removed. Roll the closed seam with a smooth silicone or steel hand roller, rolling first across the width of the seam then along the entire length, being careful not to damage the membrane. Seal lap edge with water cutoff.

- F. Repair tears, voids, and lapped seams in roofing that does not meet the quality requirements stated in this specification and the manufacturer's written standards.
- G. Spread sealant or mastic bead over deck drain flange at deck drains, and securely seal roofing membrane in place with clamping ring.

3.4 BASE FLASHING INSTALLATION

- A. Install sheet flashing and preformed flashing accessories and adhere to substrate according to membrane roofing manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side at end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashing and mechanically anchor to substrate through termination bars.

3.5 WALKWAY PADS: NOT USED

3.6 FIELD QUALITY CONTROL

- A. Arrange for roofing system manufacturer's personnel to inspect roofing installation upon completion.
- B. Notify RE 48 hours prior to schedule inspection.
- C. Remove or replace repair areas of roofing where test results or inspections indicate failure to comply with specified requirements and manufacturer's recommended installation requirements.

- - - E N D - - -

**SECTION 07 60 00
FLASHING AND SHEET METAL**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Formed sheet metal work for wall and roof flashing, copings, roof edge metal, fasciae, and drainage specialties.

1.2 RELATED WORK

- A. Manufactured flashing, copings, roof edge metal, and fasciae: Section 07 71 00, ROOF SPECIALTIES.
- B. Flashing components of factory finished roofing and wall systems: Division 07 roofing and wall system sections.
- C. Joint Sealants: Section 07 92 00, JOINT SEALANTS.
- D. Color of factory coated exterior architectural metal and anodized aluminum items: Section 09 06 00, SCHEDULE FOR FINISHES.
- E. Integral flashing components of manufactured roof specialties and accessories or equipment: Section 07 71 00, ROOF SPECIALTIES, and Division 22, PLUMBING sections.
- F. Paint materials and application: Section 09 91 00, PAINTING.
- G. Flashing of Roof Drains: Section 22 14 00, FACILITY STORM DRAINAGE.
- H. Section 04 20 00 UNIT MASONRY
- I. Section 01 43 39 MOCKUP REQUIREMENTS
- J. Section 04 43 00 NATURAL STONE VENEER
- K. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

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
- 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):
- A167-99(R2009) Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
- A653/A653M-09 Steel Sheet Zinc-Coated (Galvanized) or Zinc
Alloy Coated (Galvanized) by the Hot-Dip
Process
- B32-08 Solder Metal
- B209-10 Aluminum and Aluminum-Alloy Sheet and Plate
- B370-09 Copper Sheet and Strip for Building
Construction
- D173-03 Bitumen-Saturated Cotton Fabrics Used in
Roofing and Waterproofing
- D412-06 Vulcanized Rubber and Thermoplastic Elastomers-
Tension
- D1187-97(R2002) Asphalt Base Emulsions for Use as Protective
Coatings for Metal
- D3656-07 Insect Screening and Louver Cloth Woven from
Vinyl-Coated Glass Yarns
- D4586-07 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

- A. Wind Uplift Forces: Resist the following forces per FM Approvals 1-49:
1. Wind Zone 1: 1.00 to 1.44 kPa (21 to 30 lbf/sq. ft.): 2.87-kPa (60-lbf/sq. ft.) perimeter uplift force, 4.31-kPa (90-lbf/sq. ft.) corner uplift force, and 1.44-kPa (30-lbf/sq. ft.) outward force.
- B. Wind Design Standard: Fabricate and install copings and 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 REQUIREMENTS, for project local/regional materials, low-emitting materials, and 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.
 3. Fascia-cant.
- C. Manufacturer's Literature and Data: For all specified items, including:
1. Two-piece counterflashing.
 2. Thru wall flashing.
 3. Fascia-cant.
- 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 RE and all parties whose work is effected 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.

- F. Roof Cement: ASTM D4586.
- G. Termination Bar: Dayton Superior DA 1510, Stainless Steel, 12 gauge (1/8"), 1 1/2" wide, holes 5/16" at 8" on center, or an approved equal.
- H. Dayton Superior DA 1008 – 100% Recycled Polyester, or an approved equal.
- I. Cell Vent: One piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of joint – color to be selected from manufacturer's full range Dayton Superior Cell Vent, or an approved equal.
- J. Self-Adhering Membrane at top of walls and piers – see drawings: 40 mil EPDM.
- K. Stainless Steel Drip flashing: Stainless steel 26 ga x 3 inch wide by 8 foot sections, 3/8 inch 45 degree lip with a 3/16 inch closed hem. Manufacturer – Wire Bond or an approved equal.

2.3 SHEET METAL THICKNESS

- A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:
- B. Concealed Locations (Built into Construction):
 - 1. Stainless steel: 0.25 mm (0.010 inch) thick.
 - 2. Galvanized steel: 0.5 mm (0.021 inch) thick.
- C. Exposed Locations:
 - 1. Stainless steel: 0.4 mm (0.015 inch).
- D. Thickness of aluminum or galvanized steel is specified with each item.

2.4 FABRICATION, GENERAL

- A. Jointing:
 - 1. Lock and solder stainless steel joints, except expansion and contraction joints.
 - 2. Jointing of 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 non-reinforced elastomeric sheeting 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 stainless steel.
 - b. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
 - c. Completely remove acid and flux after soldering is completed.
- B. Expansion and Contraction Joints:
 1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.
 2. Space joints as shown or as specified.
 3. Space expansion and contraction joints for copper, stainless steel, and copper clad stainless steel at intervals not exceeding 7200 mm (24 feet).
 4. Space expansion and contraction joints for aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
 5. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
 6. Fabricate joint covers of same thickness material as sheet metal served.
- C. Cleats:
 1. Fabricate cleats to secure flashings and sheet metal work over 300 mm (12 inches) wide and where specified.
 2. Provide cleats for maximum spacing of 300 mm (12 inch) centers unless specified otherwise.
 3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
 4. Fabricate cleats from 50 mm (2 inch) wide strip. Form end with not less than 19 mm (3/4 inch) wide loose lock to item for anchorage. Form other end of length to receive nails free of item to be anchored and end edge to be folded over and cover nail heads.
- D. Edge Strips or Continuous Cleats:

1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
2. Except as otherwise specified, fabricate edge strips of minimum 0.6 mm (0.024 inch) thick stainless steel, and 1.25 mm (0.050 inch) thick aluminum.
3. Use material compatible with sheet metal to be secured by the edge strip.
4. Fabricate in 3000 mm (10 feet) maximum lengths with not less than 19 mm (3/4 inch) loose lock into metal secured by edge strip.
5. Fabricate Strips for fascia anchorage to extend below the supporting wood construction to form a drip and to allow the flashing to be hooked over the lower edge at least 19 mm (3/4-inch).
6. Fabricate anchor edge maximum width of 75 mm (3 inches) or of sufficient width to provide adequate bearing area to insure a rigid installation using 0.8 mm (0.031 inch) thick stainless steel, and 1.6 mm (0.0625 inch) thick aluminum.

E. Drips:

1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, gravel stops, wall copings, by folding edge back 13 mm (1/2 inch) and bending out 45 degrees from vertical to carry water away from the wall.
2. Form drip to provide hook to engage cleat or edge strip for fastening for not less than 19 mm (3/4 inch) loose lock where shown.

F. Edges:

1. 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. Stainless steel.
 - 2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
 - 3. Form exposed portions of flashing with drip, approximately 6 mm (1/4 inch) projection beyond wall face.
- C. For Masonry Work When Exposed Edge Forms a Receiver for Counter Flashing:
 - 1. Use same metal and thickness as counter flashing.
 - 2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
 - 3. Form exposed portion as snap lock receiver for counter flashing upper edge.
- D. For Flashing at Architectural Precast Concrete Panels or Stone Panels.
 - 1. Use plan flat sheet of stainless steel.
 - 2. Form exposed portions with drip as specified or receiver.
- E. Lintel Flashing:
 - 1. Use stainless steel plane flat sheet.
 - 2. Fabricate flashing at ends with folded corners to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening.
 - 3. Turn up back edge as shown.
 - 4. Form exposed portion with drip as specified or receiver.
- F. Door Sill Flashing:
 - 1. Where concealed, use 0.5 mm (0.018 inch) thick stainless steel.

2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, 0.6 mm (0.024 inch) 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)

- A. Use stainless steel, unless specified otherwise.
- B. Fabricate to lap base flashing a minimum of 100 mm (4 inches) with drip:
 1. Form lock seams for outside corners. Allow for lap joints at ends and inside corners.
 2. In general, form flashing in lengths not less than 2400 mm (8 feet) and not more than 3000 mm (10 feet).
 3. Two-piece, lock in type flashing may be used instead of one piece counter-flashing.
 4. Manufactured assemblies may be used.
 5. Where counterflashing is installed at new work use an integral flange at the top designed to be extended into the masonry joint or reglet in concrete.
 6. Where counterflashing is installed at existing work use surface applied type, formed to provide a space for the application of sealant at the top edge.
- C. One-piece Counterflashing:
 1. Back edge turned up and fabricate to lock into reglet in concrete.
 2. Upper edge formed to extend full depth of masonry unit in mortar joint with back edge turned up 6 mm (1/4 inch).
- D. Two-Piece Counterflashing:
 1. Receiver to extend into masonry wall depth of masonry unit with back edge turned up 6 mm (1/4 inch) and exposed edge designed to receive and lock counterflashing upper edge when inserted.
 2. Counterflashing upper edge designed to snap lock into receiver.
- E. Surface Mounted Counterflashing; one or two piece:
 1. Use at existing or new surfaces where flashing cannot be inserted in vertical surface.
 2. One piece fabricate upper edge folded double for 65 mm (2 1/2 inches) with top 19 mm (3/4 inch) bent out to form "V" joint sealant pocket with vertical surface. Perforate flat double area against vertical surface with horizontally slotted fastener holes at 400 mm

(16 inch) centers between end holes. Option: One piece surface mounted counter-flashing (cap flashing) may be used. Fabricate as detailed on Plate 51 of SMACNA Architectural Sheet Metal Manual.

3. Two pieces: Fabricate upper edge to lock into surface mounted receiver. Fabricate receiver joint sealant pocket on upper edge and lower edge to receive counterflashing, with slotted fastener holes at 400 mm (16 inch) centers between upper and lower edge.

2.8 HANGING GUTTERS – NOT USED

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.
- 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. 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.
8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.
9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
10. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:
 - a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - b. Paint dissimilar metal with a coat of bituminous paint.
 - c. Apply an approved caulking material between aluminum and dissimilar metal.
15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.

16. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.

3.2 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing as shown on plans.
2. Cut and fit to cover inside and outside corners.
3. Turn up ends at discontinuities 1 inch minimum to form end dams.
4. Roll firmly to substrate with hand roller tool. Roll laps firmly in perpendicular direction to terminating edge.
5. Product shall extend vertically up the backup wall as indicated on the drawings.
6. Keep product 1/4 inch minimum from finished exterior. Keep edge from contacting visible sealant.
7. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.
8. 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.
9. 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. At concrete backing, extend flashing to termination bar as indicated on drawings. Seal termination bar to substrate with Mastic.

B. Flashing at Top of Concrete Foundation Walls Where Concrete is Exposed:

Turn up not less than 200 mm (8 inch) high and into masonry backup mortar joint or reglet in concrete backup as specified.

C. Flashing at Top of Concrete Floors (except where shelf angles occur):

Place flashing in horizontal masonry joint not less than 200 mm (8 inch) below floor slab and extend into backup masonry joint at floor slab 38 mm (1 1/2 inch).

D. Flashing at Cavity Wall Construction: Where flashing occurs in cavity walls turn vertical portion up against backup under waterproofing, if any, into mortar joint. Turn up over insulation, if any, and horizontally through insulation into mortar joint.

E. Flashing at Veneer Walls:

1. Install near line of finish floors over shelf angles or where shown.
2. At concrete backing, extend flashing into reglet as specified.

3. 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.

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G. Flashing at Masonry, Stone, or Precast Concrete Copings:

1. Install flashing with drips on both wall faces unless shown otherwise.
2. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

3.3 BASE FLASHING

A. Install where roof membrane type base flashing is not used and where shown.

1. Install flashing at intersections of roofs with vertical surfaces or at penetrations through roofs, to provide watertight construction.
2. Install metal flashings and accessories having flanges extending out on top of the built-up roofing before final bituminous coat and roof aggregate is applied.
3. Set flanges in heavy trowel coat of roof cement and nail through flanges into wood nailers over bituminous roofing.
4. Secure flange by nailing through roofing into wood blocking with nails spaced 75 mm (3 inch) on centers or, when flange over 100 mm (4 inch) wide terminate in a 13 mm (1/2 inch) folded edge anchored with cleats spaced 200 mm (8 inch) on center. Secure one end of cleat over nail heads. Lock other end into the seam.

B. For long runs of base flashings install in lengths of not less than 2400 mm (8 feet) nor more than 3000 mm (ten feet). Install a 75 mm (3 inch) wide slip type, loose lock expansion joint filled with sealant in joints of base flashing sections over 2400 mm (8 feet) in length. Lock and solder corner joints at corners.

C. Extend base flashing up under counter flashing of roof specialties and accessories or equipment not less than 75 mm (3 inch).

3.4 COUNTERFLASHING (CAP FLASHING)**A. General:**

1. Install counterflashing over and in conjunction with installation of base flashings, except as otherwise specified or shown.
2. Install counterflashing to lap base flashings not less than 100 mm (4 inch).
3. Install upper edge or top of counterflashing not less than 225 mm (9 inch) above top of the roofing.
4. Lap joints not less than 100 mm (4 inch). Stagger joints with relation to metal base flashing joints.
5. Use surface applied counterflashing on existing surfaces and new work where not possible to integrate into item.
6. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete or masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.

B. One Piece Counterflashing:

1. Where flashing is installed at new masonry, coordinate to insure proper height, embed in mortar, and end lap.
2. Where flashing is installed in reglet in concrete insert upper edge into reglet. Hold flashing in place with lead wedges spaced not more than 200 mm (8 inch) apart. Fill joint with sealant.
3. Where flashing is surface mounted on flat surfaces.
 - a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:
 - 1) Locate fasteners in masonry mortar joints.
 - 2) Use screws to sheet metal or wood.
 - b. Fill joint at top with sealant.

C. Two-Piece Counterflashing:

1. Where receiver is installed at new masonry coordinate to insure proper height, embed in mortar, and lap.
2. Surface applied type receiver:
 - a. Secure to face construction in accordance, with manufacturer's instructions.
 - b. Completely fill space at the top edge of receiver with sealant.
3. Insert counter flashing in receiver in accordance with fabricator or manufacturer's instructions and to fit tight against base flashing.

- D. Where vented edge occur install so lower edge of counterflashing is against base flashing.
- E. When counter flashing is a component of other flashing install as shown.

3.5 REGLETS

- A. Install reglets in a manner to provide a watertight installation.
- B. Locate reglets not less than 225 mm (9 inch) nor more than 400 mm (16 inch) above roofing, and not less than 125 mm (5 inch) nor more than 325 mm (13 inch) above cant strip.
- C. Butt and align end joints on each section of reglet and securely hold in position until concrete or mortar are hardened:
 - 1. Coordinate reglets for anchorage into concrete with formwork construction.
 - 2. Coordinate reglets for masonry to locate horizontally into mortar joints.

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**SECTION 07 71 00
ROOF SPECIALTIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies manufactured copings .

1.2 RELATED WORK

- A. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Sealant material and installation: Section 07 92 00, JOINT SEALANTS.
C. Rigid insulations for roofing: Section 07 22 00, ROOF AND DECK INSULATION.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties must withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Single-Ply Roofing Institute (SPRI) Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to ANSI/SPRI ES-1 and capable of resisting the design pressures as determined by roofing specifications.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 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 must be the same and be made by the same manufacturer.
- C. Assemble each accessory to the greatest extent possible before delivery to the site.

1.5 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, and recycled content requirements.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Provide representative sample panel of color finished aluminum sheet not less than 100 mm X 100 mm (four by four inches); provide extrusions in a width not less than section to be used. Include manufacturer's identifying label.
- 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; include current testing reports confirming compliance to wind design standard.
- E. Certificates: State that aluminum has been given specified thickness of anodizing.

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 RE and all parties whose work is effected or related to the work of this section.

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 Architectural Manufacturers Association (AAMA):
2605-11 High Performance Organic Coatings on
Architectural Extrusions and Panels
- C. 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

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

| | |
|-------------------------|--|
| A653/A653M-09 | Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| B209-10 | Aluminum and Aluminum Alloy-Sheet and Plate |
| B221-13 | Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| C612-10 | Mineral Fiber Block and Board Thermal Insulation |
| D1187/D1187M-97(2011)e1 | Asphalt-Base Emulsions for Use as Protective Coatings for Metal |

E. National Association of Architectural Metal Manufacturers (NAAMM):

| | |
|----------------|-----------------------|
| AMP 500-505-06 | Metal Finishes Manual |
|----------------|-----------------------|

PART 2 - PRODUCTS**2.1 MATERIALS**

A. Galvanized Sheet Steel: ASTM A653/A653M; G-90 coating.

B. Asphalt Coating: ASTM D 1187, Type I, quick setting.

2.2 COPINGS

A. Fabricate coping cap of 0.5 mm (0.018) inch thick galvanized stainless steel.

B. Turn outer edges down each face of wall as shown.

C. Maximum lengths of 3000 mm (10 feet).

D. Provide factory mitered and continuously welded external and internal corners as one piece assemblies with not less than 300 mm (12 inch) leg lengths.

E. Provide 100 mm (four inch) wide 0.8 mm (0.032 inch) thick watertight joint covers.

F. Provide anchor gutter bar of 0.8 mm (0.032 inch) thick with anchor holes formed for underside of joint.

G. Provide concealed guttered splice plate of 0.8 mm (0.032 inch) thick with butyl or other resilient seal strips anchored to splice plate for underside of joint. Use galvanized steel anchor plate providing compression spring anchoring of coping cover.

H. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

I. Anchor Plates: Concealed, galvanized-steel sheet, 300 mm (12 inches wide), with integral cleats.

J. Face Leg Cleats: Concealed, continuous galvanized-steel sheet.

K. Finish: Fluoropolymer.

2.3 EXTRUDED ALUMINUM GRAVEL STOPS AND FASCIAS: NOT USED

2.4 ALUMINUM FASCIA-CANT SYSTEM: NOT USED

2.5 PERIMETER ACCESSORIES: NOT USED

2.6 EXTRUDED ALUMINUM ROOF EXPANSION JOINT COVERS: NOT USED

2.7 FINISH

A. In accordance with NAAMM Amp 500-505.

B. Fluoropolymer Finish: AAMA 2605 high performance organic coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof accessories where shown and as directed by manufacturer.

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; Section 07 22 00, ROOF AND DECK INSULATION.

D. Comply with section 07 92 00, JOINT SEALANTS, to install sealants where manufactures installation instructions require sealant.

E. Coordinate with roofing work for installation of items in sequence to prevent water infiltration.

3.2 PROTECTION OF ALUMINUM: NOT USED

3.3 ADJUSTING

A. Adjust expansion joints to close tightly and be watertight; insuring maximum allowance for building movement.

3.4 PROTECTION

A. Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

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**SECTION 07 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 stone veneer: Section 04 43 00, NATURAL STONE VENEER.
- D. Sealing joints in cast stone: Section 04 72 00, CAST STONE MASONRY.
- E. Glazing: Section 08 80 00, GLAZING.

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.
 - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 - 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 - 5. 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 RE seven days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present. Provide written acceptance from manufacturer's technical representative that materials pass for adhesion and compatibility.
- 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. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project local/regional materials, 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>.

1.5 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 RE and all parties whose work is effected 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):

| | |
|----------------|---|
| C612-10 | Mineral Fiber Block and Board Thermal Insulation |
| C717-12b | Standard Terminology of Building Seals and Sealants |
| C734-06(2012) | Low Temperature Flexibility of Latex Sealants after Artificial Weathering |
| C834-10 | Latex Sealants |
| C919-12 | Use of Sealants in Acoustical Applications |
| C920-11 | Elastomeric Joint Sealants |
| C1021-08 | Laboratories Engaged in Testing of Building Sealants |
| C1193-13 | Use of Joint Sealants |
| C1248-08(2012) | Staining of Porous Substrate by Joint Sealants |

| | |
|----------------|---|
| C1330-02(2013) | Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants |
| D217-10 | Cone Penetration of Lubricating Grease |
| D1056-07 | Flexible Cellular Materials—Sponge or Expanded Rubber |
| E84-12c | 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: NOT USED

G. S-7: NOT USED

H. S-8: NOT USED

I. S-9: NOT USED

J. S-10: NOT USED

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. (Must be submitted and approved by RE)
- 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 POURIOUS 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.
- 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. Follow the joint sealant manufacturer's recommendations for creating joints with the correct width to depth ratios for maximum duration for the joints. Use the following if there are not manufacturer's recommendations:
 - 1. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
 - 2. 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. All joints to receive sealant shall be cleaned and primed using the manufacturer's recommended primer.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated 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 Stone: Type S-1.
 3. Masonry to Masonry or Stone: Type S-1.
 4. Stone to Stone: Type S-1.
 5. Cast Stone to 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. Metal Reglets and Flashings:
 1. Flashings to Wall: Type S-6.
 2. Metal to Metal: Type S-6.

C. Sanitary Joints: NOT USED

D. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-11 or S-12.
2. Concrete Paving abutting columbarium walls: Type S-3

E. Interior Caulking:

1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1 and C-2.
3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
5. Exposed Acoustical Joint at Sound Rated Partitions: Type C-2.
6. Concealed Acoustic Sealant Type: S-4, C-1 and C-2.

- - - 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.
- C. This section includes custom pre-finished doors and frames at Committal Shelter.

1.2 RELATED WORK

- A. Door Hardware: Section 08 71 00, DOOR HARDWARE.

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 REQUIREMENTS, for project local/regional materials, 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>.

1.5 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.
- 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-11 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| A1008/A1008M-12a | Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| C665-12 | Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| E136-12 | 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. 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

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.

2.3 CLASSIFICATION AND PERFORMANCE

- D. Maximum Duty Doors: ANSI/SDI A250.8, Level 4, physical performance Level A, Model 2 with core construction as required by the manufacturer for indicated 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 4 for doors No. 101A, 101B, 101C, 101D, 101E, 101F AND 102A.

2.4 METAL FRAMES

- A. General: SDI Level 4, formed frames to sizes and shapes indicated.
 1. 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. Glazed Openings:
 1. Integral stop on interior side of door.
 2. Design rabbet width and depth to receive glazing material or panel shown or specified.

SPEC WRITER NOTES:

- D. 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.
 2. Floor Anchors: Provide floor anchors drilled for 10 mm (3/8 inch) anchor bolts at bottom of each jamb member.

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, with the exception of 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.

SPEC WRITER NOTES:

2.9 CUSTOM PRE-FINISHED DOORS AND FRAMES AT COMMITTAL SHELTER

- A. Design: Matching or exceeding quality of 5000 Series Swinging Steel Doors manufactured by Hope's Windows, Inc., Jamestown, NY.
- B. Manufacture door and frames from 12 gauge steel.
- C. True Divided Lite Muntins:
 - 1. Manufacture Tee muntins to size determined by design.
 - 2. Glazing rebate surfaces must be perpendicular to the stem of this section; rebate surfaces that are tapered will not be acceptable.
- D. Glazing Beads: Extruded aluminum Alloy 6063-T5 with a minimum thickness of 0.062 inches.
- E. Provide reinforcements of 10 or 12 gage to suit specified hardware.
- F. All screws to be stainless steel, except glazing bead screws to be plated steel.
- G. Factory-applied Finish: Electrodeposited epoxy primer and intermediate coats followed by baked polyurethane finish; combined overall finish thickness not less than 4.3 mils.
- H. Operable Hardware:
 - 1. Hinges: Full mortise, heavy duty bronze ball-bearing 4-1/2 x 4-1/2 x 0.180 or heavier as required.
 - 2. Mortise locks with lever handles, thumb turn and key cylinder.
 - 3. Top and bottom flush bolts with coordinated socket embeds, to maintain doors closed or open.
- I. Fabrication:
 - 1. Fabricate steel doors in accordance with approved shop drawings.
 - 2. Perimeter frame corners must be coped and fully welded for maximum strength and weather tightness with face welds dressed smooth.
 - 3. Head and jamb door stops to be an integral portion of the frame.

4. Door leaves must have top and bottom rails coped and welded to the jamb stiles.
5. Doors and door frames to be mortised, reinforced, drilled and tapped to receive specified mortised hardware; reinforce only for specified surface hardware for which drilling and tapping is performed in the field.
6. Weld true divided lite muntins to the perimeter frame. Provide muntin intersections slotted, cross notched and welded. Face weld and grind smooth interior and exterior muntin joints.
7. Provide anchoring at each hinge for maximum support.
8. Provide replaceable continuous snap-in glazing beads to suit the glass as specified; cut and shop fit glazing beads to each glass lite prior to shipment.

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. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.

D. Hang doors in accordance with clearances specified in SDI/DOOR A250.8.

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 33 00
COILING DOORS AND GRILLES**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies coiling doors of sizes shown, complete as specified.

1.2 RELATED WORK

- A. Lock cylinders for cylindrical locks: Section 08 71 00, DOOR HARDWARE.
- B. Field painting: Section 09 91 00, PAINTING.

1.3 MANUFACTURER'S AND INSTALLER'S QUALIFICATIONS

- A. Provide coiling door products of manufacturers regularly engaged in manufacturing items of type specified.
- B. Install items under direct supervision of manufacturer's representative or trained personnel.

1.4 FIRE RATED COILING DOOR REQUIREMENTS: NOT USED**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, and recycled content requirements.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Include each type of door showing details of construction, accessories and hardware., electrical and mechanical items supporting brackets for motors, location, and ratings of motors, and safety devices.
 - 2. Provide wiring diagrams for motors and controls, including wiring diagram for door, showing electrical interlock of motor with manually operated dead lock, electrical rough-in.
- C. Manufacturer's Literature and Data:
 - 1. Brochures or catalog cuts; each type door or grille.
 - 2. Manufacturer's installation procedures and instructions.
 - 3. Maintenance instructions and parts lists.
- D. Certificates:
 - 1. Attesting doors, anchors and hardware will withstand the horizontal loads specified.

2. Attesting oversize fire doors and hardware are identical in design, material, and construction to doors that meet the requirements for the class specified.

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):

| | |
|---------------|--|
| A36/A36M-12 | Structural Steel |
| A167-99(2009) | Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip |
| A653/A653M-11 | Steel Sheet, Zinc-Coated (Galvanized) Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| B209-10 | Aluminum and Aluminum-Alloy Sheet and Plate |
| B221-13 | Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes |

- C. Master Painters Institute (MPI):

| | |
|------------|---------------------------------|
| MPI #35-13 | Exterior Bituminous Coating |
| MPI #76-13 | Quick Drying Alkyd Metal Primer |

- D. National Electrical Manufacturers Association (NEMA):

| | |
|-----------------|---|
| ICS 1-00(R2008) | Industrial Control and Systems General Requirements |
| ICS 2-00(R2005) | Industrial Control, and Systems, Controllers, Contactors, and Overload Relays |
| ICS 6-93(R2006) | Industrial Control and Systems Enclosures |
| MG 1-11 | Motors and Generators |

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Steel: Comply with ASTM A653 for forming operation; ASTM A36 for structural sections.
- B. Stainless Steel: ASTM A167, Type 302 or 304.
- C. Aluminum, Plate and Sheet: ASTM B209/B209M.
- D. Aluminum, Extruded: ASTM B221/B221M.
- E. Alkyd Metal Primer: MPI No. 76.
- F. Bituminous Coating: MPI No. 35.

2.2 DESIGN REQUIREMENTS

- A. Coiling doors to be spring counter balanced, overhead coiling type, inside face mounted with guides at jambs set back a sufficient distance to provide a clear opening when door is in open position.
- B. Design doors, hardware, and anchors to withstand a horizontal or wind pressure of 958 Pa (20 psf) of door area without damage.
- C. Provide manual chain operating door.D. Operation Cycles: Door components and operators capable of operating for not less than 10,000 cycles; one operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.3 FABRICATION

- A. Coiling Door Curtains:
 - 1. Form of interlocking slats of galvanized steel of shapes standard with the manufacturer, except that slats for exterior doors to be flat type.
 - 2. Thickness of slats as required to resist loads specified except not less than the following:
 - a. For doors less than 4500 mm (15 feet) wide: 0.75 mm (0.0299 inch).
 - 3. Thickness of aluminum slats as follows:
 - a. For doors less than 4500 mm (15 feet wide): 1 mm (0.040 inch).
- B. Grilles: NOT USED
- C. Endlocks and Windlocks:
 - 1. Manufacturer's stock design of galvanized malleable iron or galvanized steel or stamped cadmium steel for doors.
 - 2. Provide ends of each slat for exterior doors and each alternate slat for grilles and interior doors with endlocks.
 - 3. Provide windlocks at ends of at least every sixth slat. Windlocks must prevent curtain from leaving guide because of deflection from wind pressure or other forces.
- D. Bottom Bar:
 - 1. Two angles of equal weight, one on each side, standard extruded aluminum members not less than 3 mm (0.125 inch) thick.
 - 2. Bottom bar designed to receive weather-stripping and safety device, and be securely fastened to bottom of curtain or grille.
- E. Barrel and Spring Counterbalance:

1. Curtain to coil on a barrel supported at end of opening on brackets and be balanced by helical springs.
2. Barrel fabricated of steel pipe or commercial welded steel tubing of proper diameter and thickness for the size of curtain, to limit deflection with curtain rolled up, not to exceed 1 in 400 (0.03 inch per foot) of span.
3. Close ends of barrel with cast iron plugs, machined to fit the opening.
4. Within the barrel, install an oil-tempered, helical, counter balancing steel spring, capable of producing sufficient torque to assure easy operation of the door curtain from any position.
5. At least 80 percent of the door weight must be counter balanced at any position.
6. Spring-tension must be adjustable from outside of bracket without removing the hood or motor operator.

F. Brackets:

1. Steel plate designed to form end closure and support for hood and the end of the barrel assembly.
2. End of barrel or shaft to screw into bracket hubs fabricated of cast iron or steel.
3. Equip bracket hubs or barrel plugs with pre-lubricated ball bearings, shielded or sealed.

G. Hoods:

1. Steel galvanized, 0.6 mm (0.0239 inch) thick Aluminum, not less than 1 mm (0.040 inch) thick.
2. Form hood to fit contour of end brackets.
3. Reinforce at top and bottom edges with rolled beads, rods or angles. Hoods more than 3600 mm (12 feet) in length must have intermediate supporting brackets.
4. Fasten to brackets with screws or bolts and provide for attachment to wall with bolts.
5. Provide a weather baffle at the lintel or inside the hood of each exterior door to minimize seepage of air through the hood enclosure.

H. Guides:

1. Manufacturer's standard formed sections or angles of steel.
 - a. Steel sections not less than 5 mm (3/16 inch) thick. //

2. Form a channel pocket of sufficient depth to retain the curtain in place under the horizontal pressure specified, and prevent ends of curtain from slipping out of guide slots.
3. Flare top sections for smooth entry of curtain to vertical sections facilitating entry of curtain.
4. Provide stops to limit curtain travel above top of guides.
5. Provide guide of aluminum with replaceable wear strips to prevent metal to metal contact.
6. Mounting brackets to provide closure between guides and jambs.

I. Weather-stripping:

1. Manually Operated Doors: Provide exterior doors with compressible and replaceable rubber, neoprene, or vinyl weather seal attached to bottom bar.
2. Motor Operated Doors: Provide bottom bar safety device as combination compressible seal and safety device specified in paragraph, ELECTRIC MOTOR OPERATORS.
3. At exterior doors, provide replaceable sweep type continuous vinyl or neoprene weather seals on guides and across head on exterior to seal against wind infiltration.

J. Locking:

1. Cylinder locks to receive standard screw in cylinders furnished under Section, 08 71 00, DOOR HARDWARE.
2. For each manually operated exterior door, provide manufacturer's standard cylinder dead lock type locking device on the inside at each door jamb, key operated from the interior.

2.4 ELECTRIC MOTOR OPERATORS – NOT USED

2.5 MANUAL OPERATORS

A. Hand Chain Operation:

1. Galvanized, endless chain operating over a sprocket and extending to within 900 mm (3 feet) of floor.
2. Obtain reduction by use of suitable permanently lubricated gearing connected by roller chain and sprocket drive.
3. Calculate gear reduction to reduce pull required on hand chain, not to exceed 1676 Pa (35 psf).

2.6 FIRE RATED COILING DOORS: NOT USED**2.7 FINISHES****A. Steel:**

1. Clean surfaces of steel free from scale, rust, oil and grease, and then apply a light colored shop prime paint after fabrication.
2. Non-galvanized steel: Treat to assure maximum paint adherence, and apply corrosion inhibitive primer.
3. Galvanized steel: Apply a phosphate treatment and a corrosion inhibitive primer.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install doors in accordance with approved shop drawings and manufacturer's instructions.
- B. Locate anchors and inserts for guides, brackets, hardware, and other accessories accurately.
- C. Securely attach guides to adjoining construction with not less than 9 mm (3/8 inch) diameter bolts, near each end and spaced not over 600 mm (24 inches) apart.
- D. Locate control switches where shown.

3.2 REPAIR

- A. Repair prime painted zinc-coated surfaces and bare zinc-coated surfaces that are damaged by the application of galvanizing repair compound. Spot prime all damaged shop prime painted surfaces including repaired prime painted zinc-coated surfaces.
- B. Lubricate coiling doors and properly adjust and demonstrate to operate freely.

3.3 PROTECTION

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze or other metals not compatible with aluminum by one of the following:
 1. Paint the dissimilar metal with a prime coat of Zinc-Molybdate or other suitable primer, followed by two coats of aluminum paint.
 2. Place an approved caulking compound, or a non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
- B. Paint aluminum in contact with or built into mortar, concrete, plaster or other masonry materials with a coat of bituminous paint.

- C. Paint aluminum in contact with wood or other absorptive materials, that may repeatedly become wet, with a coat of bituminous paint or two coats of aluminum paint.

3.4 INSPECTION

- A. Upon completion, doors to be weathertight and doors free from warp, twist, or distortion.

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**SECTION 08 63 00
METAL-FRAMED SKYLIGHTS**

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. Section specifies field erected aluminum framed skylights.

1.2 RELATED WORK

- A. Field installed joint sealants in connection with metal framed skylights: Section 07 92 00, JOINT SEALANTS.
- B. Glazing: Section 08 80 00, GLAZING.
- C. Finish Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 QUALITY ASSURANCE

- A. Qualifications:
1. Approval is required of products or service of proposed manufacturer, suppliers and installers, and will be based upon submission by Contractor of certification that:
 - a. Manufacturers Qualifications: Manufacturer with five years continuous documented experience in design, fabrication, and installation of metal framed skylights of type and size required for that project.
 - b. Installer Qualifications: An experienced installer with five years continuous documented experience who has specialized in installing metal-framed skylights similar to those indicated for this Project and who is acceptable in writing to manufacturer.
 - c. Manufacturer's product submitted has been in satisfactory and efficient use on minimum of three installations similar and equivalent to this project for past three years.
 - d. Welding: Perform welding by certified welders qualified in accordance with AWS D1.2.
 - B. Pre-Installation Conference: 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 RE and all parties whose work is effected or related to the work of this section.

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, low-emitting materials, and recycled content requirements.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data:
 - 1. Manufacturers standard details and fabrication methods.
 - 2. Data on finishing, components, and accessories.
 - 3. Instructions: Submit detail specifications and instructions for installation, and adjustments.
 - 4. Recommendations for maintenance and cleaning of exterior surfaces.
- C. Shop Drawings: Show elevations of skylights at 1:50 (1/4 inch) scale, metal gages, details of construction, methods of anchorage, glazing details, and details of installation.
 - 1. Shop drawings must be prepared qualified engineer; structural analysis data and shop drawings to be signed and sealed by professional engineer.
- D. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to AAMA CW 10 for care and handling of architectural aluminum from shop to site.

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 Architectural Manufacturers Association (AAMA):

| | |
|----------|--|
| 501-05 | Methods of Test for Exterior Walls |
| 503-08 | Field Testing of Metal Storefronts, Curtain walls and Sloped Glazing Systems |
| 2605-05 | Superior Performing Organic Coatings on Architectural Aluminum Extrusions and Panels |
| CW 10-04 | Curtain Wall Manual No. 10 Care and Handling of Architectural Aluminum from Shop to Site |

| | |
|----------|---|
| CW 13-85 | Curtain Wall Manual #13 Structural Sealant Glazing Systems |
|----------|---|

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

| | |
|----------------|--|
| A36/A36M-12 | Carbon Structural Steel |
| A123/A123M-12 | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| A193/A193M-12b | Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service |
| A307-12 | Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength |
| B209-10 | Aluminum and Aluminum-Alloy Sheet and Plate |
| B211-12e1 | Aluminum-Alloy Bar, Rod and Wire |
| B221-13 | Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| B316/B316M-10 | Aluminum and Aluminum-Alloy Rivet and Cold- Heading Wire and Rods |
| C864-05(2011) | Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers |
| C920-11 | Elastomeric Joint Sealants |
| E283-04(2012) | Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen |
| E330-02(2010) | Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference |
| E331-00(2009) | Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |
| E1105-00(2008) | Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Differences |

D. American Welding Society (AWS):

| | |
|---------------|----------------------------------|
| D1.2/D1.2M-03 | Structural Welding Code-Aluminum |
|---------------|----------------------------------|

E. Glass Association of North America (GANA):

| | |
|--------------|---------------------|
| 2009 Edition | GANA Glazing Manual |
| 2008 Edition | GANA Sealant Manual |

| | |
|--------------|--|
| 2009 Edition | ANA Laminated Glazing Reference Manual |
| 1999 Edition | ANA Fully Tempered Heavy Glass Door and Entrance Systems Design Guide |

F. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-505 Metal Finishes Manual

1.8 WARRANTY

A. Warranty metal skylight against leaks, and structural failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period extended to 5 years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Design Requirements:

1. Meet or exceed all performance requirements specified.
2. Provide extruded aluminum members with a system of alternate serrations for attachment of exterior caps and glass supports.
3. Provide integral guttering system within skylight framing members for positive drainage of condensation; integral system to drain to exterior.
4. Flush glazed exterior joints as indicated on contract drawings.
5. Structural silicone to be factory applied.
6. Glazing Requirements: Refer to Section 08 80 00, GLAZING.

B. Manufacturers Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of skylights that are similar to those indicated for this Project in material, design, and extent.

C. Performance Requirements:

1. Structural Members: Of sizes to support design loads as indicated on Structural contract drawings and as outlined below.
2. Deflection of framing member in a direction normal to plane of glass when subjected to a uniform load deflection test in accordance with ASTM E330, Procedure B, and per above specified structural design loads as indicated on Structural contract drawings, must not exceed 1/175 nor 25 mm (1 inch) of its clear span for clear spans less than 6000 mm (20 feet) or 1/240 of clear spans greater than 6000 mm (20 feet).

3. Air Infiltration: When tested in accordance with ASTM E283 cannot exceed 0.03 L/S per sqm (0.06 cfm per square foot) of fixed skylight surface.
4. Water Penetration: No water penetration when skylight is tested in accordance with ASTM E331 at a differential static pressure of 20 percent of inward acting design wind pressure, with a minimum of 300Pa (6.24 psf).

2.2 MATERIALS

A. Framework:

1. Principle Supporting Members: 3 mm (0.125 inch) minimum thickness extruded aluminum, alloy 6063-T5, 6063-T6, or 6061-T6 per ASTM B221. Profiles as indicated on Contract Drawings.
2. Snap-on Covers and Miscellaneous Non-supporting Trim: 1.5 mm (0.062 inch) minimum thickness extruded aluminum, alloy 6063-T5 per ASTM B221.
3. Principle Formed Metal Members: 3 mm (0.125 inch) minimum thickness aluminum, alloy 5052, 5005, or 6061-T6 per ASTM B209.
4. Internal Reinforcement: ASTM A36, steel shapes as required for strength and mullion size limitations, hot-dip galvanized after fabrication in accordance with ASTM A123.

B. Glazing Strips: ASTM C864:

1. Glass and glazing material as specified in Section 08 80 00, GLAZING.
2. Extruded EDPM rubber designed to comply with the following specifications:
 - a. Hardness: 55+/-5 Durometer.
 - b. Tensile Strength: 12410 kPa (1800 psi) minimum.
 - c. Elongation: 500 percent minimum.
 - d. Color: Black.
3. Heat Aging Characteristics:
 - a. 70 hours at 100 degrees C (212 degrees F).
 - b. Hardness Change: +5 Durometer.
 - c. Tensile Change: -10 percent.
 - d. Elongation Change: -20 percent.
4. Weather resistance at 1 part ozone per million, 500 hours at 20% elongation: No cracks.
5. No visual checks, cracks or breaks after completion of tests.

C. Setting Blocks:

1. Extruded Type II silicone rubber designed to permit adhesion and comply with the following specifications; comply with ASTM C864:
 - a. Hardness: 80+/- Durometer.
 - b. Color: Black.

D. Fasteners:

1. For Exterior Cap Retainers: ASTM A193 B8 300 series stainless steel screws.
2. For Framework Connections: ASTM B211 2024-T4 aluminum, ASTM A193 B8 300 series stainless steel, and ASTM B316 aluminum rivets, as required by connection.
3. For Anchoring Skylight to Support Structure: ASTM A307 zinc plated steel fasteners.

E. Flashings: Comply with Section 07 60 00, FLASHING AND SHEET METAL.

F. Glass:

1. Refer to requirements of Section 08 80 00, GLAZING.
2. Glass Sizes and Clearances:
 - a. Accommodate up to 25 mm (1 inch) glazing.
 - b. Sizes indicated are nominal; verify actual sizes required by measuring frames.
 - c. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer.
 - d. Do not nip glass to remove flares or to reduce oversized dimensions.
 - e. All cutting must occur in factory.

2.3 FABRICATION

- A. Skylight components to be of materials and thickness indicated or specified. Details indicated are representative of required design and profiles. Unless specifically indicated or specified otherwise, methods of fabrication and assembly are at discretion of manufacturer. Perform fitting and assembling of components in shop to maximum extent practicable. Anchorage devices must permit adjustment in three directions. Exposed fasteners are not permitted.
- B. Construct skylight(s) using a continuous aluminum curb with expansion joints as required.
- C. Insofar as practicable, fit and assemble work in manufacturer's shop. Work that cannot be permanently assembled must be shop-assembled, marked and disassembled before shipment to job site.

- D. Design rafter bars for snap-in type glazing strips.
- E. Attach snap-on cap retainers using stainless steel fasteners into a system of alternate serrations, at a maximum spacing of 300 mm (12 inches) on center.
- F. Design snap-on cap retainer fasteners to provide not more than 187 g/mm (10 pounds per linear inch) of compression on glazing strips and glass edge.
- G. Use snap-on type caps to conceal snap-on cap retainer fasteners.
- H. Where applicable, shop rivet or weld aluminum clips to framing members or field bolt at installation.
- I. Set glass with exterior EDPM glazing strips.
- J. Use silicone setting blocks to support glass and to provide edge clearances and glass bites as outlined below, in accordance with GANA recommendations:
 - 1. Set blocks not less than 150 mm (6 inches) from edge of glass for support of unit.
 - 2. Glass Bite: Minimum 13 mm (1/2 inch); maximum 16 mm (5/8 inch) on any side of glass unit.
 - 3. Maintain 6 mm (1/4 inch) edge clearance between glass and adjacent metal framework.
 - 4. Use rubber spacers to maintain separation of glass and adjacent metal framework.
- K. Locate weep holes in curb to positively drain condensation to exterior of skylight at each rafter connection.
- L. Dissimilar Metals: Separate dissimilar metals with bituminous paint or other separator that will prevent galvanic action.
- M. Fasteners: Conceal fasteners wherever possible. Countersink heads of exposed fasteners.

2.4 METAL FINISHES

- A. Fluorocarbon Finish: AAMA 2605:
 - 1. Color as specified in Section 09 06 00, SCHEDULE FOR FINISHES
- B. Sealants:
 - 1. Non-structural Flush Glazed Joints and Weather Seal Joints: Silicone sealants applied in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of skylight system, arrange for representative(s) of skylight manufacturer to examine structure and substrate to

determine that they are properly prepared, sized and ready to receive skylight work included herein.

3.2 INSPECTION AND PREPARATION

- A. Provide protective coating of asphaltic paint to prevent electrolytic action and corrosion, at contact between aluminum and dissimilar metals.

3.3 INSTALLATION

- A. Install skylight frame, glass and accessory items as needed in accordance with manufacturer's instructions.
- B. Install skylight system by factory trained mechanics.
- C. Erect system plumb and true in proper alignment and relation to established lines and grades as shown on approved shop drawings.
- D. Anchor skylight to structure in strict accordance with approved Shop Drawings.
- E. Use high-performance silicone sealants to seal horizontal joints between glass panels and silicone sealant to wet seal joints between snap-on cap retainers and glass.
- F. Apply sealing materials in strict accordance with sealant manufacturer's instructions. Before application, remove mortar dirt, dust, moisture and other foreign matter from surfaces it will contact. Mask adjoining surfaces to maintain a clean, neat appearance. Tool sealing compounds to fill joint and provide a smooth finish.

3.4 TOLERANCES

- A. Completed work must be within the following tolerances:
 - 1. Maximum variation from plane or location shown on approved shop drawings: 3 mm per 3600 mm (1/8 inch per 12 feet) of length, or 10 mm (3/8 inch) in total length.
 - 2. Maximum offset from true alignment between two members abutting end-to-end, edge-to-edge in line: 0.75 mm (1/32 inch).

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field quality-control tests and to prepare test reports.
- B. Sealant Adhesion Tests: Test installed sealant in a minimum of two areas and as follows:
 - 1. Test weather seal sealant as recommended in writing by sealant manufacturer.

- C. Water-Spray Test: Test skylights for compliance with requirements according to procedures in AAMA 501.
- D. Water Penetration: Test skylights for compliance with requirements according to AAMA 503, which requires testing according to ASTM E1105: Uniform Static-Air-Pressure Difference: 20 percent of positive design wind load, but not less than 300 Pa (6.24 lbf/sq. ft.).
- E. Repair or replace Work that does not meet requirements or that is damaged by testing; repair or replace to comply with specifications.

3.6 CLEANING

- A. Install skylight frame and associated metal to avoid soiling or smudging finish.
- B. Clean metal surfaces promptly after installation, exercising care to avoid damage to coatings.
- C. Remove excess glazing and sealant compounds, dirt, and other substances.
- D. Follow recommendations of skylight manufacturer in selection of cleaning agents. Do not use cleaning agents containing ammonia or other compounds that might damage finished metal surfaces.
- E. Clean glass just prior to time of final acceptance of building, subsequent to completion of installation.

3.7 PROTECTION

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

- - - E N D - - -

**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 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 33 00, COILING DOORS AND GRILLES. C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
 D. Painting: Section 09 91 00, PAINTING.

1.3 GENERAL

- A. All hardware must comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Make hardware for application on metal and frames to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- C. 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 REQUIREMENTS, 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 | ANSI/BHMA Finish Designation |
|---------------|----------|------|--------------------------------|--------|---------------------------|---------------------|----------------------------|------------------------------|
|---------------|----------|------|--------------------------------|--------|---------------------------|---------------------|----------------------------|------------------------------|

| | | | | | | | | |
|--|--|--|--|--|--|--|---------|--|
| | | | | | | | listed) | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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 RE for reference purposes. Tag must identify items by Project Specification number and manufacturer's catalog number. These items will remain on file in RE's office until all other similar items have been installed in project, at which time the RE 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 Grand Master Key System. Provide removable core cylinders that are removable only with a special key or

tool without disassembly of knob or lockset. Provide 6 or 7 pin type cylinders. Keying information will be furnished at a later date by the RE.

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.

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 for each type specified.

2.4 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1 and the following:

1. 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
2. Hold-open feature.
3. Size Requirements: Size closers in accordance with manufacturer's recommendations or provide multi-size closers, sizes 1 through 6.
4. Material of closer must be cast aluminum.
5. Steel or malleable iron arm and brackets.
6. Provide with full size cover.
7. Adjustable hydraulic back-check and separate valves for closing and latching speed.

2.5 DOOR STOPS: NOT USED**2.6 FLOOR DOOR HOLDERS: NOT USED****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 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 1. 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: NOT USED

2.9 ELECTRIC STRIKES: NOT USED

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 |

| Locks/Keys | Quantity |
|------------------------|-------------|
| Grand Master sets | 6 keys each |
| Great Grand Master set | 5 keys |
| Control key | 1 key |

2.11 KICK-MOP PLATES: NOT USED**2.12 EXIT DEVICES: NOT USED****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. 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: NOT USED**2.15 PUSH PLATES: NOT USED****2.16 COMBINATION PUSH AND PULL PLATES: NOT USED****2.17 THRESHOLDS**

- A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. Embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

- B. Provide threshold with non-slip abrasive finish.

2.18 WEATHERSTRIPS (FOR EXTERIOR DOORS): NOT USED**2.19 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES: NOT USED****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. 630: Surfaces on exterior of buildings, except where other finishes are specified.

- C. Miscellaneous Finishes:

1. Hinges - Exterior Doors: 630.

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: Verify and match finishes of hardware at existing Committal Shelters, 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 |
| | |
| 630 | Stainless steel |

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

A. Hardware Heights from Finished Floor:

1. Locksets and latch sets centerline of strike: 1000 mm (40-5/16 inches). Note: Verify height of locksets at existing Committal Shelters on site and match.
2. Deadlocks centerline of strike: 1200 mm (48 inches). Note: Verify height of deadlocks at existing Committal Shelters on site and match.
3. Locate other hardware at standard commercial heights.

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 parallel arm. Where closers are mounted on doors, mount with sex nuts and bolts; foot fastened to frame with machine screws.

B. Hinge Size Requirements:

| Door Thickness | Door Width | Hinge Height |
|--|---|-----------------------|
| 45 mm (1-3/4 inch) | 900 mm (3 feet) and less | 113 mm (4-1/2 inches) |
| 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) | Not over 1200 mm (4 feet) | 113 mm (4-1/2 inches) |

| Door Thickness | Door Width | Hinge Height |
|----------------|------------|--------------|
| doors) | | |

C. Provide hinge leaves sufficiently wide to allow doors to swing clear of door frame trim.

D. Hinges Required Per Door:

| | |
|--|------------|
| | |
| Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high | 3 butts |
| Doors over 2280 mm (7 feet 6 inches) high | Continuous |
| | |
| | |
| | |

E. 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.

F. After locks have been installed; show in presence of RE 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 RE 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 RE 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.

| | |
|---|--|
| | |
| <u>HW 1</u> (Committal Shelter Hollow Metal Doors) Each Pair to Have: 2 Continuous Hinge 1 Set Auto Flush Bolts TYPE 25 1 Dust Proof Strike L04021 1 Entry Lock F11 2 Closer (with hold open feature) C02011/C02021 | |
| | |
| <u>HW 2</u> (Storage Room Hollow Metal Door) Lockset (F07) Cylinder Butts as required Threshold Weatherstripping Door Bottom Seal Lockguard Head Rain Drip | |
| | |

**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.

1.2 RELATED WORK

- A. Factory glazed by manufacturer in following units:
1. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
 2. Section 08 63 00, METAL FRAMED SKYLIGHTS.

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 RE.
- 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 and in accordance with ASCE 7.
 3. Wind Design Data: As indicated on Drawings and in accordance with ASCE 7.
 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.

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, and 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. Laminated glass units to remain visibly clear without edge separation, delamination affecting vision, and blemishes for 5 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(2011) | Lock-Strip Gaskets |
| C716-06(2011) | Installing Lock-Strip Gaskets and Infill Glazing Materials |

- | | |
|---------------|---|
| C864-05(2011) | Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers |
| C920-11 | Elastomeric Joint Sealants |
| C1036-06-11e1 | Flat Glass |
| C1048-12e1 | Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass |
| C1172-09e1 | Laminated Architectural Flat Glass |
| E1300-12ae1 | Determining Load Resistance of Glass in Buildings |
| E1886-05 | Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials |
- 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.

2.2 HEAT-TREATED GLASS: NOT USED**2.3 COATED GLASS: NOT USED****2.4 LAMINATED GLASS**

- A. Laminated Glass: ASTM C1172. Two or more lites of glass bonded with polyvinyl butyral, ionomeric polymer, or cast-in-place and cured-transparent-resin interlayer complying with interlayer manufacturer's written instructions.
- B. Interlayer: Use min. 0.75 mm (0.030 inch) thick interlayer for vertical glazing unless otherwise indicated in Drawings.
- C. Interlayer: Use 1.5 mm (0.060 inch) thick interlayer for:
 - 1. Horizontal or sloped glazing.
 - 2. Acoustical glazing.
 - 3. Assemblies requiring heat strengthened or fully tempered glass.
- D. Interlayer: Use 2.28 mm (0.090 inch) thick interlayer where required to meet performance requirements.
- E. Interlayer Color: Clear.

2.5 INSULATING GLASS UNITS: NOT USED**2.6 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). 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.
- H. Structural Sealant: ASTM C920, silicone acetoxycure:
1. Type S.
 2. Class 25.
 3. Grade NS.
 4. Shore a hardness of 25 to 30 Durometer.
- I. Color - Glazing Compounds, Gaskets, and Sealants:
1. 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.
to the NCA.
- F. Laminated glass must be glazed with minimum 12 mm (1/2 inch) bite and continuous bead of structural silicone sealant attaching the inner lite of glass to the frame or mullions.

SPEC WRITER NOTES:

- G. Laminated Glass:
 - 1. Tape edges to seal interlayer and protect from glazing sealants.
 - 2. Do not use putty or glazing compounds.

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): NOT USED

3.6 INSTALLATION - WET METHOD (SEALANT AND SEALANT): NOT USED

3.7 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT): NOT USED

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: NOT USED

3.13 LAMINATED GLASS SCHEDULE

- A. Glass Type LG#_1_: Clear laminated glass with two plies of fully tempered float glass.
 - 1. Minimum Thickness of Each Glass Ply: 3 mm.
 - 2. Interlayer Thickness: 0.76 mm (0.030 inch).
 - 3. Safety glazing required.
 - 4. Application: Interior glazing of units unless otherwise scheduled.

- - - E N D - - -

SECTION 09 06 00
SCHEDULE FOR FINISHES

SECTION 09 06 00-SCHEDULE FOR FINISHES

NCA Facility: SACRAMENTO VALLEY NATIONAL CEMETERY
Location: 5810 MIDWAY ROAD, DIXON, CA 95620
Project No. and Name: SACRAMENTO VALLEY NATIONAL CEMETERY PHASE 2 DEVELOPMENT
Submission: BID DOCUMENTS
Date: JUNE 27, 2018

**SECTION 09 06 00
SCHEDULE FOR FINISHES**

PART I - GENERAL**1.1 DESCRIPTION**

- A. This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the Room Finish Schedule or shown for other locations.

1.2 MANUFACTURERS

- A. Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, provide quadruplicate samples for color approval of materials and finishes specified in this section.
- B. Color Schedule: Submit full color schedule including manufacturers intending to be provided for project, with equivalent colors to selections provided by this section; format to match this section.

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. MASTER PAINTING INSTITUTE: (MPI)

Architectural Painting Specification Manual

PART 2 - PRODUCTS**2.1 COLOR BOARD**

- A. Size: As required to display building finishes.
- B. Labeled for:
1. Building name and number.

2. All finishes used.

2.2 DIVISION 03 - CONCRETE

A. SECTION 03 30 53, CAST IN PLACE CONCRETE (SHORT FORM)

| | |
|------------------|--------------------|
| Surface | Finish Description |
| Exposed Concrete | Grout Finish |

2.3 DIVISION 04 - MASONRY

A. SECTION 04 05 13, MASONRY MORTARING and SECTION 04 05 31, MASONRY TUCK POINTING

| Finish Code | Manufacturer | Mfg. Color Name |
|------------------------|-------------------------------------|-------------------------|
| Mortar at Stone Type 1 | Prism Corporation (basis of design) | LM 23678 (custom color) |
| Mortar at Stone Type 2 | Prism Corporation (basis of design) | LM 23671 (custom color) |

B. SECTION 04 20 00, UNIT MASONRY

| CONCRETE MASONRY UNIT (CMU) | | | |
|-----------------------------|------|-------------|--------------|
| Finish Code | Size | Pattern | Manufacturer |
| CMU-1 | All | Smooth face | - |
| | | | |
| | | | |

C. SECTION 04 43 00, NATURAL STONE VENEER

| Name of Stone | Color, Texture, Finish | Stone Source |
|---------------|-----------------------------------|---------------|
| Stone Type 1 | Buff - Tapestry finish | Vetter Stone |
| Stone Type 2 | Caramel Cappuccino - Sandblast | Buechel Stone |
| Stone Type 3 | Caramel Cappuccino - Sanded/Honed | Buechel Stone |

2.4 DIVISION 05 - METALS

A. SECTION 05 50 00, METAL FABRICATIONS

| Item | Finish |
|-----------------------|-----------|
| Exposed Steel Channel | Paint P-1 |
| | |
| | |

2.5 DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

A. SECTION 06 10 00, ROUGH CARPENTRY

| Room No. and Name | Component | Material | Species | Finish | Color |
|-------------------------------|--|----------|---------|-------------|-------------|
| Committal Shelter Room 101 | Tongue & Groove (T & G) ceiling/soffit boards | Wood | Pine | Transparent | Transparent |
| | | | | | |

2.6 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 41 13, STANDING SEAM METAL ROOFING

| Finish Code | Manufacturer | Mfg. Color Name/No. |
|--------------------------|----------------------------|---------------------|
| Standing Seam Metal Roof | Pac Clad (basis of design) | Charcoal |
| | | |

B. SECTION 07 71 00, ROOF SPECIALTIES and 07 72 00, ROOF ACCESSORIES

| Item | Material | Finish | Manufacturer | Manufacturer/Color Name/Number |
|---------|----------|-----------|--------------|--------------------------------|
| Copings | Steel | Paint P-1 | | |
| | | | | |
| | | | | |

C. SECTION 07 92 00, JOINT SEALANTS

| Location | Product | Manufacturer | Manufacturer Color |
|---------------------|---------------------------|-------------------------------|--------------------|
| Stone Type 1 Joints | Silicone Building Sealant | Dow Corning (basis of design) | Natural Stone |
| Stone Type 2 Joints | Silicone Building Sealant | Dow Corning (basis of design) | Natural Stone |
| | | | |

2.7 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

| | |
|---|-------------------------------|
| Paint both sides of door and frames same color. | |
| Component | Color of Paint Type and Gloss |
| Door | P-1: Semi-Gloss |
| Frame | P-1: Semi-Gloss |
| Window Frame | P-1: Semi-Gloss |

B. SECTION 08 33 00, COILING DOORS AND GRILLES

| Location | Item | Material | Finish | Manufacturer | Manufacturer Color Name/No. |
|------------------|--------------|----------|-----------|--------------|-----------------------------|
| Storage Room 102 | Coiling Door | Steel | Paint P-1 | | |

| Location | Item | Material | Finish | Manufacturer | Manufacturer Color Name/No. |
|----------|------|----------|--------|--------------|-----------------------------|
| | | | | | |

C. SECTION 08 63 00, METAL-FRAMED SKYLIGHTS

| Material | Finish | Manufacturer | Manufacturer Color Name/No. |
|----------|-----------|--------------|-----------------------------|
| Aluminum | Paint P-1 | | |
| Glass | Clear | -- | -- |

D. SECTION 08 71 00, BUILDERS HARDWARE

| Item | Material | Finish |
|---------------|-----------------|--|
| Hinges | Stainless Steel | 630 |
| Door Closers | Cast Aluminum | Applied paint finish. Dull or Satin Aluminum |
| Lock/ Latches | Stainless Steel | 630 |
| Threshold | Aluminum | Mill Finish |
| | | |

E. SECTION 08 80 00, GLAZING

| Glazing Type | Manufacturer | Mfg. Color Name/No. |
|--------------|--------------|---------------------|
| G-1 | - | Clear |
| | | |

2.8 DIVISION 09 - FINISHES

A. SECTION 09 24 00, PORTLAND CEMENT PLASTERING

| Finish | Integral | Color | Manufacturer | Mfg. Color Name/No. |
|-------------------------------------|----------|------------------------|--------------|---------------------|
| Sandpebble Fine - To match existing | — | White - To Match Exist | — | — |
| | | | | |

B. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards:

| | | | | | |
|---------------|---|-----------|--------------------|-----------|---------------|
| Gloss Level 1 | a traditional matte finish-flat | Gloss @60 | max 5 units, and | Sheen @85 | max 10 units |
| Gloss Level 2 | a high side sheen flat-"a velvet-like" finish | | max 10 units, and | | |
| Gloss Level 3 | a traditional "egg-shell like" finish | | 10-25 units, and | | 10-35 units |
| Gloss Level 4 | a "satin-like" finish | | 20-35 units, and | | 10-35 units |
| Gloss Level 5 | a traditional semi-gloss | | 35-70 units | | min. 35 units |
| Gloss Level 6 | a traditional gloss | | 70-85 units | | |
| Gloss level 7 | a high gloss | | more than 85 units | | |

| 2. Paint Code | Gloss | Manufacturer | Mfg. Color Name/No. |
|----------------------------|--|------------------|------------------------|
| P-1 | Level 5 - Semi Gloss | Sherwin Williams | SW 6208 - Pewter Green |
| | | | |
| | | | |
| 3. Stain Code (S) | Gloss and Transparency | Manufacturer | Mfg. Color Name/No. |
| S-1 | Match existing Committal Shelter ceiling | — | — |
| | | | |
| | | | |
| 4. Clear Coatings Code(CC) | Gloss | Manufacturer | Mfg. Color Name/No. |

| | | | |
|------|--|---|---|
| CC-1 | Match existing Committal Shelter ceiling | — | — |
| | | | |

2.9 DIVISION 10 - SPECIALTIES

A. SECTION 10 14 00, EXTERIOR SIGNS

| Component | Background Finish | Type Color | Manufacturer | Mfg. Color Name/No. |
|---|----------------------|------------|----------------|---------------------|
| Type A, B, C, D, E & Visitor Information & Floral Regulations | Victor Stanley Black | White | Victor Stanely | MP26309 |
| Accessible Parking Sign | B2, Handicapped Blue | White | Matthews | MP15085 |

| Component | | Color and Finish |
|--|--|-----------------------------|
| Type A, B, C, D, E & Visitor Information & Floral Regulations Sign Posts | | Cast Stone - Match Existing |
| Type A, B, C, D, E & Visitor Information & Floral Regulations Sign Posts Collars | | Concrete - Match Existing |

2.10 DIVISION 32 - EXTERIOR IMPROVEMENTS

A. SECTION 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

| Surface | Manufacturer | Finish Description | Mfg. Color Name/No. |
|------------------------------------|----------------|---------------------|-----------------------------|
| Curb and Gutter | N/A | Medium Broom Finish | |
| Sidewalks and Pedestrian Pavements | N/A | Medium Broom Finish | |
| Colored Concrete Materials | Solomon Colors | Medium Broom Finish | SGS Integral Color 920 Onyx |

B. SECTION 32 14 13, PRECAST CONCRETE UNIT PAVING

| Surface | Manufacturer | Finish Description | Mfg. Color Name/No. |
|---|------------------|-----------------------|---------------------|
| Detectable Warning Panels (Columbarium Court 3 Only) | Tile Tech Pavers | Shot-blasted & Sealed | Charcoal |

B. SECTION 32 17 23, PAVEMENT MARKINGS

| Color | Manufacturer | Mfg. Color Name/No. |
|--------|--------------|--------------------------------|
| Yellow | | Federal 595 color number 33538 |
| White | | Federal 595 color number 37925 |
| Blue | | Federal 595 color number 35180 |

C. SECTION 32 30 00, SITE FURNISHINGS

| Item | Style Name/No. | Finish | Manufacturer | Mfg. Color Name/No. |
|-------------------------|---|-----------------------------|-----------------------------|---------------------|
| Benches (6' and 8') | RB-28 | Powder coat | Victor Stanley | Black |
| Trash Receptacles | RB-36 | Powder coat | Victor Stanley | Black |
| Planter | S-24 | Powder coat | Victor Stanley | Black |
| Double Barrier Bar Gate | 30' Sentinel Manual Dual Swing Bar Gate | Galvanized & Powder Coat | Guardian Traffic Systems | Black |

PART III - EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

| FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS | |
|---|--------------|
| Term | Abbreviation |
| Acoustical Ceiling | AT |
| Anodized Aluminum Colored | AAC |
| Anodized Aluminum Natural Finish | AA |
| Baked On Enamel | BE |
| Brick Face | BR |
| Carpet | CP |
| Carpet Module Tile | CPT |
| Concrete | C |
| Concrete Masonry Unit | CMU |
| Existing | E |
| Exposed Divider Strips | EXP |
| Exterior | EXT |
| Exterior Finish System | EFS |
| Exterior Paint | EXT-P |
| Exterior Stain | EXT-ST |
| Fabric Wallcovering | WF |
| Facing Tile | SCT |
| Floor Mats & Frames | FM |
| Floor Tile, Mosaic | FT |
| Fluorocarbon | FC |
| Granite | GT |
| Gypsum Wallboard | GWB |
| High Glazed Coating | SC |
| Latex Mastic Flooring | LM |
| Marble | MB |
| Material | MAT |
| Mortar | M |
| Multi-Color Coating | MC |
| Natural Finish | NF |
| Paint | P |
| Paver Tile | PVT |
| Plaster | PL |

| | |
|-------------------------------------|------|
| Plaster High Strength | HSPL |
| Plaster Keene Cement | KC |
| Plastic Laminate | HPDL |
| Polypropylene Fabric Wallcovering | PFW |
| Porcelain Paver Tile | PPT |
| Rubber Base | RB |
| Rubber Tile Flooring | RT |
| Stain | ST |
| Stone Flooring | SF |
| Suspension Decorative Grids | SDG |
| Veneer Plaster | VP |
| Vinyl Base | VB |
| Vinyl Coated Fabric Wallcovering | W |
| Vinyl Composition Tile | VCT |
| Vinyl Sheet Flooring | VSF |
| Vinyl Sheet Flooring (Welded Seams) | WSF |
| Wall Border | WB |
| Wood | WD |

3.2 FINSIH SCHEDULE SYMBOLS

| Symbol Definition | |
|-------------------|--------------------------------|
| ** | Same finish as adjoining walls |
| - | No color required |
| E | Existing |
| XX | To match existing |
| EFTR | Existing finish to remain |
| RM | Remove |

--- E N D---

**SECTION 09 24 00
PORTLAND CEMENT PLASTERING**

PART 1 GENERAL**1.1 DESCRIPTION**

- A. This section specifies lathing and Portland cement based stucco.

1.2 RELATED WORK

- A. Section 03 30 53, Cast-in-Place Concrete. B. Room finish schedule and color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TERMINOLOGY

- A. Definitions and description of terms to be in accordance with ASTM C11, C841, and C926 and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead to be the underside of the floor or roof construction supported by beams, trusses, and bar joists.
- C. Self-furring Lath: Metal plastering bases having dimples or crimps designed to hold the plane of the back of the lath 6 to 10 mm (1/4 to 3/8 inch) away from the plane of the solid backing.
- D. Solid Backing or Solid Bases: Concrete, masonry, sheathing, rigid insulation, and similar materials to which plaster is directly applied.
- E. Wet Areas: Areas of a building where cyclic or continuous exposure to very humid or wet conditions, or in which a dew point condition may occur in the plaster. Dew point conditions occur frequently in such areas as laundries, bathing or shower rooms and similar areas.

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, 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. Manufacturer's Literature and Data:
1. Accessories for plaster, each type.
 2. Metal plastering bases, each type.
 3. Fasteners.
 4. Bonding compounds, including application instructions.

5. Admixtures, including mixing and application instructions.

C. Samples:

1. Accessories for plaster, each type, not less than 150 mm (6 inches) long.
2. Panel showing finish coat 16 inches by 16 inches.

1.6 PROJECT CONDITIONS

- A. Comply with ASTM C926.
- B. Maintain work areas for interior work at a temperature of not less than 4°C (40°F) for not less than 48 hours prior to application of plaster, during application of plaster and until plaster is completely dry.
- C. Exterior plaster must not be applied when the ambient temperature is less than 4°C (40°F).
- D. Plaster must not be applied to frozen surfaces or surfaces containing frost.
- E. Frozen materials must not be used in the mix.
- F. Plaster coats must be protected against freezing for a period of not less than 24 hours after application.

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):

| | |
|---------------|---|
| A653/A653M-11 | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| C11-13 | Terminology Relating to Gypsum and Related Building Materials and Systems |
| C150/C150M-12 | Portland Cement |
| C206-03(2009) | Finishing Hydrated Lime |
| C847-12 | Metal Lath |
| C897-05(2009) | Aggregate for Job-Mixed Portland Cement Based Plasters |
| C926-12a | Application of Portland Cement-Based Plaster |
| C932-06 | Surface-Applied Bonding Compounds for Exterior Plastering |
| C933-13 | Welded Wire Lath |
| C979-05 | Pigments for Integrally Colored Concrete |

C1063-12c Installation of Lathing and Furring to Receive
Interior and Exterior Portland Cement-Based
Plaster

PART 2 - PRODUCTS

2.1 METAL PLASTERING BASES

- A. Expanded Metal Lath:
 - 1. ASTM C847, with ASTM A653 G60, Hot Dipped Galvanized Coating.
 - 2. Weight: 1.8 kg/m² (3.4 pounds per square yard).
- B. Building Paper Backing for Metal Plastering Bases:
 - 1. Backing attached to lath as specified in ASTM C933.

2.2 ACCESSORIES FOR CEMENT PLASTER (STUCCO)

- A. Provide products fabricated to compliance with ASTM C1063.
- B. Accessories include, but not limited to:
 - 1. Control Joints: ASTM C841, zinc.
 - 2. Corner Bead.
 - 3. Casing Bead.
- C. Finish: Zinc-coated (galvanized) steel.

2.3 FASTENERS

- A. Comply with ASTM C1063.

2.4 CEMENT

- A. Portland Cement: ASTM C150, Type I; white.

2.5 LIME

- A. ASTM C206, Type S.

2.6 AGGREGATES (SAND)

- A. ASTM C897, graded as required to suit texture of finish specified.

2.7 BONDING AGENT

- A. ASTM C932.

2.8 FACTORY PREPARED FINISH COAT FOR CEMENT PLASTER (STUCCO)

- A. Factory prepared dry blend of materials, integrally colored, designed for exterior finish coat application.
- B. Pigments: ASTM C979, lime proof mineral oxide.
- C. Mix: Not more than 35 percent, by weight of all ingredients (cement, aggregate, hydrated lime, admixture and coloring pigment) can pass a number 100 sieve.

PART 3 - EXECUTION

3.1 APPLYING METAL PLASTERING BASES

- A. In accordance with ASTM C1063, except as otherwise specified or shown.

3.2 INSTALLING PLASTERING ACCESSORIES

- A. Install accessories in accordance with ASTM C1063, except as otherwise specified.
- B. Corner Beads: Install at all vertical and horizontal external plaster corners, as required to establish grounds, and where shown.
- C. Casing Beads: Install where shown and at transitions to dissimilar materials.
- D. Control Joints:
 - 1. Where control joints are placed parallel to framing members, install joints within 100 mm (4 inches) of the framing member.
 - 2. Install control joints only to the edges of abutting sheets of lath so that the lath is not continuous or tied across the joint.
 - 3. Extend joints the full width and height of the wall or length of soffit/ceiling plaster membrane.

3.3 SURFACE PREPARATION OF SOLID BASES

- A. Prepare and condition surfaces that are to receive plaster in accordance with ASTM C926, except as otherwise specified.

3.4 PORTLAND CEMENT BASED PLASTER

- A. Apply stucco in three coats to a thickness of not less than 25 mm (1 inch) as measured from the back plane of metal reinforcement, exclusive of ribs or dimples or from the face of solid backing or support, with or without metal reinforcement, to the finished stucco surface, including moderate texture variations.
- B. Conform to the applicable requirements of ASTM C926 and the following:
 - 1. evenly dampen masonry surfaces to receive stucco immediately prior to application of stucco.
 - 2. Apply each stucco coat continuously in one general direction, without allowing mortar to dry at edges. Where it is impossible to work the full dimension of a wall surface, in a continuous operation, jointing to be made at a break, opening, or other natural division of the surface.
 - 3. Dampen edges to be joined to produce a smooth confluence.
 - 4. Slightly round exterior corners.
 - 5. Pitch Portland cement plaster on soffit surfaces forward to form a drip.
 - 6. Scratch Coat:

- a. Apply not less than 10 mm (3/8 inch) thick under sufficient pressure to form good keys and to completely embed the reinforcement.
 - b. Lightly scratch before the scratch coat has set, in one direction; scratch vertical surfaces in the horizontal direction only.
 - c. Fog cure scratch coat for a minimum of 72 hours.
7. Brown Coat:
- a. Dampen the scratch coat evenly to obtain uniform suction before the brown coat is applied; there cannot be no visible water on the surface when the brown coat is applied.
 - b. Apply the brown coat to the scratch coat with sufficient pressure to force the stucco into the scratches and brought to a plumb, true, even plane with rod or straightedge.
 - c. Uniformly float brown coat with dry float when set sufficiently, to promote densification of the coat and to provide a surface receptive to bonding of the finish coat.
 - d. Fog cure brown coat for a minimum of 72 hours.
8. Finish Coat:
- a. Dampen surfaces of the brown coat not more than 1 hour before the finish coat is to be applied to a uniform wetness with no free-standing water on the surface.
 - b. The finish coat to have a sand/float finish to match stucco finish on existing Committal Shelter columns and and the approved sample.
 - c. Fog cure finish coat for a minimum of 48 hours; take care to prevent staining.

3.5 CURING AND PROTECTION

- A. Perform fog curing by applying a fine mist of water to the Portland cement plaster.
- B. Exercise care during fog curing to avoid erosion damage of the stucco surfaces.
- C. Do not use a solid stream of water.
- D. Frequency of fogging cannot be not less than three times daily.
- E. Protect the stucco from the direct rays of the sun during severe drying conditions using canvas, cloth or other approved sheet material, when directed.

3.6 PATCHING AND POINTING

- A. Replace or patch loose, cracked, damaged or defective work as directed.
- B. Patching must match existing work in texture and color; finished flush.

3.7 TOLERANCES

- A. Do not deviate more than 6 mm in 3 m (1/4 inch in 10 feet) from true plane in finished plaster surfaces as measured with a 3 m (10 foot) straight edge.
- B. Finish plaster flush with metal accessory surfaces and other built-in items unless otherwise directed.

- - - 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, and Division 08 - OPENINGS sections. B. 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 local/regional materials, 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/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.

PAINTING

- 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.

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. 71-13 | Polyurethane, Moisture Cured, Clear, Flat (PV) |
| No. 94-13 | Exterior Alkyd, Semi-Gloss (EO) |
| No. 95-13 | Fast Drying Metal Primer |
| No. 119-13 | Exterior Latex, High Gloss (acrylic) (AE) |
| No. 134-13 | Primer, Galvanized, Water Based |
| 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. Plastic Tape:
 - 1. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.
 - 2. Pressure sensitive adhesive back.
 - 3. Widths as shown.
- C. Interior/Exterior Latex Block Filler: MPI 4.
- D. Exterior Alkyd Wood Primer: MPI 5.
- E. Exterior Oil Wood Primer: MPI 7.
- F. Exterior Alkyd, Flat (EO): MPI 8.
- G. Exterior Alkyd Enamel (EO): MPI 9.
- H. Exterior Latex, Flat (AE): MPI 10.
- I. Exterior Latex, Semi-Gloss (AE): MPI 11.
- J. Polyurethane, Clear Gloss: MPI 31.
- K. Knot Sealer: MPI 36.
- L. Polyurethane, Moisture Cured, Clear, Flat (PV): MPI 71.
- M. Exterior Wood Stain, Semi-Transparent (WS): MPI 90.
- N. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- AA. Fast Drying Metal Primer: MPI 95.
- BB. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- CC. Waterborne Galvanized Primer: MPI 134.

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, and 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. 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.

3.3 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 RE.
- 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.
 - additions or separate buildings.
- G. Do not spray paint in existing occupied spaces unless approved by RE, 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:

1. Transparent finishes as specified under Transparent Finishes on Wood.E.

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)).

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Steel and Ferrous Metal:

1. Two coats of Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).

C. 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. Transparent Finishes on Wood.

a. Natural Finish:

- 1) One coat of sealer as written in 2.1 E.

2) TWO COATS OF MPI 71 POLYURETHANE, MOISTURE CURED, CLEAR FLAT (PV).3.7**INTERIOR FINISHES: NOT USED****3.8 REFINISHING EXISTING PAINTED SURFACES; NOT USED****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.

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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APPENDIX

Coordinate the following abbreviations used in Section 09 91 00, PAINTING, with other Sections, especially Section 09 06 00, SCHEDULE FOR FINISHES and other COATING SECTIONS listed. Use the same abbreviation and terms consistently.

| Paint or coating | Abbreviation |
|-----------------------------------|--|
| Acrylic Emulsion | AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss) |
| Alkyd Gloss Enamel | G (MPI 48) |
| Alkyd Semigloss Enamel | SG (MPI 47) |
| Aluminum Paint | AP) |
| Cementitious Paint | CEP (TT-P-1411) |
| Exterior Latex | EL?? (MPI 10 / 11 / 119) |
| Exterior Oil | EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss) |
| Fire Retardant Paint | FR |
| Fire Retardant Coating (Clear) | FC (intumescent type) |
| Heat Resistant Paint | HR |
| Latex Emulsion | LE (MPI 53, flat/MPI 52, eggshell/MPI 54, semigloss/MPI 114, gloss Level 6 |
| Latex Flat | LF (MPI 138) |
| Latex Gloss | LG (MPI 114) |
| Latex Semigloss | SG (MPI 141) |
| Latex Low Luster | LL (MPI 139) |
| Plastic Floor Coating | PL |
| Polyurethane Varnish | PV |
| Rubber Paint | RF (CID-A-A-3120 - Paint for Swimming Pools (RF)) |
| Water Paint, Cement | WPC (CID-A-A-1555 - Water Paint, Powder). |
| Wood Stain | WS |

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**SECTION 10 14 00
EXTERIOR SIGNAGE**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the work required to furnish and install the indicated and specified exterior cemetery site signage systems, including, but not limited to, posts and mow strips.
- B. Signs shall be products of manufacturers regularly engaged in manufacturing signs of types specified.
- C. Signs included are as follows:
 - 1. Type A - Traffic Regulatory
 - 2. Type B - Directional
 - 3. Type C - Identification
 - 4. Type D - Pylon Section Marker
 - 5. Type F - Pylon Street Sign
 - 6. Accessible Parking Sign
 - 7. Visitors Information & Floral Regulations Sign
 - 8. Electronic Reader Board Sign
 - 9. Temporary Construction Signs
 - 10. Faucet Post with Sign Panel
 - 11. Dimensional Letters, Numbers and Seals

1.2 RELATED WORK

- A. Post Setting Excavation, Material, Backfill, Section 31 20 00, EARTH MOVING.
- B. Concrete Bases for posts: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE
- C. Cast Stone Masonry Posts: Section 04 72 00 CAST STONE MASONRY.
- D. Flower Watering Station piping, appurtenances and mounting: Section 32 30 00 SITE FURNISHINGS.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Sign manufacturer shall regularly and presently manufacture signs similar to those specified as one of their principal products. Sign manufacturer shall submit qualifications demonstrating a minimum of three years of experience manufacturing the qualifying signs and shall, if possible, demonstrate the successful manufacturing of exterior site signs installed at one or more State or National Veteran Cemeteries.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Submit 3 sets - One set to the Contractor, one set to the Resident Engineer or Contracting Officer's Representative (RE/COR) and one set to the A/E Designer. The Contractor shall provide submittal documents that indicate each of the sign types, mounting types and materials to be used for the various combinations to be used for this project. Submittal materials shall indicate the location(s) for the various sign types including their mounting.
1. Post & panel sign mock-up, not less than 8" by 10", shall be constructed and submitted, showing typical color, texture and fonts shown on Contract Drawings. Mock-up shall show typical fabrication methods, including panel to post(s) connection. Sample shall be capable of demonstrating how the face panels can be removed, for repair or replacement, from the mounted location between the posts, for a two post sign system. Mock-ups of all other sign systems for post mounted signs shall be capable of demonstrating how the sign panels are to be removed and replaced from the posts, or mounting support system attached to the posts, without moving the posts. Post, other than concrete or stone types, shall include typical post cap secured with tamperproof screws. Top surface of the sign panel shall not contain screws or metal joints that could trap or allow water to enter the sign assembly.
 2. Aluminum samples showing full range of finish colors available.
 3. Cast Metal Letter, of the style, size and finish indicated
 4. Color samples of each color, 6 inches x 6 inches. Show anticipated range of color and texture.
 5. Sample of typeface, arrow and symbols in a typical full size layout.
- C. Shop Drawings: All signs showing material, finish, colors, size of members, details of construction, letter spacing, size and type, numbers, symbols or image details, and mounting details. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes. The details of construction shall clearly show how the sign is to be disassembled to replace the entire sign or just one side panel, where applicable.

- D. Full size layout template for individually mounted dimensional letters and numbers, showing pin locations and letter spacing. Approved template shall be used during the actual installation of the lettering/numbers.
- E. Full size layout in full color of the Sign Panels.
- F. Manufacturer's Literature and Data (Mark literature to indicate items proposed to be furnished): Signs, each type. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions. Manufacturer's recommendations for mounting the Sign Panels shall be provided.
- G. Manufacturer's Certificates: Provide certification from the coating installer, indicating exactly what they did to prepared the aluminum as and applied the coating(s) to the specified thickness(es). The certification shall indicate that the coating has been installed according to specific and identified contract specifications and/or approved submittal materials so it is absolutely clear what was done.

1.5 DELIVERY AND STORAGE

- A. 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.
- B. Deliver signs only when the site, mounting materials, and equipment are ready for installation work to proceed.
- C. Store products in dry condition inside enclosed facilities.

1.6 WARRANTY

- A. Sign Manufacturer shall guarantee the text and symbols applied to the powder coated aluminum for an extended warranty period of five years following final acceptance of the project. A warranty inspection shall be performed no later than one year following project final acceptance and the Contractor shall be responsible for removing and replacing any text and/or symbols identified, during the inspection, that have started to fade, chip, peel or otherwise fail. The Contractor shall remove and replace any sign panel faces with new, where the applied lettering, or the paint system itself, is causing damage to, or failure of, the paint system. All work to produce replacement sign panels with new lettering and/or paint system shall be provided at no cost to the Government, as part of the Warranty work for the signage system.

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. Americans with Disabilities Act - 1990, as amended and in effect as of 01-01-2009
- C. Federal Highway Administration:
Manuals on Uniform Traffic Control Devices for Street and Highways - Single Post Traffic Regulatory Signs.
- D. American Society for Testing and Materials (ASTM):
- | | |
|------------------|--|
| B209-10 | Aluminum and Aluminum-Alloy Sheet and Plate |
| B221-12 | Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes. |
| B449-93 (2010)e1 | Standard Specification for Chromates on Aluminum |
- E. American Architectural Manufacturer's Association (AAMA):
- | | |
|--------------|---|
| AAMA 2605-05 | Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels. |
|--------------|---|
- F. Federal Specifications (Fed. Spec.):
- | | |
|-------------|-----------------------------------|
| MIL-P-8184F | Plastic Sheet, Acrylic, Modified. |
| A-A-59502 | Plastic Sheet, Polycarbonate |
- G. VA Signage Design Guide:
Section 12 National Cemetery Signs -
<http://wbdg.org/ccb/VA/VASIGN/signage12.pdf>

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Aluminum, Extruded: Fed. Spec. QQA-200-9, alloy 6063-T5, applicable as material.
- B. Aluminum, Sheet and Plate: ASTM B209
- C. Aluminum, Extrusions and Tubing: ASTM B221
- D. Zinc Chromate Primer: Fed. Spec. TT-P-645.

2.2 SIGNAGE GENERAL

- A. Signs shall be of type, size and design shown on the drawings and as specified.

- B. Signs shall be complete with lettering, framing, and related components for a complete sign 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 all dimensions and conditions shown by the drawings. Resident Engineer and/or Contracting Officer's Representative (RE/COR) is to be notified of any discrepancy in drawing(s), in field directions or conditions, and/or of any changes required for any such related construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. Warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

2.3 SIGN STANDARDS

- A. Typography:
 - 1. Type Style: Optima Bold. Initial caps or and lower case as indicated in Site Signage Plan, unless otherwise indicated.
 - 2. Arrow: See graphic standards in drawings.
 - 3. Letter spacing: See graphic standards on drawings.
 - 4. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only. Text to be installed on specific signs shall be as submitted, reviewed and finally approved in shop drawings processed as submittal materials.
- B. Sign Colors and Finishes: As specified in this Specification Section and approved in the Shop Drawing & Submittal process.
 - 1. Aluminum sign system color scheme shall be powder coated matching "Victor Stanley" black with white text.

2.4 SIGNS TYPES

- A. General: The exterior sign system shall be comprised of sign type families that are derived from the 10 Types developed in Chapter 12 - National Cemetery Signs, of the VA Signage Design Guide (SDG). The

sign designations used herein follow those in the SDG. An example sign designation, to identify what each of the elements is designated to represent is "NC-07.01 A - m1". "NC" Designates a National Cemetery sign. "07" the two digit numbers identify a particular sign type. "01" the two digit number following the period identifies a specific sign size within the sign type. "A" the letter designates a specific sign configuration, version and/or layout for graphics. "m1" the letter and number designates the post family and style. "c1" denotes concrete family with square insert style; "c2" denotes concrete family with round insert style; "m1" denotes metal family with square style; and "m2" denotes metal family with rectangular style. All of the above is duplicated herein, originally from the graphical indications in the SDG. The basic sign designations for this project are indicated as follows:

1. NC-01 - Information/Regulations Signs, three size designations.
 2. NC-03 - Traffic Regulatory Signs.
 3. NC-04 - Post and Panel Signs.
 4. NC-06 - Pylon Street Signs.
 5. NC-07 - Pylon Section Marker.
 6. NC-10 - Dimensional Letters.
 7. NC-11 - Dimensional Seal.
- B. Location, layout and construction details for the all of the project exterior signs shall be found in the Construction Drawings. Refer to the signage details for the specific sign panel sizes, text and graphic sizes as well as the layout and content for the text and images for the respective individual signs.

2.5 TEXT AND GRAPHICS

- A. There are multiple Message Layout types for some of the different size signs within the same type of sign. See the drawing layout and detail drawings for the specifics of the locations for the signs, as well as the size, types, materials and messages for the individual signs for the project.
1. Surface applied letters, numbers and graphics shall be of a published quality and life expectancy equal to or exceeding that for reflective white opaque Engineering Grade 3M™ Scotchlite™ vinyl, unless otherwise noted. Contractor to refer to Section 09 06 00 Schedule of Finishes for color information, as selected from the

manufacturer's standard color selection, during the submittal process. Font Type Style shall be as indicated in Paragraph "SIGN STANDARDS" as approved during the submittal process.

- B. All text and graphics for the exterior signage shall be provided in detailed submittal information. Each sign face shall be represented in scaled drawings, with exact font, letter style, letter spacing, graphics being shown. Only signs and/or sign faces approved in the submittal process shall be manufactured. Contractor to refer to Section 09 06 00 Schedule of Finishes for color information.

2.6 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 shall be true. Assemble so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces shall be smooth flat and without oil-canning, free of rack and twist. Maximum variation from true plane of surface shall be plus or minus 0.4mm (1/64 inch). Restore texture to filed or cut areas.
- F. Extruded members to be free from extrusion marks. Members shall have square turns and corners sharp, and curves shall be true.
- G. 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.
- H. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges,

drips, bubbles, thickness variations, peeling, foreign matter and other imperfections.

- I. 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.
- J. Completed sign installations shall not have any exposed openings so insect nesting inside of signs will be prevented.
- K. No signs are to be manufactured until final sign message schedule and location review has been completed by the RE/COR & forwarded to contractor.
- L. Final sign fabrication shall not proceed until samples and shop drawings detailing the sign system as it will be installed, have been submitted and approved during the submittal process.

2.7 PROTECTION OF ALUMINUM

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze or other metals compatible with aluminum by one of the following:
 - 1. Painting the dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - 2. Placing an approved caulking compound, or a non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
- B. Paint aluminum in contact with or built into mortar, concrete, or other masonry materials with bituminous paint or zinc chromate primer.

2.8 POST-PANEL SIGNS

- A. Furnish the standard post style for each of the Post and Panel Signs, as designated in the drawings.
 - 1. Cast Stone Post Signs:
 - a. The posts shall be Cast Stone with the face for mounting the metal frame and panel(s) being smooth and flat. The cast stone posts shall be of the required height (to be imbedded in the ground and extending above finished grade as indicated on the drawings), with the detailing as indicated on the drawings. The Cast Stone posts shall be constructed and installed in the locations indicated on the drawings, or as approved in the submittal materials, see paragraph below.

- b. Posts shall be manufactured in accordance with Section 04 72 00 Cast Stone Masonry using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Refer to Section 09 06 00 Schedule of Finishes for finish, color and texture and conformance shall be demonstrated by submitting samples of the post, minimum of 300mm (12") in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. An acceptable sample must be obtained prior to manufacturing the units.
 - c. Provide a reinforced concrete mow collar as specified herein.
2. Tubular aluminum frame system:
- a. The minimum size for the tubular aluminum frame system, if not indicated in the drawings, shall be 25 mm x 25 mm x 3 mm (1-inch x 1-inch x 1/8-inch) with the 3 mm(1/8 - inch) aluminum panels anchored to the tubing, with all corners mitered and welded and ground smooth. When the sign panel system is mounted to the posts, there shall be no openings for insects to enter. Mounting holes for attaching the sign panel and frame to the posts shall be pre-drilled before the coating system is applied. The entire sign panel and frame system shall be coated with the submitted and approved powder coating system, as indicated herein or on the drawings. The sign panels shall be secured to the frame system with tamperproof screws and each panel face shall be removable, without removing the sign system from the posts.
 - b. Exposed fasteners shall be aluminum, tamper-proof type, and shall be colored to match the color for the sign panels.
 - c. Finishes of exposed aluminum surfaces:
 - 1) Pretreatment: Before the finish is applied, a five-stage pretreatment must be applied to assure maximum adhesion and corrosion resistance:
 - a) Stage 1: High alkaline cleaner to prepare the surface
 - b) Stage 2: Water rinse
 - c) Stage 3: Combination of chromic, phosphoric and hydrofluoric acids that produce the chrome-phosphate conversion coating for maximum adhesion and corrosion resistance.
 - d) Stage 4: Water rinse

- e) Stage 5: Water rinse
- 2) Coating: The coatings for the metal signs shall produce results that meet or exceed the testing results indicated in AAMA 2605-05. After pretreatment, the metal is dried and paint is then applied. The aluminum shall have an electrostatically applied baked-on flexible acrylic finish that meet or exceeds industry standard tests, achieving a 75 - 125 micron (3.0 - 5.0 mil) thickness, super-tough finish with maximum exterior durability and superior adhesion characteristics. Contractor to refer to Section 09 06 00 Schedule of Finishes for color information.
- 3) Tests:
 - a) AAMA 2605-05 (covers Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels)
 - b) ASTM D2247 (Humidity resistance of 1,000 hours)
 - c) ASTM B117 (Salt spray resistance of 1,000 hours)
 - d) Accelerated weathering for 500 hours under Method 6152 of Federal Test Method 141 shall show no adhesion loss, with only slight fading, chalking and water staining.
 - e) Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for one year in Florida facing south at a 45 degree angle.
 - f) Minimum hardness of 2H using ASTM D3363.
 - g) Color of exposed portions of fastenings shall match sign panel being attached.
- 3. Insulating sleeves, gaskets, bolts and concrete anchors shall be provided and signs anchored to sign posts generally as indicated on the drawings and specifically as submitted and approved on the shop drawings as meeting or exceeding the drawing requirements.

2.9 SINGLE-POST TRAFFIC REGULATORY SIGNS

- A. Signs shall be constructed of square tubular galvanized steel post or cast stone with an aluminum plate sign panel.
- B. Sign panel shall be a 2 mm (0.080") aluminum plate with surface applied reflective vinyl traffic regulatory decals. Panel, text & graphics shall comply with the Department of Transportation, Manual for Uniform Traffic Control Devices in color, shape, proportions, text and symbols.

Panel shall mechanically fasten to support post with tamper resistant fasteners. Onsite "STOP" signs shall use all caps, unless specifically directed otherwise by the Project Manager.

- C. Square tubular galvanized steel posts shall be a minimum thickness of 2.5 mm (12 gauge) finished as specified on the Drawing Detail(s). Cast stone posts size shall be as indicated on the drawings.

2.10 ELECTRONIC READERBOARD SIGN

- A. Outdoor, weatherproof, computer controlled LED display sign fully encased in its own aluminum frame, approximately 700 mm (28") high by 1600 mm (64") long, by approximately 200 mm (8") deep.
- B. Sign shall contain its own fan system to control heat and humidity in sign. Provide at least 75 mm (3") clearance below fan covers and fresh air intakes for proper circulation of air through the sign.
- C. LED Display:
 - 1. Rated 100,000 hours
 - 2. 128 x 48 pixel Red Lamp
 - 3. Full matrix display capable of presenting text in multiple character heights.
 - 4. Pixel luminance shall be viewable in direct sunlight.
- D. Message Capacity: Shall be such that a minimum of 60 different messages can be stored and scheduled to be displayed according to time and date.
- E. Connectivity to the controlling government PC shall be accomplished by RS232 or RS485 cable, phone modem, Ethernet or fiber optic line.
- F. Electrical requirements:
 - 1. Input voltage: 120V
 - 2. Input Frequency: 60 Hertz

2.11 BRONZE PLAQUES - SERVICE EMBLEMS - SEALS

- A. Furnish and install the Bronze Plaques, Emblems and Seals as indicated on the contract drawings. Bronze elements shall be cast of a lead free tin bronze, such as C900300 (Navy "G" Bronze) or similar alloy approved by the VA. The Bronze elements shall be BAS relief casting based upon the VA Drawing as submitted and approved.
- B. BAS relief castings shall be of uniform quality and condition, free from injurious blow holes and porosity, cracks and other defects and not warped or distorted, well finished, free from burrs, sharp edges, scratches and defects that may affect appearance or service ability. Casing shall not be repaired, plugged, welded or burned.

Finish to be detailed, hand chased for true alignment, filed, belt polished, sides ground smooth, raised surfaces and borders to be polished and buffed to a bright satin finish, background textures to be reverse medium pebble background, fine pebble background, moss as cast. Bronze to be chemically oxidized to a statuary medium color and finish with one coat of clear protective exterior metal lacquer. Fasteners to be corrosion resistant metal compatible with material or casting. Details for the size, thickness, content, and mounting for the Bronze signage elements shall be as indicated on the contract drawings and as described as follows:"

1. Service Emblem Plaques - The five bronze service emblem plaques shall be of the sculpted BAS relief style. The five emblems include one of each military branch: Army, Navy, Air Force, Marines and Coast Guard. Examples of previously accepted BAS relief sculpted casting molds are available at the manufacturer, United States Bronze, 811 Second Avenue, Hyde Park, NY 11040, telephone 516-352-5155, as a basis of design. Shop drawings, as well as samples of material showing color, texture and border, and photos of sculpted molds of all sculpted BAS relief elements shall be submitted for approval prior to fabrication.

2.12 PYLON STREET SIGNS

- A. Signs shall be non-illuminated posts with street name messages directed specifically to vehicles. They shall be cast stone, with location, materials, color, messages and configuration as indicated on the Drawings. Position sign to provide vehicles and pedestrians with a clear unobstructed view of the sign, or position according to the drawings, if so indicated. Unless indicated differently on the drawing details, the signs shall be as follows:

1. Cast Stone Pylon Street Signs
 - a. 190mm x 190mm x 1200mm (7.5" x 7.5" x4') above finished grade, and depth as indicated on the drawings.
 - b. The style for the posts shall have round ends cast into the four sides of the post. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels

- +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.
- c. The text panel shall be 3mm (1/8") thick powder coated aluminum with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.
 - d. The dimensions for the aluminum text panels shall be 93mm (3.75") wide with the text being 63mm (2.5") in height. The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete posts, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete sign post with the aluminum text panel, as complete. The approximate height for the aluminum text panels is 900mm (3'). Dimensions shown on detailed construction drawings shall take precedence over these specifications.
 - e. The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors.
 - g. Provide a concrete mow collar as specified herein.
- B. The approved shop drawings and sample(s) of the complete pylon street sign shall be the basis for manufacturing and assembly.

2.13 PYLON SECTION MARKERS

- A. Pylon section markers are non-illuminated type with messages directed specifically at vehicles and pedestrians. Markers can present a maximum of three characters on a side, as indicated in the drawing details. Position each marker to provide vehicles and pedestrians with a clear unobstructed view of the marker, or locate and orientate according to the drawings, where so indicated. Unless indicated differently on the drawing details, the markers shall be as follows:
- 1. Cast Stone Section Markers
 - a. 190mm x 190mm x 400mm (7.5" x 7.5" x 1'-4") above finished grade, and depth as indicated on the drawings.
 - b. The style for the markers shall have round ends cast into the four sides of the marker. The text panels shall be indented with beveled transition to the text panel mounting surface. The

mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.

- c. The text panel shall be 3mm (1/8") thick powder coated aluminum with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.
 - d. The dimensions for the aluminum text panels shall be 95mm (3.75") wide with the text being 75mm (3") in height. The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete pylon section markers with the aluminum text panel, as complete. Dimensions shown on detailed construction drawings shall take precedence over the specifications.
 - e. The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors.
 - g. Provide a concrete mow collar as specified herein.
- B. The approved shop drawings and sample(s) of the complete Pylon Section Marker shall be the basis for manufacturing and assembly.

2.14 FAUCET POST WITH SIGN

- A. Faucet posts with signs are non-illuminated pylon style with attached message and graphic decals. The decals are mounted directly on a separate metal panel attached to the cast stone post.
- B. The posts contain the water pipe and the spigot at the Flower Watering Stations. Details for the water pipe, appurtenances, and mounting are included in the related Section 32 30 00 SITE FURNISHINGS. Details for the water pipe and appurtenances are included in the related Section 33 10 00 WATER UTILITIES.
- C. The posts shall be cast stone and match finish and color of existing sign posts. Messages and configuration as indicated on the Drawings.

Position sign to provide pedestrians with a clear unobstructed view of the sign, or position according to the drawings, if so indicated.

1. Unless indicated differently on the drawing details, the faucet posts with signs shall be as follows:

a. Cast Stone Faucet Posts

- 1) 190mm x 190mm x 710mm (7 1/2" x 7 1/2" x 2'-4") above finished grade, and depth as indicated on the drawings.
- 2) The style for the markers shall have round ends cast into the four sides of the marker. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.
- 3) The text panel shall be 3mm (1/8") thick powder coated aluminum with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.
- 4) The dimensions for the aluminum text panels shall be 95mm (3 3/4") wide with the symbol being 75mm (3") in height and 30 mm (1 1/4") from top of text panel to the top of the symbol. The text height shall be 19mm (3/4"). The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete pylon section markers with the aluminum text panel, as complete. Dimensions shown on detailed construction drawings shall take precedence over the specifications.
- 5) The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors.

- D. "Do Not Drink" decal shall be as indicated on the drawing details, and as approved during the submittal process.
- F. Bronze escutcheon plate shall be included for the spigot assembly. See Section 32 33 00 and drawings.

2.15 CONCRETE MOW COLLARS OR STRIPS

- A. Reinforced concrete mow collars shall be provided for all new single elements in this Specification Section, where they are to be located in lawn areas and are not connected to another adjoining element. The requirements for the collars are as follows:
 - 1. Reinforced and free floating, concrete not in contact with the element.
 - a. As detailed on the drawings
 - b. Submitted and approved during the submittal process
 - c. Separated from the element with expansion joint material the full depth of the mow collar.
 - d. Closed steel rebar, with overlap at joint, 50mm (2") minimum distance from surrounding earth.
 - e. Minimum 10mm (#3) diameter rebar as enclosing the element or elements approximately 50mm (2") inside the perimeter of the concrete. On the strips, there shall be an additional bar in the middle between the elements that extends to within 50mm (2") from the closest parts of the adjoining elements.
 - f. Construct the collars to be 25mm (1") above finished grade at the junction with the lawn, and with a slope up toward the element(s) and or middle, for drainage, of 13mm (1/2") to 19mm (3/4").
 - g. Finish and color shall match existing.

2.16 DIMENSIONAL LETTERS

- A. Cast dimensional metal letters and numbers shall be aluminum.
- B. Color, finish and font type for the individual letters and numbers for the columbarium addressing shall match existing dimensional letters and numbers on the adjacent columbarium structures, as selected and approved during submittal review process.
- C. Letters to be mounted to stone masonry veneer walls shall be mounted based upon the wall construction. Before manufacturing the letters, a full sized template of the letters, with correct size and spacing, shall be placed on the wall at the correct location and temporarily secured. The letter template shall be marked for each letter

indicating where the joints are located immediately below the letter placement. The marking of the template is to locate where the relatively flat portions of the stones are below the letters so the pins can be manufactured and installed out of the joints between the stones. The template with the joint locations (or flatter portions of the stones) shall be provided to and/or used by the letter manufacturer so the pin placement supporting the individual letters can be adjusted and placed so the pins do not extend into the joints below the letters during the installation of the letters. Layout, size and spacing shall be as indicated on the drawings.

- D. Unless otherwise indicated on the drawings, dimensional lettering and numbers shall match the size and thickness of existing dimensional letters and numbers on the adjacent columbarium structures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist and set parallel or perpendicular as required to line and plane the surface.
- B. Signs shall be installed with direct burial of post into concrete or compacted aggregate as shown on Contract Drawings. Depth of posts shall be such that the bottom of the concrete or compacted aggregate surrounding the posts is at least below the frost, or as indicated in the drawings, whichever is the greater depth.
- C. Protect aluminum in contact with dissimilar metals or mortar as specified in Paragraph "PROTECTION OF ALUMINUM".
- D. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
- E. Provide anchoring devices and fasteners as shown and as necessary for securing signs to construction as specified.
- F. Utilize approved layout template for the installation of the cast metal lettering on the columbarium. Pins shall be securely anchored. Face of all lettering shall be in the locations as shown on the drawings.
- G. Verify that behind or beneath each sign location there are no utility lines, or other buried infrastructure elements, that will be affected by installation of signs. Any damage during installation of signs to

utilities, or other buried infrastructure will be the sole responsibility of the Contractor to correct and repair.

- H. 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.

I. ELECTRONIC READER BOARD SIGN INSTALLATION

1. Extend separate 2" power and communication wire electrical conduits from location of existing electronic reader board sign conduits where shown to location of new electronic reader board sign. Replace or extend all existing power and communication wiring as required from Public Information Building to location of new electronic reader board sign. Verify power and communication wiring requirements with sign manufacturer.
2. Install concrete footing and base to support electronic reader board sign. Verify sign location with RE. Install sufficient anchors in concrete in accordance with sign manufacturer's instructions to support sign and wind loads. Verify base dimensions with sign manufacturer.
3. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
4. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
5. Install new reader board sign in accordance with sign manufacturer's written instructions.
6. Conduct on-site sign maintenance and operation training session with cemetery personnel. Schedule session in advance to meet cemetery personnel schedules.

- J. Furnish and install concrete collars with reinforcing to prevent cracking as well as expansion joints around the posts, or other elements of this section installed in the lawn areas, to allow for movement due to frost action. The mow strips shall be set so they are parallel to the finished grade around the sign posts, so mowers can

drive around them without hitting the concrete, or going into a depression.

- K. Sign message panels shall be mounted using tamper-proof mechanical fasteners that are coated and colored to match the message panels.
- M. Mounting details and materials shall be provided as samples during the submittal process, and complete demonstration of all of the installation features, materials and methods shall be provided during the submittal process.

3.2 PLAQUE INSTALLATION

- A. Install plaques as detailed on Contract Drawings and as follows:
 - 1. For all plaques, a 25 mm (1-inch) diameter hole shall be drilled in the unit masonry or stone to receive the mounting pins. The plaque/emoles shall be attached with non-shrink grout placed into the holes with the plaques/emoles being set when the mortar is wet. Contractor shall hold the plaques until the mortar has set. The plaques shall be set no more than 6 mm (1/4 inch) from the mounting substrate and shall be set plumb. A template of the mounting pins shall be made for each installation and the locations transferred to the masonry or stone substrate and locations approved by the owner's designated representative before the mounting holes are drilled.
 - 2. Provide samples and drawings indicating all details of the installation as part of the submittal process. Submittals shall be revised and resubmitted until approved, and installation shall not proceed without approved submittals and/or samples.

3.3 CLEANING

- A. After installation, all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

3.4 PROTECTION

- A. Protect finished surfaces from damage during fabrication, erection and after completion of the work.

- -END- - -

**SECTION 11 83 00
GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)
REFERENCE SYSTEM**

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish all labor, materials, manpower, tools and equipment required to install, and make fully operational, a Global Navigation Satellite System (GNSS) Reference System. The installed system shall provide full Real Time Kinematic (RTK) coverage for the rover equipment, operating at centimeter-level (i.e. survey-grade) accuracy, at all developed portions of the cemetery and consist of the following equipment and facilities:
1. CORS Type Reference Station (to be referred to as "Base Station").
 2. Professional survey-grade GNSS handheld receiver systems (to be referred to as "Rover Units"). Provide one Rover Unit for each six (6) interments per day (estimated or using the previous year's rate), plus one Rover Unit as a backup, with minimum of three (3) Rover Units. Provide four (4) Rover Units to Sacramento Valley National Cemetery.
 3. Radio Antenna Facilities (RAF) for transmitting satellite corrections from the Base Station to the Rover Units. A radio survey will determine the number and locations of RAFs.
- B. The Base Station is to be a Continuously Operating Reference System (CORS) comprised of the following specific hardware and software components: a GNSS reference antenna, a GNSS receiver, UHF radio transmitter, transmitting antenna, voltage converter, cables and conduits necessary to link the system equipment. The Base Station will not be registered with the NGS as a fully approved CORS facility but is required to follow published guidelines for establishing and operating CORS.
- C. The Base Station shall be installed at a location recommended by the GPS Sales and Service Contractor within the cemetery satisfying both the requirements specified in the *NGS Guidelines for New and Existing CORS*, except for distance from other CORS sites, and suitable areas identified in the radio survey. If no such areas exist to suffice both requirements, the areas meeting to the NGS requirements will take precedence and adjustments to the RAF strategy will need to be made. The Contractor shall provide all required labor, materials, manpower,

tools and equipment necessary to furnish, install, test and certify a fully operational GNSS reference station as specified herein.

- D. The Base Station and Rover Units shall be an operating RTK system, capable of broadcasting corrections through UHF radio signals at 5 and 35 watt power. The radio frequency for the equipment shall meet VA approved radio frequency requirements and each RAF shall be approved by the VA Radio Frequency Spectrum Management Office for the system to be considered fully operational.
- E. The GNSS receiver shall be capable of utilizing Global Positioning System (GPS), Modernized GPS, and GLONASS satellite signals. The system shall be capable of code and phase measurements, internal raw data logging, raw data streaming, and have internal data storage capabilities.
- F. All field data collected by the Rover Units shall meet or exceed 1 centimeter accuracy standards as defined by the Federal Geographic Data Committee, Draft Geospatial Positioning Accuracy Standards, Part 2, Standards for Geodetic Networks.
- G. There will be at least one (1) RAF but more may be required depending on the result of a radio survey. The selected antenna location(s) shall be established in areas where respective signals combined produce full coverage for all developed areas of the cemetery. The antenna location(s) shall be confirmed and adjusted, as required, following the Contractor provided radio survey (if the survey hasn't been completed before bidding). The radio survey will be conducted with "leaves on" and used to determine suitable locations and elevations for each RAF. One RAF location shall be within a 200 foot cable run (signal booster is required for longer cable runs when necessary, as recommended by the equipment provider) from the Base Station. Additional antenna locations, as needed to provide complete coverage, shall function as radio repeater stations. If the radio survey determines that the location for one or more of the antennas needs to be on top of an existing building, then the mounting options, as recommended by the manufacturer, will be evaluated by the RE and A/E. All final antenna locations shall be approved by the RE and A/E, acceptable to the GPS equipment supplier/installer, and selected from within the areas determined suitable during the radio survey; taking into consideration the mounting of each antenna and the aesthetics of the mounted location.

- H. Any appurtenant work required to make the system fully functional shall be provided, including but not limited to furnishing and installing all required labor, materials, tools and equipment. The completed work shall be performed as much as possible to hide the equipment, conduit, wiring, mounting hardware, etc. and shall include restoration and/or repair of any disturbed materials and facilities to pre-work conditions. This appurtenant work shall also include: calibrating and testing all other required facilities and equipment to make the GNSS Reference System fully functional as described herein, including work that is covered in other specifications sections or indicated on the contract drawings.
- I. The Contractor shall provide training for the cemetery staff on the use and maintenance of all equipment, components, and software. This training shall be video recorded and made into a DVD for future use by the VA, and the Contractor shall provide O&M Manuals for all equipment. The O&M Manuals shall include specific procedures for operation of equipment provided under this contract and shall include photographs of equipment provided for this project.

1.2 RELATED WORK

- A. See Section: 32 12 16 Asphalt Paving
- B. See Section: 03 30 00 Cast-in-Place Concrete
- C. See Section: 32 05 23 Cement and Concrete Work for Exterior Improvements
- D. See Section: 26 05 33 Raceway and Electrical Boxes
- E. See Section: 31 20 00 Earth Moving
- F. See Section: 11 83 02 GNSS & GIS Mapping and GeoData

1.3 REFERENCES

- A. The entire installation shall comply with all local and state laws and ordinances, and with all established codes applicable thereto.
- B. In all cases where the specifications require that the work be performed under the direction and/or inspection of the Resident Engineer, notify the Resident Engineer at least 24 hours in advance of the time when such inspection and/or direction is required. Any alterations to the system needed because of the Contractor's failure to have the required inspections shall be performed at the Contractor's expense.
- C. National Geodetic Survey, Guidelines for New and Existing Continually Operating Reference Stations (CORS), January 2013.

- D. Federal Geographic Data Committee, Draft Geospatial Positioning Accuracy Standards, Part 2, Standards for Geodetic Networks - FGDC-STD-007.2-1998.
- E. US Army Corp of Engineers EM 1110-1-1002 Survey Markers and Monumentation.

1.4 SUBMITTALS

- A. Provide manufacturer's literature and specifications of system components for review by RE and A/E.
- B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Complete shop and installation drawings of all GNSS system components, showing dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorages, attachments, location of all conduit and other items to be installed in the work of other trades, joint treatment, and other work required for a complete installation.
- C. Provide product information, O&M manuals and any additional paperwork associated with each system component, individually tabbed for ease in location, and the entire system in triplicate in separate three-ring binders for Government records. Provide a photo documented record of the installation, with each pieces of equipment identified and referenced to the applicable tabbed location in the three-ring binders. Include in the Appendix a list of all devices with their make, model, and serial number.
- D. Include in the O&M manual a troubleshooting list of items to check in the event of problems with the normal operation of the equipment, or system failure. The equipment in the troubleshooting list shall also be photo documented with the actual equipment installed for this project. Provide the owner with a step by step guide of operational checks to try and fix problems, prior to calling technical support.

1.5 QUALITY CONTROL

- A. Have a competent superintendent satisfactory to the Resident Engineer, with authority to act in all matters pertaining to the installation of the project work, present on the project site during all installation activities.
- B. Coordinate all work with other site contractors and the RE.
- C. The Base Station installation, including the calibration, startup, testing, and all activities needed to make the station fully functional and operational with the rover units, as well as transferring

information to and from the TerraFlex servers, shall be coordinated with the GPS equipment supplier and the GIS contractor for this project. The Contractor shall insure that appropriate quality control is provided throughout the construction process, up to the turn-over of the fully functional GNSS reference system for this project, as required to insure that the end result meets the performance specifications for the GNSS reference system being provided.

1.6 SITE CONDITIONS

- A. Submission of an executed proposal shall be considered evidence that the site, plans and specifications as issued, and/or legally modified, have been examined and accepted.
- B. Report to the Resident Engineer any deviations between contract documents and actual conditions. Failure to do so prior to the installation of equipment and which results in the replacement and/or relocation of equipment shall be at the Contractor's expense.
- C. The exact location of all new and existing utilities and structures may not be indicated on the drawings; their locations shall be field verified by the Contractor prior to starting work, and installation of work shall proceed so as to prevent interruption of service or damage to them. Protect existing structures and utility services and replace, at no cost to the Government, if damaged. Where conflicts occur, notify the Resident Engineer of any relocation required to complete the work of this contract.

1.7 GUARANTEE

- A. The furnished and installed operational GNSS reference system shall be capable of providing Real Time Kinematic (RTK) corrections for the roving GNSS handheld receivers as described herein.
- B. Contractor shall demonstrate complete site coverage radio operation for Real Time Kinematic (RTK) system operation prior to VA acceptance of installation. The system components shall be guaranteed as operational in every detail, except for power interruption, for a period of five (5) years from the date of its acceptance. Provide any required labor, manpower, tools, materials and equipment required to repair and/or replace any contractor provided elements of the functional GNSS reference system within that five year period with no cost to the owner.

1.8 ACCEPTANCE

- A. Acceptance of the CORS Base Station facilities and the Rover Units will result only when the installed system has been demonstrated to function as specified herein. The acceptance of the above systems shall require approval of the radio broadcast frequency by the VA Radio Frequency Spectrum Management Office, demonstration that data collection using the Rover Units as described in the contract documents can be achieved, and the data is accessible in NCA's Trimble TerraFlex account in the cloud. Prior to requesting final inspection of equipment, contact the Resident Engineer to review installation of hardware, software, cable and conduit runs, demonstrate the functionality of the equipment, and schedule staff training.
- B. The training for the use of the system equipment shall be performed after final acceptance of the training materials by the RE and when the equipment can be utilized with the GIS data, as specified in Section 11 83 02. The training program shall not be considered complete until after the O&M Manual has been submitted and approved in its final form.

PART 2 - MATERIALS**2.1 GNSS REFERENCE SYSTEM EQUIPMENT**

All equipment and accessories will be brand new, unused, and not reconditioned, remanufactured, nor recertified.

A. GNSS Receiver for Base Station

Hardware and Software shall be from a single manufacturer. Basis of design is the Trimble NetR9 Ti-1 Reference Station w/Zephyr Antenna or approved equal.

1. GNSS Receiver shall process multi-bit analog-to-digital conversion and Surface Acoustic Wave (SAW) filter at both RF and IF frequencies to provide anti-spoofing performance.
2. The GNSS Receiver shall, after the loss of satellite signals, provide re-acquisition of both L1 and L2 signals within 15 seconds.
3. Electronics shall be 100% fully sealed from sand, dust, and moisture.
4. Shall be able to operate to measurement specification in temperatures between -40 degrees F to +149 degrees F.
5. Shall not be less than 100% condensing humidity proof.
6. Connectors shall fully seal the receiver when a like-connector is attached.

7. Power requirements shall be in the range of 9.5 V DC to 28V DC external power input with over-voltage protection.
 8. The GNSS Receiver shall support simultaneous signal tracking of all:
 - a. GPS: L1C/A, L2C, L2E, L5
 - b. GLONASS: L1C/A, L2C/A, L3CDMA
 - c. SBAS: L1C/A, L5
 - d. Galileo L1CBOC, E5A, E5B, E5AltBOC
 9. When Anti-Spoofing (A/S) (P-code) is activated, the GNSS Receiver shall measure L1 C/A pseudo ranges, L2 and L5 range measurements, and the full cycle L1, L2 and L5 carrier phases.
 10. The GNSS receiver shall contain a high-precision multiple correlator for L1, L2 and L5 pseudo-range measurements.
 11. Performance of receiver shall not be lower during times when anti-spoofing is activated, compared to during times when anti-spoofing is not activated.
 12. The GNSS receiver shall employ multipath mitigation techniques.
 13. All damaged or rejected materials due to defect or non-conformance shall be removed from the site.
- B. Radio Transmitter for Base Station
- Basis of design is the Trimble TDL 450H Radio or approved equal.
1. Radio to transmit the satellite corrections from the base station shall be of the same manufacturer as the Base Station GNSS receiver.
 2. All radio equipment must be able to broadcast in the UHF 406 MHz to 420 MHz frequency range.
 3. All radio equipment shall be dustproof.
 4. Radio must be able to withstand operating temperatures of -40 degrees F to +149 degrees F.
- C. Antenna Mount and Support Hardware
1. Roof-based mounting is the preferred mounting choice and should be used when mounting options conforming to NGS roof-based monument guidelines are available. Should the roof-based mounting option not be available then reinforced concrete pier foundation shall be installed per drawings at the location specified on contract drawings.
 2. All necessary hardware, conduits, junction boxes and fittings required for a complete and functional system in accordance with manufacturer's recommendations and NGS CORS guidelines shall be provided.

3. Roof-based mounts shall be made of stainless steel and mounted per NGS CORS guidelines to the building. Ground-based mounting will use Earl Conic eight (8) foot stainless steel mast, with a four place reinforced gusset system along the lower four (4) feet of the mast. All hardware for fastening the mast to the foundation shall be included and be specified according to manufacturer.
4. A NGS approved leveling & orientating device is to be used to mount the GNSS Antenna to the monument.

D. GNSS Antenna

Basis of design is the Trimble Zephyr Geodetic 2 GNSS Antenna or approved equal.

1. GNSS antenna shall be of the same manufacturer as the base station receiver and capable of receiving all satellite signals the base station receiver is required to track.
2. Quality signal tracking, even below 5 degrees elevation.
3. Four point antenna feed for phase center stability and enhanced polarization.
4. Small cross-sectional area to reduce wind loading.
5. 13 dB amplifier margin supports cable runs of over 60 m without special coaxial cable on in-line amplifiers.
6. North orientation marking on exterior.
7. 50 dB signal gain for reliable tracking in difficult environments.
8. Low voltage, low power consumption.
9. Integral low noise amplifier.
10. 5/8" x 11 female threaded stainless steel mount point.
11. Powered by GNSS receiver via coaxial cable.
12. Advanced LNA (low noise amplifier) to reduce jamming by high power out-of-band transmitters.
13. Stealth Ground Plane - integrated lightweight stealth technology with enhanced right hand
14. 100% humidity proof and fully sealed.
15. Meets MIL-STD-810-F to survive a 2 meter drop onto concrete.
16. Operating temperature (-40 to +158 degrees F)

E. Handheld GNSS Receivers and Data Loggers

Basis of design is the Trimble R2 GNSS Receiver(RTK Rover, GPS/GLO/GLA/BEI, UHF Rx, NMEA) used with an Trimble TDC100(4G) running Trimble TerraFlex data collection software.

1. Each Rover Unit (mobile GNSS receiver and data logger combination) shall receive correction signals from the on-site Base Station, via a built-in radio receiver, and provide real time positional accuracies within the manufacturer's published horizontal and vertical positioning accuracy on all parts of the property.
2. The GNSS antenna for the rover shall be able to track GPS, GLONASS, Galileo, BeiDou, QZSS satellites.
3. The GNSS antenna for the rover shall be of the same manufacturer as the Base Station receiver.
4. The GNSS receiver shall be capable of utilizing Trimble's CenterPoint RTX correction service.
5. The horizontal accuracy classification shall be a one (1) centimeter horizontal accuracy at the 95-percent confidence interval.
6. The data logger will have an integrated camera with an integrated flash, autofocus, at least 5 megapixels, and can tie photographs to the captured position.
7. The GNSS receiver shall use a rechargeable and removable battery. Extra batteries to provide full day of use shall be provided for each component. The data logger should use a rechargeable battery that will provide a full day of use off a full charge.
8. Data logger and GNSS receiver shall connect via integrated Bluetooth to remove the need for cables. The option for Bluetooth discoverability by devices other than rover components shall be disabled.
9. The data logger shall be 3G/4G enabled with a major cellular carrier and have 24 months of cellular data prepaid to allow for real-time synchronization of data with the software cloud services.
7. All rover components shall meet or exceed IP65 rating. A case may be used for the data logger to meet this requirement.
8. Rover GNSS receivers shall be able to withstand a 2 meter drop onto concrete.
9. Rover data loggers shall be able to withstand a 1.22 meter drop onto concrete. A case may be used for the data logger to meet this requirement.
10. All rover components shall have an operating temperature range of at least -4 degrees F to +122 degrees F.
11. The system shall include a ruggedized carry case for each rover that both protects the rover and provides storage while in the field.

12. An accessory kit with a 2 meter carbon fiber snap-lock rover pole, with thumb-release bipod, pole storage bags, alternate rubber foot pads or spike caps for all pole legs, and a data logger mount shall be included for each rover.
13. The data logger shall be loaded with the latest version of Trimble TerraFlex and have a one year subscription beginning the day of acceptance to be added to NCA's existing Trimble account.

2.2 SYSTEM CONTROL BOX

A. General

1. The base station receiver and radio shall be installed in a rack enclosure storage cabinet, similar to the Tripplite SRW6u Wall Mount Rack Enclosure. The control box shall be mounted in the selected location, shall have a painted 1" thick panel board mounted inside of the control box for mounting the equipment. Inside of the control box shall be an uninterrupted power supply (UPS) capable of providing 30 minutes or more of power to the GNSS receiver and radio. The size of the control box shall be no larger than 3 feet wide by 3 feet high, by 2 feet deep. It shall include a locking door.
2. The control box shall provide a secure location for equipment placement and ventilation for continuous system operation.
3. All connections to hardware shall be made in accordance to component manufacturer specifications, including length of cable, type of cable and connection types. No modifications to cables, connections or installation shall be made that would void component manufacturer warranties.
4. Technical instructions on troubleshooting the system and restarting after power failure, shall be created and installed by the Contractor on the inside door of system control box.

2.3 CABLE AND CONDUIT CONNECTIONS

- A. Design basis for cable shall be the Times Microwave LMR 600 Flooded DB (direct bury) coaxial cable, or approved equivalent.
- B. Furnish and install antenna signal amplifier as indicated on drawings. Basis of design is Model LA20RPDC by GPS Networking Inc. (Denver CO).
- C. See Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS, for conduit specifications.
- D. Provide grounding and lightning protection as shown on contract drawings.

2.4 REFERENCE MONUMENTS**A. General**

1. Five (5) survey monuments shall be installed being a minimum 3.5 inches in diameter, with a 1/2 inch minimum metallic rod centered within the concrete, running the length of the monument. The monuments shall be a minimum 3 feet in length.
2. Monument locations shall be installed in a stable surface that is not subject to effects of geologic and soil activity in the region, in accordance with contract drawings and reference provided in paragraph 1.3. Monuments must be highly visible away from vegetation, floodplain, or man-made structures that are subject to movements, etc.
3. The Contractor shall submit a map of permanent survey markers installed with the applicable coordinates along with temporary benchmarks (i.e. PK nails, etc.) required by this contract.

PART 3 - EXECUTION**3.1 SITE CALIBRATION AND QUALITY CONTROL**

- A. Static satellite observations shall be made on all five (5) reference monuments, with a minimum of two (2) hours of static data being collected on each monument, with a geodetic grade GNSS receiver.
- B. Static observations shall be collected on the GNSS Reference Station simultaneous to all reference monuments being observed, to ensure simultaneous data is collected on both the reference station and all reference monuments for final evaluation and approval of adjusted coordinates.
- C. All static observations shall be submitted to the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) for calculation of state plane coordinates, using the State Plane Coordinate System.
- D. Adjusted coordinate values as obtained from the NGS OPUS adjustment shall be used as record coordinates for the CORS Reference Station and on any future data collection of stakeout of site facilities.
- E. The Contractor shall install the record coordinates in the CORS Reference Station firmware, and initiate broadcast signals. All reference monuments shall be navigated to using the record coordinates obtained from OPUS. The residual error shall be noted by the Contractor and certified to be within tolerances set forth in specification documents.

F. A/E shall provide CAD files to the Contractor at NTP for use in building the GIS maps. The Contractor shall populate the maps with geodata per geospatial standards as work progresses. The early turn over area and features must be provided in GIS format prior to transferring the area to the cemetery so the cemetery may start tracking interments and populating the GIS database.

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**SECTION 11 83 02
GNSS & GIS MAPPING AND GEODATA**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The contractor shall collect GeoData with Global Navigation Satellite System (GNSS) coordinate locations and elevations for the work to be performed as part of this project. The collection of GNSS coordinates and elevations shall comply with the requirements of Section 11 83 00 GNSS.
- B. The contractor shall collect the GeoData for the features indicated in Part 2 for the new work being performed as part of this project. The net result shall be a complete newly created collection of GeoData for the specific identified features within the developed portions of the cemetery at the end of the project.
- C. The specific means and methods for collecting the GeoData shall be as described herein with the features being displayed as points, lines, polylines or closed polygons with the applicable symbology, line types, layers and colors in accordance with VA Geospatial Data Standards referenced below.

PART 2 - MATERIALS

2.1 GENERAL

- A. For this specification section, the production of the electronic information that shall be provided as an ArcGIS File Geodatabase are referenced as materials.
 - 1. GIS information from the contractor work areas for the project. The representation of the work constructed by the contractor as part of the project, is collected according to standards established herein, where the contractor shall produce detailed description and representation of the system for data collection, documentation and transfer to GIS format.
 - 2. The various elements within the work area to be collected shall be represented using the VA Geospatial Data Standards. The data associated with the polyline elements shall be as indicated below for the respective elements constructed, with the date of installation, (month and year) being provided for all new work materials. The contractor shall coordinate the field collected data for assimilation and configuration into the GIS format. The contractor shall be responsible for providing the means and methods for achieving the end results for the data indicated herein.

2.2 DESCRIPTION OF DATA COLLECTION BY ELEMENT TYPE

A. The data collection for the new project work areas shall be consistent for the same types of entities in each location. The following paragraphs describe the site elements and the way they should be indicated in the GIS mapping, as well as indicating the information that should be included in the GeoData for the respective elements being represented.

1. GIS data for the contractor constructed areas in the project area. All facilities constructed in the project area shall be documented to the level required in Section 11 83 00. The information for the elements being represented shall be identified to the level of 1 centimeter and 2-centimeter accuracy for the horizontal and vertical coordinate, respectively. A geodatabase template for all required features and associated data will be provided to, and be used by, the contractor. Unless otherwise noted, all unique IDs needing to be generated must use the three-digit cemetery ID (AKA station number), followed by a hyphen, as a prefix for the ID (e.g. XXX-).

a. Points

- 1) Gravesite Grid Monuments- The features within the burial areas established to allow the staff to find their location within each burial section using taped measurements offset from reference lines between these monuments. A unique ID will be generated using the cemetery ID, burial section, "GGM" designation, and a sequential number starting at 1 for the monument closest to the street and left side of the section as viewed from the closest street (e.g. CEMETERYID-SECTION-GGM-X).
- 2) Burial Section Markers - Permanent above ground markers with the identification of the burial section number (typically two per burial section). A unique ID will be generated using the cemetery ID, burial section, "BSM" designation, and a sequential number starting at one (1) for the monument closest to the street and left side of the section as viewed from the closest street (e.g. CEMETERYID-SECTION-BSM-X). A digital photograph of the section marker shall be taken and attached as part of the data for the feature.
- 3) Trees and Shrubs - All trees six inch (6") caliper or smaller, and shrubs two foot (2') diameter and smaller, within the

developed portion of the cemetery. Data is to include genus, species, and common names. For larger trees and shrubs see the requirements for closed polygons.

- 4) Signs - All sign posts, pads, and panel assemblies shall be collected as a point feature. For pads and panel assemblies, the point is to be the center of the feature. Data is to include signage type, installation date, material, sign text, and reverse side text. Unique identification shall be provided. Each sign shall be digitally photographed at the completion of its installation and the image shall be attached as part of the data for the point. A unique ID will be generated using the cemetery ID, "SIGN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-SIGN-X).
- 5) Irrigation Structures - the actual locations for the installed sprinkler heads, valves, controls, fittings, quick couplers, flower watering spigots, and all other irrigation system components shall be collected. Information on the type, make, model, size, and material shall be included as installed. A unique ID will be generated using the cemetery ID, "IRR" designation, and a sequential number starting at 1 (e.g. CEMETERYID-IRR-X).
- 6) Flags Sleeves (A.K.A. Avenue of Flag Sleeves) - The installed sleeves for displaying flag for special days and events, located along the roadways throughout the cemetery. Unique identification shall be provided using the "FS" designation along with the cemetery ID (e.g. CEMETERYID-FS-X).
- 7) Utility markers - The above ground markers indicating the location of a utility line, easement, or no dig areas around the underground utility lines. This is to include markers indicating locations of gas, water, sewer, telecommunication, and electric utilities.
- 8) Monument Points - Monuments, pins, or other markers set by surveyor to identify the cemetery boundary property line. Information about each point shall include type, designation and monument ID (if applicable), installation date, survey date, installation contractor name, northing, easting, and elevation in the local state plane coordinate system. Unique

- identification shall be provided using the "SM" designation along with the cemetery ID (e.g. CEMETERYID-SM-X).
- 9) Cemetery Entrance – The point location of the main cemetery entrance within the cemetery boundary to be used as the geocode address point. The cemetery entrance point will hold all cemetery information including cemetery ID, cemetery name, mailing and physical addresses, phone numbers, and other administrative information.
- 10) Water Utility Structures – the actual locations for the installed water hydrants, fire hydrants, valves, fittings, wells, and all other water system components shall be collected. Information on the type, make, model, size, and material shall be included as installed when applicable. A unique ID will be generated using the cemetery ID, "WATER" designation, and a sequential number starting at 1 (e.g. CEMETERYID-WATER-X). Fire hydrant data should also include the configuration of the hydrant, including the threaded connections, an attached photograph and if available, fire flow test. A digital photograph of spigots shall be taken and attached to the data file that show the completed installation as well as the configuration of the piping with the materials identified prior to installation, so the operations staff can order replacements as needed in the future.
- 11) Sanitary Sewer Structures – the actual locations for the installed sanitary sewer or septic system manholes, cleanouts, pumps, and other sanitary sewer components shall be collected. Information on the type, make, model, size, elevations, and material shall be included as installed when applicable. A unique ID will be generated using the cemetery ID, "SAN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-SAN-X). A digital photograph of the interior of all manhole structures shall be taken and attached to the data file, with the outlet always at the bottom of the picture.
- 12) Storm Sewer Structures – the actual locations for all installed storm sewer junction boxes, catch basins, outlets, weir boxes, and other storm sewer components shall be collected. A digital photograph of headwalls, in addition to the interior of all junction boxes, inlets, and catch basins,

shall be taken and attached to the data file, with the outlet always at the bottom of the picture. Information on the type, make, model, size, elevations, and material shall be included as installed when applicable. A unique ID will be generated using the cemetery ID, "STORM" designation, and a sequential number starting at 1 (e.g. CEMETERYID-STORM-X).

- 13) Electrical Structures – the actual locations for all installed electrical transformers, duct banks, boxes, and other electrical features shall be collected. Information on the type, make, model, size, elevation, and material shall be included as installed. A unique ID will be generated using the cemetery ID, "ELEC" designation, and a sequential number starting at 1 (e.g. CEMETERYID-ELEC-X).
- 14) Gas Structures – the actual locations for all installed gas fittings, valves, meters and other gas features shall be collected. Information on the type, make, model, size, elevation, and material shall be included as installed. A unique ID will be generated using the cemetery ID, "GAS" designation, and a sequential number starting at 1 (e.g. CEMETERYID-GAS-X).
- 15) Flagpoles – Points representing the location of permanent flagpoles within the cemetery. The data associated shall indicate the type of flag flown, the size of the flag, the height of the pole, material of the pole, model, and the manufacturer for the pole. A unique ID will be generated using the cemetery ID, "FP" designation, and a sequential number starting at 1 (e.g. CEMETERYID-FP-X).
- 16) Lighting – the locations for all exterior lighting to include lighting for landscaping, signage, pathways, and streets within the cemetery. Attributes for each point shall include the lighting type, installation date, and a unique ID will be generated using the cemetery ID, "LIGHT" designation, and a sequential number starting at 1 (e.g. CEMETERYID-LIGHT-X).
- 17) Interment – Feature class to hold GNSS location records of each interment. Attributes fields shall include the name of the interred, interment date, section, row, wall, gravesite number, BOSSID (unique ID), position accuracy type, and observer name and notes. A photograph of the tag and remains

(casket/urn), once placed in their final resting place, will be associated with each interment.

- 18) Gravesite Marker – The GNSS location of each headstone installed. Attributes shall include installation date, marker type, section, row, wall, gravesite number, position accuracy type, and observer name and notes. Photographs of the front and back will be associated with each feature once installed after each interment. The GRAVESITE_ID is a combined key and will serve as the unique ID (CEMETERYID-SECTION-WALL-ROW-GRAVESITE).
- 19) Benches – A point representing the GNSS location of each bench installed. The data for benches shall include one digital photo of one of the bench, as well as the manufacturer make and model number. A sequential unique ID shall be created for each bench (e.g. CEMETERYID-BENCH-X).
- 20) Bollards – The GNSS location for each bollard and the elevation at the ground surface shall be provided. The data shall indicate the top elevation of the bollard, diameter, material, and paint manufacturer and color. A sequential unique ID shall be created for each bollard (e.g. CEMETERYID-BOLL-X). If the bollards are covered with plastic, the make and manufacturer shall also be indicated in the data.

b. Polylines

- 1) Water lines – Location of the waterlines, along the centerline on top of the pipe (maximum 50 foot intervals), with GNSS location and elevation shots at each change in direction or elevation, at all fittings, valves and any appurtenances. The data associated with the polyline should include the pipe material, size, and class of pipe. Each fitting, valve or appurtenance shall be identified in the data for the respective location and shall include the size, material, type of joint and class of the fitting, valve or appurtenance. A unique ID will be generated using the cemetery ID, "WATERLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-WATERLN-X). Lines are to be snapped to fittings.
- 2) Sanitary Sewer Lines – Location of sanitary sewer gravity lines and sanitary sewer force mains shall be provided along the top centerline of the pipes when outside of structures.

The data shall indicate the size, type and pressure class for the pipe installed, as well as the joint type. For the force mains, any changes in direction or elevation shall be location points for the installed pipe. Same information shall be provided for the data on the pipe. Provide upstream and downstream invert elevations at all junctions. A unique ID will be generated using the cemetery ID, "SANLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-SANLN-X). Lines are to be snapped to fittings.

- 3) Storm System Piping - Location of the storm drain pipe lines between structures, or between structures and daylight outlets, shall be located along the top of the pipe. Attributes shall include the installation date, size, material, and pressure rating for the pipe, and the joint type. Provide upstream and downstream invert elevations at all junctions. A unique ID will be generated using the cemetery ID, "STORMLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-STORMLN-X). Lines are to be snapped to fittings.
- 4) Electrical lines - direct bury electrical lines, electrical lines in conduit, direct bury control wiring, control wiring in conduit, ground wires, phone lines, or any other buried wiring. Along with the location and depth for these lines, the data should identify the type, size, purpose, conduit size, whether the information is for the conduit, wire, or encasement of the conduit. Any overhead lines and poles that are in or through the contract work area for the project shall also be located and identified. A unique ID will be generated using the cemetery ID, "ELECCLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-ELECCLN-X). Lines are to be snapped to fittings.
- 5) Gas lines - Location of all gas lines in the developed portion of the cemetery. Centerlines should be used for location. Installation date, depth, material, and size for the lines should be identified. A unique ID will be generated using the cemetery ID, "GASLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-GASLN-X). Lines are to be snapped to all fittings.

- 6) Fencing – All permanent fencing in the project construction area with the data regarding the type and details for the fencing being included.
- 7) Contour lines – The as constructed contour lines, major and minor, with elevation and creation date attributes at 1 foot contour intervals.
- 8) Streams – All perennial, intermittent, and ephemeral streams, creeks, and rivers within, or touching, the cemetery boundary will be provided. Included in this will be the stream type and local name if available. A unique ID will be generated using the cemetery ID, "HYDROLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-HYDROLN-X).
- 9) Expansion Joints – Lines representing the joints between individual pavement and sidewalk features. The data for the expansion joints shall indicate the materials used for the joint construction as well as the date of installation. A unique ID will be generated using the cemetery ID, "EXPANLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-EXPANLN-X).
- 10) Irrigation Lines – Cemetery layout of all irrigation lines with polylines snapped to and split at each irrigation structure and fitting. The data associated with the polyline should include the pipe material, size, depth, and class of pipe. A unique ID will be generated using the cemetery ID, "IRRLN" designation, and a sequential number starting at 1 (e.g. CEMETERYID-IRRLN-X).

c. Closed Polygons

- 1) Pavement- The roadways, sidewalks, paths, stairs, handicap access ramps, plazas, and curb areas within the developed site shall be documented with the GNSS equipment. When pavement areas can be differentiated by time of installation, they should be individually included as separate closed polygons, with the appropriate date of placement indicated in the data for the area. The entire roadway pavement, parking areas, maintenance yard, shall be documented with closed polygons that adjoin to provide a complete area for the entire pavement, when selected. Curbs shall be differentiated by changes in the curb type, age, etc. and the appropriate information differentiating the various areas shall be included in the data associated with the closed polygons. Sidewalks shall be done like curbs, with the different types, surfaces, ages, etc. being created as separate closed polygons. The closed polygons shall be created to adjoin each other, without breaks or overlaps so the selection of all will provide the cumulative square footage for the surface type. Individual closed polygons shall be created representing the distinct concrete elements of plazas surrounded by expansion joints or open sides to planter beds, lawn, etc. The closed polygons shall be created to differentiate differing materials used in the creation of the plaza. The data for the individual closed polygons shall indicate the date of construction and the material and finish for the specific closed polygons. A unique ID will be generated using the cemetery ID, "PAVEPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-PAVEPOLY-X).
- 2) Turf Grass - The closed polygons for the lawn areas shall be created based upon the different types of lawn area (seeded, sod, different times for installation, differing mixes, etc.). A unique ID will be generated using the cemetery ID, "TURFPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-TURFPOLY-X). The closed polygons shall be created to adjoin each other, without breaks or overlaps so the selection of all will provide the cumulative square footage for the lawn area.

- 3) Landscape Beds - Closed polygons shall be created for each individual planter bed. Each Planter bed shall be assigned a unique identification designation using the cemetery ID, "BEDPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-BEDPOLY-X).
- 4) Gravesites - Gravesite plots shall have individual closed polygons that have been created to the nominal size for the plot in the specific area. Example, the crypt field burial plots shall be created as standard size of (3' x 7'-8" or 3' x 8'-0") and the oversized crypt plots shall be created (4' x 10'). Each burial plot shall also be provided with a unique identification (CEMETERYID-SECTION-WALL-ROW-GRAVESITE) stored in the Gravesite ID field. The same closed polygon feature shall be created for each in-ground cremains plot, columbarium wall niche, memorial plot, and memorial wall marker. Text fields associated with burial plots shall be provided for the following: section, row, wall, gravesite number, and comment. Domain fields associated with burial plots shall be provided for the following: position source, gravesite type, gravesite size, gravesite status.
- 5) Burial Sections - The burial sections should be represented as closed polygons delineating the area for each section with the burial section attributed as the unique ID (e.g. CEMETERYID-SECTION).
- 6) Site Walls - The site walls shall be located with the GNSS equipment at the top of the caps (or for the base, if the wall does not have any caps), at the edges of the caps at the center of the joints between the caps. The joints between the caps shall be indicated as lines or polylines as separate elements, so they can be evaluated as to length for replacement (see expansion joints lines). The date of installation of the products as well as the identification (Manufacturer and model) and color of the product shall be included in the data for the element. A unique ID will be generated using the cemetery ID, "WALL" designation, and a sequential number starting at 1 (e.g. CEMETERYID-WALL-X). Site walls are to include for all wall types to be found at the site, including, seat walls, retaining walls, decorative walls

and any other types not listed. The GNSS location information for the walls shall provide accurate position for the walls within the cemetery, and shall provide accurate location for the visible top of the walls. The elevation information shall be for the finished grade below the points indicated for the tops of the walls.

- 7) Buildings and Structures – Provide closed polygons representing the exterior wall lines for the buildings as they exist at the ground surface including any decking, exterior stairs, or platforms. For new and existing buildings, provide a set of exterior photos with views of each of the exterior walls that can be accessed as data for the closed polygon. Include the date of completion for work completed as part of the project, original construction date for existing buildings, building type, and a sequential unique ID for each building (e.g. CEMETERYID-BLDG-X).
- 8) Fuel Storage Tank/Dispenser – The closed polygon shall indicate the footprint for the tank and fuel dispenser system. Data shall indicate the size, type, number and size of chambers, manufacturer, contact for servicing, as well as photo(s) of the tank system. A unique ID shall be created for each tank (e.g. CEMETERYID-FUELPOLY-X).
- 9) Materials Storage Bins – The footprint for the storage bins shall be delineated, with each bin being a separate closed polygon. Data shall identify the date of construction, and shall include digital photo(s) of the installation. A unique ID shall be created for each bin (e.g. CEMETERYID-BIN-X).
- 10) Easements – Closed polygons shall be created to identify the best known location for any easements. Data shall indicate what the easement is for.
- 11) Cemetery Boundary – Closed polygon(s) representing the legal property line(s) of the cemetery.
- 12) Sanitary Sewer Polygon – Closed polygon(s) representing larger sanitary sewer features such as septic leach field or septic tank. The piping into the leach field or absorption bed shall be included in an overall closed polygon of the outside of the area of the system. Data will include the piping configuration of the system, number size and length of

laterals installed, in addition to photo(s) of the installation prior to backfill, with the pipes indicated. A unique ID will be generated using the cemetery ID, "SANPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-SANPOLY-X). Septic tank features shall indicate the footprint for the septic tank and the elevation at each of the corners on the top. The finished grade elevation above the corners shall be included. The data shall include digital photographs of the installation, prior to backfill showing the pipe routing, the access opening(s), and interior photos of the inlet and outlet pipe configuration. Coating information and date of installation shall be included in the data.

- 13) Storm Sewer Polygon – Closed polygon(s) representing drainage areas such as retention or detention ponds. Data shall include capacity, top elevation, and bottom elevation. A unique ID will be generated using the cemetery ID, "STORMPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-STORMPOLY-X).
- 14) Water Feature Areas – shall include closed polygons of natural and manmade lakes, ponds, and wetlands, except for storm water ponds, located in or touching the boundary of the property. A unique ID will be generated using the cemetery ID, "HYDROPOLY" designation, and a sequential number starting at 1 (e.g. CEMETERYID-HYDROPOLY-X).
- 15) Tree Areas – Closed polygons representing wooded areas within the cemetery property boundary and solitary trees greater than six inch (>6") caliper not within a wooded area. Data is to include diameter (in inches), genus and species, and common name for individual trees, in addition to providing a sequential unique ID (e.g. CEMETERYID-TREE-X). Except for the diameter and ID, the same is to be included for the dominant species of wooded areas.

2. AERIAL PHOTOGRAPHY

- A. The GIS configuration shall include georeferenced and orthorectified aerial imagery, with a pixel size no greater than 4 inch, of the cemetery project areas under this contract. The contractor shall demonstrate a sample of the imagery to VA for approval prior to purchasing. The imagery

dataset shall include an image depicting the baseline cemetery conditions, prior to this project. Upon completion of the project, during the 11 months following acceptance of the work, the contractor shall have the entire developed portion of the cemetery flown as a second image, with leaf off conditions and no snow on the ground. All imagery shall be flown with survey ground control so images can display the work installed as part of this project, with 1 centimeter accuracy GPS coordinate "As-Built" drawings overlaid.

PART 3 - EXECUTION

3.1 GENERAL

- A. The required GNSS/GIS work shall result in a fully integrated GIS/GNSS system with covering entire developed portion of the cemetery. The GIS elements that are created by the contractor as part of this work shall be sufficient to allow the display of the cemetery with improvements visible on ArcGIS mapping software.
- B. The various elements that will be used to depict the site using the GIS mapping are to be made up of points, polylines and closed polygons that shall be created and displayed by the contractor.
- C. A/E shall provide CAD files to contractor at NTP for use in building the GIS maps. The contractor shall populate the maps with geodata per Geospatial standards as work progresses. The early turn over area must be completed when the area is transferred to the cemetery so the cemetery may start collecting interments and marker points with the GPS equipment provided in Section 11 83 00.
- D. The contractor shall provide the graphical representation of the location and elevation, as well as the data information for the geographically displayed information, for the elements in the provided ArcGIS Geodatabase format. The source for the graphical portion of the GIS shall be from the "As-Built" AutoCAD data supplemented with the field collected data. The geographic coordinate and elevation information for the elements being added to the GIS system, whether points, polylines or closed polygons, shall be collected and represented in the GIS based upon the accuracy level for the GNSS equipment being provided for the project.

3.2 DEMONSTRATION

- A. Both specification sections included as part of the GNSS/GIS, Section 11 83 00 Global Navigation Satellite System (GNSS) and Section 11 83 02 GNSS & GIS Mapping and Geodata, require complete demonstration as part of the GNSS equipment and GIS data being furnished and made fully functional.
- B. The demonstration shall be sufficient to show all the GNSS/GIS facilities provided perform as approved during the submittal and review process for the project, and that the completed system, including all hardware, facilities, equipment, software, and appurtenances are completely operational and perform as specified.
- C. The GNSS/GIS facility demonstration shall be performed to the satisfaction of the RE and the A/E prior to proceeding with the training.

3.3 TRAINING

- A. After construction is complete and the contractor has verified that the system is operating as intended through the demonstration, the submittal of the training materials and methods shall be completed and accepted through the submittal process, prior to the training. contractor shall notify the Resident Engineer when he is ready to schedule the cemetery staff training.
 - 1. Provide two (2) eight hour training days, and follow-up two (2) eight hour training days, providing staff training on the system operation, field procedures and maintenance.
 - 2. Training may or may not be consecutive days, but should be scheduled in close proximity.
 - 3. All training sessions shall be digitally video recorded and such recordings turned over to the Government for future use.

- - - 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. AC: Alternating Current
2. ACR: Air Conditioning
3. AISI: American Iron and Steel Institute
4. AWG: American Wire Gauge
5. COR: Contracting Officer's Representative
6. CPVC: Chlorinated Polyvinyl Chloride
7. CR: Chloroprene
8. CWP: Cold Working Pressure
9. db(A): Decibels (A weighted)
10. DN: Diameter Nominal
11. DWV: Drainage, Waste and Vent
12. EPDM: Ethylene Propylene Diene Monomer
13. F: Fahrenheit
14. FD: Floor Drain
15. FNPT: Female National Pipe Thread
16. FPM: Fluoroelastomer Polymer
17. GPM: Gallons Per Minute
18. HDPE: High Density Polyethylene
19. HOA: Hands-Off-Automatic
20. HP: Horsepower
21. ID: Inside Diameter
22. IPS: Iron Pipe Size
23. MAWP: Maximum Allowable Working Pressure
24. MAX: Maximum
25. MFG: Manufacturer
26. MIN: Minimum
27. NPTF: National Pipe Thread Female
28. NPS: Nominal Pipe Size
29. NPT: Nominal Pipe Thread

- 30. OD: Outside Diameter
- 31. OS&Y: Outside Stem and Yoke
- 32. PLC: Programmable Logic Controllers
- 33. PP: Polypropylene
- 34. PPM: Parts per Million
- 35. PSIG: Pounds per Square Inch
- 36. PTFE: Polytetrafluoroethylene
- 37. PVC: Polyvinyl Chloride
- 38. PVDF: Polyvinylidene Fluoride
- 39. RPM: Revolutions Per Minute
- 40. SCFM: Standard Cubic Feet Per Minute
- 41. SPEC: Specification
- 42. STD: Standard
- 43. SWP: Steam Working Pressure
- 44. TEFC: Totally Enclosed Fan-Cooled
- 45. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
- 46. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
- 47. T/P: Temperature and Pressure
- 48. V: Volt
- 49. VA: Veterans Administration
- 50. VAC: Voltage in Alternating Current
- 51. 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 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- H. Section 07 92 00, JOINT SEALANTS.
- I. Section 09 91 00, PAINTING.
- J. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- K. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- L. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- M. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

N. 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-2013.....Welding and Brazing Qualifications
B31.1-2012.....Power Piping
- C. American Society for Testing and Materials (ASTM):
A36/A36M-2012.....Carbon Structural Steel
A575-96(R2013)e1.....Steel Bars, Carbon, Merchant Quality, M-Grades
E84-2013a.....Standard Test Method for Burning
Characteristics of Building Materials
E119-2012a.....Standard 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-2015.....International Building Code
IPC-2015.....International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-2009.....Pipe Hangers and Supports-Materials, Design and
Manufacture
SP 69-2003.....Pipe Hangers and Supports-Selection and
Application
- F. Military Specifications (MIL):
P-21035B.....Paint High Zinc Dust Content, Galvanizing
Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
MG1-2007.....Motors and Generators
- H. National Fire Protection Association (NFPA):
51B-2014.....Standard for Fire Prevention During Welding,
Cutting and Other Hot Work
54-2012.....National Fuel Gas Code

70-2014.....National Electrical Code (NEC)

I. NSF International (NSF):

14-2012.....Plastic Piping System Components and Related
Materials

J. Department of Veterans Affairs (VA):

PG-18-10.....Plumbing Design Manual

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 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, 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. Hangers, inserts, supports, and bracing.
 2. Pipe sleeves.
 3. Equipment penetrations of floors, walls, ceilings, or roofs.
- J. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
 2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE**A. Products Criteria:**

1. **Standard Products:** Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. **Equipment Service:** There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 90 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, critical instrumentation, 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, printed 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. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All piping and valves 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.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings

are to be provided, and a copy of them on Auto-Cad version 2014 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

- A. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61.

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 stainless steel; ends shall be braked and drilled and attached to pump base with minimum of four (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 160° F shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.
 - b. 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.
- 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 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. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 (3/16-inch) high riveted or bolted to the equipment.
- C. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- D. Valve Tags and Lists:
 - 1. 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 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage 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 8-1/2 inches by 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 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.
- 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 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 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. General Types (MSS SP-58):
 - a. Wall brackets: Types 31, 32 or 33.
 - b. Saddle support: Type 36, 37 or 38.
 - c. Turnbuckle: Types 13 or 15.
 - d. U-bolt clamp: Type 24.
 - e. Riser clamps: Type 8.
 - f. Supports for plastic piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
 3. 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, 18 gage minimum.

2.9 PIPE PENETRATIONS

- A. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- B. 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.
- C. Sleeve clearance through walls shall be 1 inch greater in diameter than external diameter of pipe.
- D. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

2.10 ASBESTOS

- A. Materials containing asbestos are prohibited.

2.11 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 1 quart of oil, and 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, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, and equipment shall be located clear of openings, 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, 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 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. 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, 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 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, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Locate and position 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 control devices, control and instrumentation panels, alarms, instruments. Comply with NFPA 70.
 - L. 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, pumps, belt guards, transformers, and piping.

3.2 RIGGING

- A. 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.

- B. 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.
- C. 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.
- D. 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.
- E. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.

3.3 PIPE AND EQUIPMENT SUPPORTS

- A. Plumbing horizontal and vertical pipe supports, refer to the International Plumbing Code.
- B. 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 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.

3.4 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 quart of oil and 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.

3.5 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.
 - f. Lubrication devices and grease fittings.
 - g. Aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gauges.
 - j. Glass.
 - k. Name plates.
 - 3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.

5. The final result shall be 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.

3.6 IDENTIFICATION SIGNS

- A. Laminated plastic signs, with engraved lettering not less than 3/16 inch high, shall be provided that designates equipment function, for all equipment, motor controllers, relays, meters, and control devices. 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, and performance data shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.7 STARTUP AND TEMPORARY OPERATION

- A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.8 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost 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.

3.9 OPERATION AND MAINTENANCE MANUALS

- A. All new and temporary equipment and all elements of each assembly shall be included.
- B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- C. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- D. Lubrication instructions, type and quantity of lubricant shall be included.
- E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- F. Set points of all interlock devices shall be listed.
- G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
- H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- I. Emergency procedures for shutdown and startup of equipment and systems.

3.10 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.

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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 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.
- 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.
- E. Section 25 10 10, ADVANCED UTILITY METERING SYSTEM.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
B40.100-2013.....Pressure Gauges and Gauge Attachments
- C. Institute of Electrical and Electronics Engineers (IEEE):
C2-2012.....National Electrical Safety Code (NESC)
- D. International Code Council, (ICC):
IPC-2015.....International Plumbing Code
- H. National Fire Protection Association (NFPA):
70-2014.....National Electrical Code (NEC)

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 19, METERS AND GAGES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pressure Gages.
 2. Product certificates for each type of gage.
- D. Operations and Maintenance manual shall include:
1. System Description.
 2. Troubleshooting and preventive maintenance guidelines.
 3. Spare parts information.
- E. Shop Drawings shall include the following: Product information.

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, a written description of system design, 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.
 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 90 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 piping and vales 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 STORM WATER USAGE

- A. ASME B40.100 all metal case 4 1/2 inches diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 50 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.

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. Pressure gages shall be installed where indicated on the drawings.
- D. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.
- E. 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.

F. Gages 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.

G. 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 shall NOT be painted.

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**SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section describes the requirements for general-duty valves for storm water 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 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below (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):
 - A112.1.2-04.....Air Gaps in Plumbing Systems
 - A112.14.1-2003.....Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
 - 1001-2008.....Atmospheric Type Vacuum Breakers
- D. American Society for Testing and Materials (ASTM):
 - A126-2004(R2009).....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
 - A276-2013a.....Standard Specification for Stainless Steel Bars
and Shapes
 - A536-1984(R2009).....Standard Specification for Ductile Iron
Castings
 - B62-2009.....Standard Specification for Composition Bronze
or Ounce Metal Castings
 - B584-2013.....Standard Specification for Copper Alloy Sand
Castings for General Applications
- E. International Code Council (ICC):
 - IPC-2015.....International Plumbing Code

- F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
- SP-25-2008.....Standard Marking Systems for Valves, Fittings, Flanges and Unions
 - SP-67-2011.....Butterfly Valves
 - SP-70-2011.....Gray Iron Gate Valves, Flanged and Threaded Ends
 - SP-71-2011.....Gray Iron Swing Check Valves, Flanged and Threaded Ends
 - SP-80-2013.....Bronze Gate, Globe, Angle, and Check Valves
 - SP-85-2011.....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
 - SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. 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 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. Check Valves.
- D. 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.

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 gate valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. 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 valves larger than 16-inch. 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. 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. Storm Water:
1. 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 150 psig and a CWP rating of 600 psig. The body material shall be PVC. The ends shall be non-lead solder.
 2. Less than 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 200 psig. The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
 3. 4 inches and larger:

- a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 200 psig. The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 8 inches and crank operated for sizes 8 inches and above.

2.3 CHECK VALVES

- A. 3 inches and smaller shall be PVC check valves with PVC 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 200 psig. The check valve shall have a Y pattern horizontal body design with PVC body material solvent joints, and PVC disc.
- B. 4 inches and larger:
 - 1. Check valves shall be Class 125, cast iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 200 psig. The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, and bronze trim.
 - 2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its

material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be installed in horizontal piping with stem at or above center of pipe.

C. Valves shall be installed in a position to allow full stem movement.

D. 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.

E. 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. Shutoff valves.

2. Check valves.

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.

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.

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SECTION 22 14 36
PACKAGED, SUBMERSIBLE DRAINAGE PUMP UNITS

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Packaged submersible drainage pump units. See schedule on Drawings for pump capacity and head.
- 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.
- E. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- F. 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 National Standard Institute (ANSI)/Hydraulic Institute (HI):
 - 1.1-1.2-2014.....Rotodynamic Centrifugal Pumps for Nomenclature and Definitions
 - 1.3-2013.....Rotodynamic Centrifugal Pumps for Design and Application
 - 1.4-2014.....Rotodynamic Centrifugal Pumps for Manuals Describing Installation, Operation and Maintenance
- C. ASTM International (ASTM):
 - A48/A48M-2003(R2012)....Standard Specification for Gray Iron Castings
 - A532/A532M-2010(R2014)..Standard Specification for Abrasion-Resistant Cast Irons
- D. National Electrical Manufacturers Association (NEMA):
 - ICS 6-1993(R2006).....Industrial Control and Systems: Enclosures
 - 250-2014.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- E. Underwriters' Laboratories, Inc. (UL):
 - 508-1999(R2013).....Standards 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 14 36, PACKAGED, SUBMERSIBLE, DRAINAGE PUMP UNITS", 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 (rpm).
 - c. Capacity.
 - d. Characteristic performance curves.
 - 2. Electric Motor:
 - a. Manufacturer.
 - b. Speed.
 - c. Current Characteristics and W (HP).
 - d. Efficiency.
 - 3. Control panel.
- D. Certified copies of all the factory and construction site test data sheets and reports.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
 - 1. Include complete list which indicates all components of the system.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance, and troubleshooting.

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 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 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 2014 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.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.

PART 2 - PRODUCTS**2.1 SUBMERSIBLE DRAINAGE PUMPS (STDP01, STDP02, STDP03, STDP04)****A. Acceptable Manufacturers:**

1. Wemco.
2. Flygt.

B. Screw-centrifugal or non-clog, submersible, designed for 140 degrees F maximum water temperature. Driver shall be electric motor with rigid type support. Provide perforated, nonferrous suction strainer: Systems may include one or two pumps with alternator as required by Contract Documents:

1. Pump housings may be cast iron, bronze, or stainless steel. Cast iron housings for submersible pumps shall be epoxy coated.
2. Located at Storm Water Pump Station No. 1 and Storm Water Pump Station No. 2.
3. Size and capacity as scheduled on drawings.

C. Impeller: Brass, bronze, hardened iron, or stainless steel.**D. Shaft: Bronze, stainless steel or other corrosion resisting metal.****E. Bearings: As required to hold shaft alignment, anti-friction type for thrust permanently lubricated. Bio-based materials shall be utilized when possible.****F. Motor: Maximum 104 degrees F ambient temperature rise, hermitically sealed, lifting eye, voltage and phase as shown in schedule on Electrical drawings conforming to NEMA Type 6P. Size the motor capacity to operate the pump without overloading the motor at any point on the pump curve. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.****G. Motor Starter: As specified in Section 26 29 11, MOTOR CONTROLLERS.****H. Automatic Control and Level Alarm: Furnish a control panel in a NEMA Type 4X enclosure for outdoors. The controls shall be suitable for operation with the electrical characteristics listed on the Electrical drawings. The control panel shall accept a remote level signal to start and stop pumps automatically, activate a high water alarm, and shut pumps off at low level. Pump failure and the high water alarm shall have a red beacon light at the control panel and a buzzer, horn, or bell. The alarm shall have a silencing switch.****1. The circuitry of the control panel shall include:**

- a. Power switch to turn on/off the automatic control mechanism.

- b. HOA switches to manually override automatic control mechanism.
 - c. Run lights to indicate when pumps are powered up.
 - d. Level status lights to indicate when water in sump has reached the predetermined on/off and alarm levels.
 - e. Magnetic motor contactors.
 - f. Disconnect/breaker for each pump.
 - g. Automatic motor overload protection.
 - h. Wiring terminal block.
 - i. Dead front.
 - j. Auxiliary contacts.
 - k. Control circuit protection.
 - l. Fused control step down transformer.
- 2. For a duplex system, provide an alternating relay to automatically alternate leadoff and standby duties of each pump of a duplex unit at the end of each pumping cycle. Standby pump shall start when water level in sump rises to a predetermined level that indicates excessive inflow or failure of the lead pump.
 - 3. Sensors that detect the level of water in the sump shall be so arranged as to allow the accumulation of enough volume of liquid below the normal on-level that the pump shall run for a minimum cycle as recommended by pump manufacturer to protect short cycling. Sensors shall be located to activate the alarm adequately before the water level rises to the inlet pipe.
 - 4. Provide two separate power supplies to the control panel, one for the control/alarm circuitry and one for power to the pump motors. Each power supply is to be fed from its own breaker so that if a pump overload trips a breaker, the alarm system shall still function. Each powersupply is to be wired in its own conduit.
 - 5. Wiring from the sump to the control panel shall have separate conduits for the pump power and for the sensor switches. All conduits are to be sealed at the basin and at the control panel to prevent the intrusion of moisture and of flammable and/or corrosive gases.
- I. Sump: Furnish precast concrete basin with access hatch per Section 33 40 00 and as indicated on drawings. Sump shall be sized to allow an adequate volume of water to accumulate for a minimum one-minute cycle of pump operation.

- J. Provide a check and gate valve in the discharge of each pump where indicated on drawings and as specified in Section 22 05 23.
- K. Removal/Disconnect System: Where indicated on drawings, a removal/disconnect system shall be provided. The system shall consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the discharge fitting as the pump is raised from or lowered into the sump. The discharge piping shall connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping. Materials of construction are shown on the Drawings.

2.2 SUBMERSIBLE DRAINAGE PUMPS (PPC NO. 1, PPC NO. 2, PPC NO. 3, PPC NO. 4, PPC NO. 5, PPC NO. 6, PPC NO. 7, PPC NO. 8)

- A. Acceptable Manufacturers:
 - 1. Wemco.
 - 2. Flygt.
- B. Screw-centrifugal or non-clog, submersible, designed for 140 degrees F maximum water temperature. Driver shall be electric motor with rigid type support. Provide perforated, nonferrous suction strainer: Systems may include one or two pumps with alternator as required by Contract Documents:
 - 1. Pump housings may be cast iron, bronze, or stainless steel. Cast iron housings for submersible pumps shall be epoxy coated.
 - 2. Located at Crypt Pump Stations No. 1 through No. 4.
 - 3. Size and capacity as scheduled on drawings.
- C. Impeller: Brass, bronze or stainless steel.
- D. Shaft: Bronze, stainless steel or other VA approved corrosion resisting metal.
- E. Bearings: As required to hold shaft alignment, anti-friction type for thrust permanently lubricated. Bio-based materials shall be utilized when possible.
- F. Motor: Maximum 104 degrees F ambient temperature rise, hermitically sealed, lifting eye, voltage and phase as shown in schedule on Electrical drawings conforming to NEMA Type 6P. Size the motor capacity

to operate the pump without overloading the motor at any point on the pump curve. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

- G. Provide power cord and plug with length to extend to a 240V, single phase outlet above the sump. See drawings for location of outlets.
- H. Furnish pumps with packaged level float control to energize pumps at low level and de-energize pumps at high level.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

- A. Pump installation to comply with ANSI/HI 1.4 for sump pumps.
- B. Leak Test: Charge piping system and test for leaks. Test until there are no leaks. 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. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.
- D. When any defects are detected, correct defects and repeat test at no additional time or cost to Government.
- E. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.2 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.

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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. Contractor shall provide electrical equipment, materials, related components and accessories in accordance with the specifications and drawings.
- C. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval for sizes and settings of these devices.
- D. Conductor shall be copper. Conductor ampacities are based on copper conductors, with the conduit and raceways properly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. Reference to the International Building Code (IBC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes are minimum required standards.
- B. Drawings and specification sections shall govern in cases where requirements exceed the ones required in the above standards.

1.3 TEST STANDARDS

- A. Materials and equipment shall be listed, labeled or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc., standards where test standards have been established. Materials and equipment not listed by UL Standards will be accepted providing that materials and equipment is listed, labeled, and certified to meet safety requirements of a NRTL. Materials and equipment that no NRTL lists, labels, and certifies, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, or NETA. Evidence of compliance shall include certified test reports and shop drawings.
- B. Definitions:
 - 1. Listed: Material or equipment included in a list published by an organization that:
 - a. Is acceptable to the Authority Having Jurisdiction (AHJ) and concerned with evaluation of products or services.

- b. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
- c. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
- 2. Labeled: Material or equipment is labeled when:
 - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
 - b. The laboratory makes periodic inspections of the production of such equipment.
 - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
- 3. Certified: Material or equipment is certified when:
 - a. It has been tested and validated by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. It is periodically inspected by a NRTL.
 - c. It bears a label, tag, or other record of certification.
- 4. Nationally Recognized Testing Laboratory (NRTL): laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.
- 5. Provide: The term "provide" denotes "furnish, install and connect".

1.4 QUALIFICATIONS (MANUFACTURERS, PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 - 1. Product shall have been in satisfactory operation, on three installations of similar size and type as this project, and for a minimum of three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render service to this installation within eight (8) hours of receipt of notification

that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATION

- A. Applicable publications listed in all sections of Division 26 are the latest issues, 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 of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment, and shown 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. Additionally, the Contractor shall comply with the following requirements:
 - 1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government, through the Resident Engineer/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 report to the Resident Engineer/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 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 Contractor shall provide additional materials, equipment, related components and accessories to satisfy these variations. If the Contractor requests variations from the contract requirements, contractor shall be liable for all additional costs and expenses.

1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and Equipment shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 1. During installation, materials and equipment such as enclosures, switchboards, panelboards, conductors, luminaires etc. shall be protected against entry of foreign matter. Materials and equipment shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Damaged equipment shall be, as determined by the Resident Engineer/COR, replaced or repaired.
 3. Painted surfaces shall be protected with removable factory installed heavy kraft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of latest publications of the NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 110, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K 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 and equipment de-energized. Only non-invasive and non-destructive electrical testing may be performed under energized electrical work. In

such case, Contractor shall submit request, and obtain authorization for such work from the Resident Engineer/COR.

- D. For work on existing electrical system, arrange, prioritize and perform work to assure no or minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Sections 01 00 01 (Major NCA Projects) or 01 00 02 (Minor NCA Projects), GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions. Refer to Article RESTORATION under Sections 01 00 01 (Major NCA Projects) or 01 00 02 (Minor NCA Projects), GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on drawings.
- B. Working spaces shall not be less than specified in the NEC.
- C. Readily Accessible Equipment:
 - 1. Installed equipment shall be readily accessible. When the Government determines that the contractor has installed equipment not readily accessible, contractor shall remove and re-install the equipment as directed by the Government.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the latest NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.
- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E.

1.12 SUBMITTALS

- A. Submit six copies to Resident Engineer/COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. The Government prohibits delivery, storage or installation of equipment or material which has not been approved through the submittal process.
- C. All submittals shall include descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- 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 SPECIFICATION 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, pictures, nameplate data and test reports as required.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 - 3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 4. Parts list to include replacement parts and part numbers recommended by the equipment manufacturer, and quantity of parts.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of the Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. 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 and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Lubrication schedule including type, grade, temperature range, and frequency.
 - j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - k. List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

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 WARRANTY

- A. Workmanship, labor, equipment, materials, related components and accessories shall be free from defects, and shall remain so for a period of one year from the date of project acceptance by the Government

1.15 TRAINING

- A. Training shall be provided to designated Government personnel for particular equipment or system as required in each associated specification section.
- B. Contractor shall furnish the services of factory certified and experienced instructors to provide full instruction in the adjustment, operation, and maintenance of the specified equipment and system. Instruction shall also include safety requirements.
- C. Contractor shall develop a training schedule, and submit training schedule to Resident Engineer/COR for review and approval at least thirty (30) days prior to the scheduled training.

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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. Low-voltage electrical power conductors and cables are also referred to as conductor(s), cable(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 31 20 00, EARTH MOVING: Excavation and backfill for cables that are installed in conduit.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- 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 for conductors and cables.
- F. 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: Manufacturer's Literature and Data - Showing each cable type and rating.
 2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COR four copies of the certification that the material is in accordance with the drawings and specifications and has 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 reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-10.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
 - WC 70-09.....Power Cable Rated 2000 Volts or less for the
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14.....Thermoset-Insulated Wires and Cables
 - 83-14.....Thermoplastic-Insulated Wires and Cables
 - 467-13.....Safety Electrical Grounding and Bonding
Equipment
 - 486A-486B-13.....Safety Wire Connectors
 - 486C-13.....Safety Splicing Wire Connectors
 - 486D-15.....Safety Sealed Wire Connector Systems
 - 486E-15.....Safety Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
 - 493-07.....Safety Thermoplastic-Insulated Underground
Feeder and Branch Circuit Cable
 - 514B-12.....Fittings for Cable and Conduit
 - 1479-15.....Safety Fire Tests of Through-Penetration Fire
Stops

PART 2 - PRODUCTS**2.1 CONDUCTORS**

- A. Conductors shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.
- B. Single conductor shall be:
 - 1. Copper.
 - 2. Stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.

3. Minimum size No. 12 AWG, except where smaller sizes are specified herein or as shown on the drawings.

C. Insulation shall be:

1. THHN-THWN.
2. Direct burial: UF or USE.

D. Color Code:

1. Conductors shall be color coded as follows:

| 208/120 volt | Phase | 480/277 volt |
|---|---------|--------------|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray * |
| *or white with colored (other than green) tracer. | | |

2. No. 10 AWG and smaller: Solid color insulation or solid color coating.
3. No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. 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.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding distinct (i.e. pink and purple) from the color coding indicated above. The distinct color codes shall be solid and 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.
- D. Above Ground Splices for 250kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.

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

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

2.5 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install conductors in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Install conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Conductors of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install conductor 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, and equipment assemblies, neatly form, train, and tie the conductors in individual circuits.
- G. Seal conductor entering a building from underground, between the conductor and conduit where the conductor exits the conduit, with a non-hardening approved compound.
- H. Conductor and Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of conductors.
 2. Use ropes made of nonmetallic material for pulling feeders conductors.
 3. Attach pulling lines for feeders conductors by means of either woven basket grips or pulling eyes attached directly to the conductors.
 4. Pull in multiple conductors and wires that share the same conduit, simultaneously.
- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.

3.2 INSTALLATION IN MANHOLES

- A. Install and support conductors in manholes on the steel racks with porcelain or equal insulators. Train the conductors around the manhole walls, but do not bend to a radius less than six (6) times the overall conductor diameter.

3.3 SPLICE 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, remove the devices and install approved devices.

3.4 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 Volts or lower where shown on the drawings or as required by the NEC.

3.5 CONTROL AND SIGNAL SYSTEM 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.

3.6 FEEDER IDENTIFICATION

- A. In each interior pullbox and junction box, install metal tags on each circuit conductor to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the conductor type and voltage rating. Attach the tags to the conductors with slip-free plastic cable lacing units.

3.7 DIRECT BURIAL CONDUCTOR INSTALLATION

- A. Tops of the conductors:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
 - 3. Do not install direct burial conductors under railroad tracks.
- B. Under road and paved surfaces: Install conductors in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
- C. Work with extreme care near existing ducts, conduits, conductors and other utilities to prevent any damage.
- D. Cut the trenches neatly and uniformly:
 - 1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
 - 2. Place a 75 mm (3 inches) layer of sand in the trenches before installing the conductors.
 - 3. Place a 75 mm (3 inches) layer of sand over the installed conductors.
 - 4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inches) preservative impregnated wood planking 75 mm (3 inches) above the conductors before backfilling.

- E. Provide horizontal slack in the conductors for contraction during cold weather.
- F. Install the conductors in continuous lengths. Splices within conductor runs will not be accepted.
- G. Connections and terminations shall be submersible type designed for the conductors being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried conductors.

3.8 EXISTING CONDUCTORS AND CABLES

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

3.9 ACCEPTANCE CHECKS AND TESTS

- A. Feeders and branch circuit conductors shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by Megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. Perform phase rotation test on all three-phase circuits. For renovation project, phase rotation shall be consistent between existing and new installations.
- E. The Contractor shall furnish the instruments, materials, and labor for these tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of grounding and bonding system to form a complete electrical grounding system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, including made, supplementary, lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification.

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 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.
- E. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.
- F. 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. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - b. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

2. Test Reports: Two weeks prior to the final inspection, submit four copies of the ground resistance test reports to the Resident Engineer/COR.
3. Certification: Prior to final inspection, submit to the Resident Engineer/COR four copies of the certification that the grounding equipment has been properly installed in accordance with the drawings and specifications

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 the basic designation only.
- B. American Society for Testing and Materials (ASTM):
B1-13.....Specification for Hard-Drawn Copper Wire
B8-11.....Specification for Concentric-Lay-Stranded
Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
81-12.....IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface Potentials
of a Ground System
- D. National Fire Protection Association (NFPA):
70-17.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
44-14Safety Thermoset-Insulated Wires and Cables
83-14Safety Thermoplastic-Insulated Wires and Cables
467-13Safety Grounding and Bonding Equipment
486A-486B-13Safety Wire Connectors and Soldering Lugs for
Use with Copper Conductors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

- C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

- A. Provide ground rod(s) made of copper clad steel, 19 mm (3/4 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings.

2.3 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire. Location is as shown on the drawings.

2.4 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 lock washers.
 - 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.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.6 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.7 GROUNDING BUS BAR

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

PART 3 - EXECUTION

3.1 GENERAL

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

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchboards:
1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

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

F. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

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

H. 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.
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. 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.

L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.4 CORROSION INHIBITORS

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

3.5 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.6 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 GROUND ROD INSTALLATION

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

3.8 ACCEPTANCE CHECKS AND TESTS

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

- C. Below-grade connections shall be visually inspected by the Resident Engineer/COR prior to backfilling. The Contractor shall notify the Resident Engineer/COR twenty four (24) hours before the connections are ready for inspection.

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**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 and electrically grounded raceway systems. Raceways are required for all wiring unless specified otherwise.
- B. Definitions: The term conduit, used in this specification, shall imply any 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 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- E. 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.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.
- G. 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. The specific item proposed and its area of application shall be identified on the catalog cuts.
2. Certification: Prior to final inspection, submit to the Resident Engineer/COR four (4) copies of the certification that the equipment has been properly installed in accordance with the drawings and specifications.

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 the basic designation only.
- B. American National Standards Institute (ANSI):
 - C80.1-15.....Electrical Rigid Steel Conduit
 - C80.3-15.....Electrical Metallic Tubing - Steel
 - C80.5-15.....Electrical Rigid Metal Conduit - Aluminum
 - C80.6-05.....Electrical Intermediate Metal Conduit
- C. National Electrical Manufacturers Association (NEMA):
 - TC 3-15.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB 1-14.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 1-05.....Flexible Metal Conduit
 - 5-16.....Surface Metal Raceway and Fittings
 - 6-07.....Rigid Metal Conduit
 - 50-15.....Safety Enclosures for Electrical Equipment
 - 360-13.....Safety Liquid-Tight Flexible Steel Conduit
 - 467-13.....Safety Grounding and Bonding Equipment
 - 514A-13.....Safety Metallic Outlet Boxes
 - 514B-12.....Safety Conduit, Tubing, and Cable Fittings
 - 514C-14.....Safety Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-11.....Safety Schedule 40, 80, Type EB and A Rigid PVC
Conduit and Fittings

797-07.....Safety Electrical Metallic Tubing - Steel

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduits shall be in accordance with ANSI, NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- C. Conduit:
 - 1. Rigid steel conduit (RMC steel): Shall Conform to UL 6, ANSI C80.1.
 - 2. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
 - 3. Flexible metal conduit (FMC): Shall Conform to UL 1.
 - 4. Liquid-tight flexible metal conduit (LTMC): Shall Conform to UL 360.
 - 5. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 - 6. Surface metal raceway: Shall Conform to UL 5.
- D. Conduit Fittings:
 - 1. Rigid steel and IMC conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB 1.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in

- conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Electrical metallic tubing fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
5. Direct burial plastic conduit fittings:
- a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:

- a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- E. 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 by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- F. Outlet, Junction, and Pull Boxes:
- 1. UL-50 and UL-514A.
 - 2. Cast metal: Where required by the NEC or shown on the drawings, and equipped with rustproof boxes.
 - 3. Sheet metal boxes: Galvanized steel.
 - 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- G. Wireways: Equip with hinged covers, except where removable covers are shown.

PART 3 - EXECUTION

3.2 INSTALLATION

- A. Install conduits in accordance with NEC, UL, as shown on the drawings, in accordance with manufacturer's recommendations, and as required below:.
- 1. In complete runs before pulling in conductors and cables.

2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Ensure that conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Ensure that conduit shall be mechanically and electrically continuous.
6. Independently support conduit at 2.4 m (8 feet) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support conduit 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 the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR/Resident Engineer.

3.2 CONDUIT PENETRATIONS**A. Cutting or Drilling Holes:**

1. Mark up proposed locations of conduit penetrations in the structural sections such as ribs or beams with permanent markers prior to cutting or drilling through. Field inspect the proposed locations with Resident Engineer/COR. Obtain approval of the Resident Engineer/COR prior to cutting and drilling through structural sections.
2. Only cut or drill holes through concrete and masonry structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed.

B. Fire Stop: 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.**C. Waterproofing:** At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight**3.3 CONDUIT INSTALLATION - CONCEALED****A. In Concrete:**

1. Conduit: Rigid steel or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Resident Engineer/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 1/3 of the slab thickness is prohibited.

- b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
- c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
 - 1. Conduit for conductors above 600 volts:
 - a. Rigid steel.
 - 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
 - 3. Align and run conduit parallel or perpendicular to the building lines.
 - 4. Connect recessed lighting fixtures to conduit runs with maximum 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.

3.4 CONDUIT INSTALLATION - EXPOSED

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
 - 1. Rigid steel.
 - 2. Different type of conduits mixed indiscriminately in the system is prohibited
- C. Conduit for conductors 600 volts and below:
 - 1. Rigid steel or EMT.
 - 2. Different type of conduits mixed indiscriminately 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.

H. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inches) 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 CONDUIT INSTALLATION – DIRECT BURIAL

A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1.5 m (5 feet) from the buildings):

1. Conduit: Thick wall PVC unless otherwise shown.
2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
4. Tops of conduits shall be as follows unless otherwise shown:
 - a. Not less than 600 mm (24 inches) below finished grade.
 - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
 - a. Cut the trenches neatly and uniformly.
 - b. Do not kink the conduits.
7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with 0.5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

3.6 CONDUIT INSTALLATION – WET OR DAMP LOCATIONS

A. Unless otherwise shown, use conduits of rigid steel.

- 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. Unless otherwise shown, 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. Conduit shall include an outer factory coating of 0.5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.7 CONDUIT INSTALLATION - 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. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.9 CONDUIT INSTALLATION - EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inches) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.10 CONDUIT SUPPORTS

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 feet) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 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 on the drawings, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. For new boxes, remove only box knockouts if used to terminate conduits. If new conduits are terminated into existing boxes, plug any existing unused knockouts. Use threaded plugs for cast metal boxes and snap-in metal covers to plug unused openings of sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inches), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2 1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

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**SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation and connection of handholes and ducts to form a complete underground raceway system.
- B. "Duct" and "conduit", and "rigid metal conduit" and "rigid steel conduit" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 05 50 00, METAL FABRICATIONS: Ladders.
- B. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.

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. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - b. Include handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.
 - c. If necessary to locate ducts or handholes at locations other than shown on the drawings, show the proposed locations accurately on

scaled site drawings, and submit four copies to the Resident Engineer/COR for approval prior to construction.

2. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer/COR:
 - a. Certification that the materials are in accordance with the drawings and specifications.
 - b. Certification, by the Contractor, that the complete installation 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 Concrete Institute (ACI):
 - 318-14.....Building Code Requirements for Structural Concrete & Commentary
 - SP 66-04.....ACI Detailing Manual
- C. American National Standards Institute/Society of Cable Telecommunication Engineers (ANSI/SCTE):
 - 77-13.....Underground Enclosure Integrity
- D. American Society for Testing and Materials (ASTM):
 - C478/C478M-15.....Standard Specification for Precast Reinforced Concrete Manhole Sections
 - C858-10.....Underground Precast Concrete Utility Structures
 - C990/C990M-09.....Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
- E. National Electrical Manufacturers Association (NEMA):
 - TC 2-13.....Electrical Polyvinyl Chloride (PVC) Conduit
 - TC 3-15.....Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit And Tubing
 - TC 6 & 8-13.....Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installations
 - TC 9-04.....Fittings For Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installation
- F. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
 - 70E-15.....National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

- 6-07.....Electrical Rigid Metal Conduit-Steel
- 467-13.....Grounding and Bonding Equipment
- 651-11.....Schedule 40, 80, Type EB and A Rigid PVC
Conduit and Fittings
- 651A-11.....Schedule 40 and 80 High Density Polyethylene
(HDPE) Conduit

PART 2 - PRODUCTS**2.1 PRE-CAST CONCRETE MANHOLES AND HARDWARE**

- A. Structure: Factory-fabricated, reinforced-concrete, monolithically-poured walls and bottom. Frame and cover shall form top of manhole.
- B. Cable Supports:
 - 1. Cable stanchions shall be hot-rolled, heavy duty, hot-dipped galvanized "T" section steel, 56 mm (2.25 inches) x 6 mm (0.25 inch) in size, and punched with 14 holes on 38 mm (1.5 inches) centers for attaching cable arms.
 - 2. Cable arms shall be 5 mm (0.1875 inch) gauge, hot-rolled, hot-dipped galvanized sheet steel, pressed to channel shape. Arms shall be approximately 63 mm (2.5 inches) wide x 350 mm (14 inches) long.
 - 3. Insulators for cable supports shall be porcelain, and shall be saddle type or type that completely encircles the cable.
 - 4. Equip each cable stanchion with one spare cable arm, with three spare insulators for future use.
- C. Ladder: Aluminum with 400 mm (16 inches) rung spacing. Provide securely-mounted ladder for every manhole over 1.2 m (4 feet) deep.
- D. Ground Rod Sleeve: Provide a 75 mm (3 inches) PVC sleeve in manhole floors so that a driven ground rod may be installed.
- E. Sump: Provide 305 mm x 305 mm (12 inches x 12 inches) covered sump frame and grated cover.

2.2 PULLBOXES

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI/SCTE 77 Tier 15 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.

- B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.

2.3 DUCTS

- A. Number and sizes shall be as shown on the drawings.
- B. Ducts (direct-burial):
 - 1. Plastic duct:
 - a. UL 651 and 651A, Schedule 40 PVC Schedule 80 PVC.
 - b. Duct shall be suitable for use with 75° C (167° F) rated conductors.
 - 2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.

2.4 GROUNDING

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.5 WARNING TAPE

- A. 4-mil polyethylene 75 mm (3 inches) wide, detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

2.6 PULL ROPE FOR SPARE DUCTS

- A. Plastic with 890 N (200lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 MANHOLE AND PULLBOX INSTALLATION

- A. Assembly and installation shall be in accordance with NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
 - 1. Install manholes and pullboxes level and plumb.
 - 2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
- B. Access: Ensure that top of frames and covers are flush with finished grade.
- C. Grounding in Manholes:
 - 1. Ground Rods in Manholes: Drive a ground rod into the earth, through the floor sleeve, after the manhole is set in place. Fill the sleeve with sealant to make a watertight seal. Rods shall protrude approximately 100 mm (4 inches) above the manhole floor.

2. Install a No. 3/0 AWG bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips.
3. Connect the ring grounding conductor to the ground rod by an exothermic welding process.
4. Bond the ring grounding conductor to the duct bank equipment grounding conductors, the exposed non-current carrying metal parts of racks, sump covers, and like items in the manholes with a minimum No. 6 AWG bare copper jumper using an exothermic welding process.

3.2 TRENCHING

- A. Refer to Section 31 20 00, EARTH MOVING for trenching back-filling, and compaction.
- B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- C. Cut the trenches neatly and uniformly.
- D. For Concrete Encased Ducts:
 1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1.2 m (4 feet) intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings wherever possible.
 3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
 4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, with appropriate warning tape attached.
- E. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the Resident Engineer/COR.

3.3 DUCT INSTALLATION

- A. General Requirements:
 1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.

2. Join and terminate ducts with fittings recommended by the manufacturer.
3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inch) in 30 m (100 feet).
4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 m (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 m (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six (6) times conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 m (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, and chilled water.
10. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
11. Clearances between individual ducts:
 - a. For similar services, not less than 75 mm (3 inches).
 - b. For power and signal services, not less than 150 mm (6 inches).
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.

14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. Direct-Burial Ducts:

1. Install direct-burial ducts only where shown on the drawings. Provide direct-burial ducts only for low-voltage power and lighting branch circuits.
2. Tops of ducts shall be:
 - a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
 - b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
 - c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
3. Do not kink the ducts. Compaction shall not deform the ducts.

C. Connections to Manholes: Ducts connecting to manholes shall be flared to have an enlarged cross-section to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 300 mm (12 inches) in each direction. Perimeter of the duct bank opening in the manhole shall be flared toward the inside or keyed to provide a positive interlock between the duct and the wall of the manhole. Use vibrators when this portion of the encasement is poured to ensure a seal between the envelope and the wall of the structure.

D. Connections to Existing Manholes: For duct connections to existing manholes, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut steel and extend into the

duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

- E. Connections to Existing Ducts: Where connections to existing ducts are indicated, excavate around the ducts as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.
- F. Partially-Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

- A. Duct Testing and Cleaning:
1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
 2. The mandrel shall be not less than 300 mm (12 inches) long. The mandrel shall have a diameter of not less than 13 mm (0.5 inch) from the inside diameter of the duct. A brush with stiff bristles shall be pulled through each duct to remove the loosened foreign particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
 3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct, and retest as specified in this section.
 4. Duct testing and cleaning shall be witnessed by the Resident Engineer/COR.

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**SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.
- B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- B. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer, and performed by licensed electrical engineer or qualified person with professional experience and credential as required by the NEC.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Product data on the SKM software program to be used for the study. Software shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
 - 2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
 - 3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 241-90.....Recommended Practice Electrical Systems in Commercial Buildings
 - 242-01.....Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 399-97.....Recommended Practice for Industrial and Commercial Power Systems Analysis
 - 1584-02.....Performing Arc-Flash Hazards Calculations
 - 1584A-04.....Performing Arc-Flash Hazards Calculations - Amendment 1
 - 1584B-11.....Performing Arc-Flash Hazards Calculations - Amendment 2
- C. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
 - 70E-15.....Standard for Electrical Safety in the Workplace

1.6 STUDY REQUIREMENTS

- A. The study shall be in accordance with the latest IEEE and NFPA standards.
- B. The study shall include one line diagram, short-circuit and ground fault analysis, protective coordination plots for all overcurrent protective devices, and arc flash calculations and analysis.
- C. One Line Diagram:
 1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
 2. Show the following specific information:
 - a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
 - b. Relay, circuit breaker, and fuse ratings.
 - c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.

- d. Voltage at each bus.
 - e. Identification of each bus, matching the identification on the drawings.
 - f. Conduit, conductor, and busway material, size, length, and X/R ratios.
- D. Short-Circuit Study:
- 1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
 - 2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
 - 3. Present the results of the short-circuit study in a table. Include the following:
 - a. Device identification.
 - b. Operating voltage.
 - c. Overcurrent protective device type and rating.
 - d. Calculated short-circuit current.
- E. Selective Coordination Study:
- 1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
 - 2. The following specific information shall also be shown on the coordination curves:
 - a. Device identification.
 - b. Potential transformer and current transformer ratios.
 - c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
 - d. Applicable circuit breaker or protective relay characteristic curves.
 - e. No-damage, melting, and clearing curves for fuses.

- f. Transformer in-rush points.
- 3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
 - a. Device identification.
 - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
 - c. Fuse rating and type.
- F. Arc Flash Calculations and Analysis:
 - 1. Arc flash warning labels shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 2. Arc flash calculations shall be based on actual over-current protective device clearing time. Maximum clearing time shall be in accordance with IEEE 1584.
 - 3. Arc flash analysis shall be based on the lowest clearing time setting of the over-current protective device to minimize the incident energy level without compromising selective coordination.
 - 4. Arc flash boundary and available arc flash incident energy at the corresponding working distance shall be calculated for all electrical power distribution equipment specified in the project, and as shown on the drawings.
 - 5. Required arc-rated clothing and other PPE shall be selected and specified in accordance with the latest NFPA 70E.

1.7 ANALYSIS

- A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS

- A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

---END---

**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 01 GENERAL REQUIREMENTS (MAJOR 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 electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)**PART 3 - EXECUTION****3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and

resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical 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 fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

1.3 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.
 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.

- 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the transformers.
- 2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the transformers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
IBC-15.....International Building Code
- C. National Fire Protection Association (NFPA):
70-17.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):
TR 1-13.....Transformers, Step Voltage Regulators and
Reactors
ST 20-14.....Dry Type Transformers for General Applications
- E. Underwriters Laboratories, Inc. (UL):
506-08.....Standard for Specialty Transformers
1561-11.....Dry-Type General Purpose and Power Transformers
- F. United States Department of Energy
10 CFR Part 431.....Energy Efficiency Program for Certain
Commercial and Industrial Equipment

PART 2 - PRODUCTS

2.1 TRANSFORMERS

- A. Unless otherwise specified, transformers shall be in accordance with NEMA, NEC, UL and as shown on the drawings.

- B. Transformers shall have the following features:
1. Self-cooled by natural convection, isolating windings, and outdoor dry-type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
 2. Rating and winding connections shall be as shown on the drawings.
 3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
 4. Copper windings.
 5. Insulation systems:
 - a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
 - b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
 6. Core and coil assemblies:
 - a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
 - b. Cores shall be grain-oriented, non-aging, and silicon steel.
 - c. Coils shall be continuous windings without splices except for taps.
 - d. Coil loss and core loss shall be minimized for efficient operation.
 - e. Primary and secondary tap connections shall be brazed or pressure type.
 - f. Coil windings shall have end filters or tie-downs for maximum strength.
 7. Average audible sound levels shall comply with NEMA.
 8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
 9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.

10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
 - a. Comprised of not less than code gauge steel.
 - b. Outdoor enclosures shall be NEMA 3R.
 - c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
 - d. Ventilation openings shall prevent accidental access to live components.
 - e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy's 10 CFR Part 431.

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. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Exterior Location: Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (6 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (3 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turn-ups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab

surface. Concrete work shall be as specified in Section 03 30 53, CAST-IN-PLACE CONCRETE.

- D. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform tests in accordance with the manufacturer's recommendations, and as required below:

1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
- d. Perform specific inspections and mechanical tests as recommended by manufacturer.
- e. Verify correct equipment grounding.
- f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

---END---

**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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical 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 fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

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-15.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
 - PB 1-11.....Panelboards
 - 250-14.....Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
 - 70E-15.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
 - 50-15.....Enclosures for Electrical Equipment
 - 67-09.....Panelboards
 - 489-16.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings.
- 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 as shown on the drawings.
- 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. In seismic areas, panelboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Develop schedules of circuits to reflect final load descriptions, room numbers, and room names connected to each circuit breaker of the panelboards. Each schedule of circuits shall be printed on the panelboard directory card and installed in the appropriate panelboard, after being reviewed and approved by the Resident Engineer/COR.
- E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1.98 m (78 inches).
- F. Provide blank cover for each unused circuit breaker mounting space.
- G. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims with finishes to match surrounding surfaces after the panelboards have been installed. Do not paint nameplates.
- H. 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.
- I. 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. Vacuum-clean enclosure interior. Clean enclosure exterior.

---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 apply 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 Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
 - WD 1-15.....General Color Requirements for Wiring Devices
 - WD 6-16Wiring Devices - Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-16.....Surface Metal Raceways and Fittings
 - 20-10.....General-Use Snap Switches
 - 231-16.....Power Outlets
 - 467-13.....Grounding and Bonding Equipment
 - 498-12.....Attachment Plugs and Receptacles
 - 943-16.....Ground-Fault Circuit-Interrupters
 - 1449-14.....Surge Protective Devices
 - 1472-15.....Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
 - 1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.

2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles – specification 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. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, specification-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 milli-amperes and shall function to interrupt the current supply for any value of ground leakage current above five milli-amperes (+ 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.
 4. Tamper-Resistant Duplex Receptacles:
 - a. Bodies shall be gray in color.
 - 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
 - 2) Screws exposed while the wall plates are in place shall be the tamperproof type.
- C. Receptacles – 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.

- D. 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, single-pole or three-way as shown on the drawings.
- 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.
- B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

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 grade. See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.

3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.

4. Conductors shall be as specified in Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.

5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.

6. Bond the assemblies to the branch circuit conduit system.

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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. 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 applicable codes. 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.

---END---

**SECTION 26 29 11
MOTOR CONTROLLERS**

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of all motor controllers.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical 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 fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, weights, mounting details, materials, overcurrent protection devices, overload relays, sizes of enclosures, wiring diagrams, starting characteristics, interlocking, and accessories.
 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - 1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.

- 2) Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
- 3) Elementary schematic diagrams shall be provided for clarity of operation.
- 4) Include the catalog numbers for the correct sizes of overload relays for the motor controllers.
- 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 motor controllers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the motor controllers 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 basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 519-14.....Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
 - C37.90.1-12.....Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- C. International Code Council (ICC):
 - IBC-15.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
 - ICS 1-15.....Industrial Control and Systems: General Requirements
 - ICS 1.1-15.....Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
 - ICS 2-05.....Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
 - ICS 4-15.....Industrial Control and Systems: Terminal Blocks

ICS 6-11.....Industrial Control and Systems: Enclosures
 ICS 7-14.....Industrial Control and Systems: Adjustable-
 Speed Drives

ICS 7.1-14.....Safety Standards for Construction and Guide for
 Selection, Installation, and Operation of
 Adjustable-Speed Drive Systems

E. National Fire Protection Association (NFPA):

70-17.....National Electrical Code (NEC)

F. Underwriters Laboratories Inc. (UL):

508A-13.....Industrial Control Panels

508C-16.....Power Conversion Equipment

UL 1449-14.....Surge Protective Devices

PART 2 - PRODUCTS

2.1 MOTOR CONTROLLERS

- A. Motor controllers shall comply with IEEE, NEMA, NFPA, UL, and as shown on the drawings.
- B. Motor controllers shall be separately enclosed, unless part of another assembly.
- C. Motor controllers shall be combination type, with magnetic controller per Paragraph 2.3 below and with circuit breaker or motor circuit protector disconnecting means, with external operating handle with lock-open padlocking positions and ON-OFF position indicator.
- 1. Circuit Breakers:
 - a. Bolt-on thermal-magnetic type with a minimum interrupting rating as indicated on the drawings.
 - b. Equipped with automatic, trip free, non-adjustable, inverse-time, and instantaneous magnetic trips for less than 400A. The magnetic trip shall be adjustable from 5x to 10x for breakers 400A and greater.
 - c. Additional 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, a common trip bar for all poles, and one operator for all poles.
- 2. Motor Circuit Protectors:
 - a. Magnetic trip only.

- b. Bolt-on type with a minimum interrupting rating as indicated on the drawings.
 - c. Equipped with automatic, adjustable magnetic trip. Magnetic trip shall be adjustable up to 1300% of the motor full load amperes.
- D. Enclosures:
- 1. Enclosures shall be NEMA-type rated 1, 3R, or 12 as indicated on the drawings or as required per the installed environment.
 - 2. Enclosure doors shall be interlocked to prevent opening unless the disconnecting means is open. A "defeater" mechanism shall allow for inspection by qualified personnel with the disconnect means closed. Provide padlocking provisions.
 - 3. All metal surfaces shall be thoroughly cleaned, phosphatized, and factory primed prior to applying light gray baked enamel finish.
- E. Motor control circuits:
- 1. Shall operate at not more than 120 Volts.
 - 2. Shall be grounded, except where the equipment manufacturer recommends that the control circuits be isolated.
 - 3. For each motor operating over 120 Volts, incorporate a separate, heavy duty, control transformer within each motor controller enclosure.
 - 4. Incorporate primary and secondary overcurrent protection for the control power transformers.
- F. Overload relays:
- 1. Thermal type. Devices shall be NEMA type.
 - 2. One for each pole.
 - 3. External overload relay reset pushbutton on the door of each motor controller enclosure.
 - 4. Overload relays shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 5. Thermal overload relays shall be tamperproof, not affected by vibration, manual reset, sensitive to single-phasing, and shall have selectable trip classes of 10, 20 and 30.
 - 6. Electronic overload relays shall utilize internal current transformers and electro-mechanical components. The relays shall have ambient temperature compensation, single-phase protection, manual or automatic reset, and trip classes of 10, 15, 20 and 30.

The relay shall provide fault cause indication, including jam/stall, ground fault, phase loss, and overload.

- G. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular controller. H-O-A switch shall be operable without opening enclosure door. H-O-A switch is not required for manual motor controllers.
- H. Incorporate into each control circuit a 120 Volt, electronic time-delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time-delay relay is not required where H-O-A switch is not required.
- I. Unless noted otherwise, equip each motor controller with not less than two normally open (N.O.) and two normally closed (N.C.) auxiliary contacts.
- J. Provide green (RUN) and red (STOP) pilot lights.
- K. Motor controllers incorporated within equipment assemblies shall also be designed for the specific requirements of the assemblies.
- L. Additional requirements for specific motor controllers, as indicated in other specification sections, shall also apply.

2.2 MANUAL MOTOR CONTROLLERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Manual motor controllers shall have the following features:
 - 1. Controllers shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
 - 2. Units shall include thermal overload relays, on-off operator, red pilot light, normally open auxiliary contacts.
- C. Fractional horsepower manual motor controllers shall have the following features:
 - 1. Controllers shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
 - 2. Units shall include thermal overload relays, red pilot light, and toggle operator.

2.3 MAGNETIC MOTOR CONTROLLERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Controllers shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum NEMA size 1.

- C. Where combination motor controllers are used, combine controller with protective or disconnect device in a common enclosure.
- D. Provide phase loss protection for each controller, with contacts to de-energize the controller upon loss of any phase.
- E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity.
- F. Operating and Design Conditions:
 - 1. Elevation: 200 feet Above Mean Sea Level (AMSL)
 - 2. Temperatures: Maximum +110°F Minimum 25°F
 - 3. Relative Humidity: 95%

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. In seismic areas, motor controllers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Install manual motor controllers in flush enclosures in finished areas.
- D. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and electronic overload relay pickup and trip ranges.
- E. Adjust trip settings of circuit breakers and motor circuit protectors with adjustable instantaneous trip elements. Initially adjust at six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cool down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficiency motors if required). Where these maximum settings do not allow starting of a motor, notify Resident Engineer/COR before increasing settings.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.

- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage, required area clearances, and correct alignment.
- d. Verify that circuit breaker, motor circuit protector, and fuse sizes and types correspond to approved shop drawings.
- e. Verify overload relay ratings are correct.
- f. Vacuum-clean enclosure interior. Clean enclosure exterior.
- g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- h. Test all control and safety features of the motor controllers.
- i. For low-voltage variable speed motor controllers, final programming and connections shall be by a factory-trained technician. Set all programmable functions of the variable speed motor controllers to meet the requirements and conditions of use.

3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, provide one complete set of spare fuses for each motor controller.

3.4 INSTRUCTION

- A. Furnish the services of a factory-trained technician for two 4-hour training periods for instructing personnel in the maintenance and operation of the motor controllers, on the dates requested by the Resident Engineer/COR.

---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: General electrical requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

2. Manuals:
 - a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
 - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
 - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
 - IBC-15.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
 - KS 1-13.....Heavy Duty Enclosed and Miscellaneous
Distribution Equipment Switches (600 Volts
Maximum)
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 98-16.....Safety Enclosed and Dead-Front Switches
 - 248-1-11.....Safety Low Voltage Fuses
 - 489-16.....Safety Molded Case Circuit Breakers and Circuit
Breaker Enclosures

PART 2 - PRODUCTS**2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the open position.
 - 3. An arc chute for each pole.
 - 4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
 - 6. Fuse holders for the sizes and types of fuses specified.
 - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 - 8. Ground lugs for each ground conductor.
 - 9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

- A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 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 manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.
- D. Install nameplate identification signs on each enclosed switch or circuit breaker to identify the equipment controlled. Nameplate shall comply with section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Resident Engineer/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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that apply 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 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. Product Data: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.
 - a. Material and construction details include information on housing, optics system and lens/diffuser.
 - b. Physical dimensions and description.
 - c. Wiring schematic and connection diagram.
 - d. Installation details.
 - e. Energy efficiency data.
 - f. Photometric data based on laboratory tests complying with the Illuminating Engineering Society North America (IESNA) Lighting Measurements, testing and calculation guides.

- g. Lamp data including lumen output (initial and mean), color rendering index (CRI), rated life (hours) and color temperature (degrees Kelvin).
 - h. LED lighting fixtures including luminaire input voltage, total input wattage, lumens, color temperature (degrees Kelvin), CRI, lamp life (measured in accordance with IESNA standards), THD, driver life, and driver type.
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. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Resident Engineer/COR.
3. Certifications:
- a. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer/COR:
 - 1) Certification by the Contractor that the equipment has 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. American Society for Testing and Materials (ASTM):
 - C635/C635M-13.....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
- C. Environmental Protection Agency (EPA):
 - 40 CFR, Part 261.....Identification and Listing of Hazardous Waste
- D. Federal Communications Commission (FCC):
 - 47 CFR, Part 15.....Radio Frequency Devices
 - 47 CFR, Part 18.....Industrial, Scientific, and Medical Equipment
- E. Institute of Electrical and Electronic Engineers (IEEE):
 - C62.41.1-02.....Guide on the Surge Environment in Low Voltage (1000V and less) AC Power Circuits
- F. Illuminating Engineering Society North America (IESNA):

- LM-79-08.....Electrical and Photometric Measurements of
Solid-State Lighting Products
- LM-80-15.....Measuring Luminous Flux and Color Maintenance
of LED Packages, Arrays, and Modules
- LM-82-12.....Characterization of LED Light Engines and LED
Lamps for Electrical and Photometric Properties
as a Function of Temperature
- G. National Electrical Manufacturer's Association (NEMA):
- SSL 1-10.....Electronic Drivers for LED Devices, Arrays, or
Systems
- H. National Fire Protection Association (NFPA):
- 70-17.....National Electrical Code (NEC)
- 101-15.....Life Safety Code
- I. Underwriter Laboratories, Inc. (UL):
- 496-08.....Safety Lamp holders
- 924-16.....Emergency Lighting and Power Equipment
- 1598-08.....Luminaires
- 2108-15.....Standard for 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 ASTM, NEMA, 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; lens doors shall close in a light tight manner.
 4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.

- C. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- D. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- E. Metal Finishes:
 - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 - 2. Interior light reflecting finishes shall be white with a minimum of 85 percent reflectance, except where otherwise shown on the drawing.
 - 3. Exterior finishes shall be as shown on the drawings.
- F. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

2.3 EMERGENCY LIGHTING UNIT

- A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch. Comply with UL 924.
 - 1. Enclosure: Shall be impact-resistant thermoplastic which will protect components from dust, moisture, and oxidizing fumes from the battery. Enclosure shall be suitable for the environmental conditions in which installed.
 - 2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
 - 3. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be 10years.
 - 4. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.

5. Integral Self-Test/Self-Diagnostic: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing indicator.

2.4 LED EXIT LIGHT FIXTURES

- A. Exit light fixtures shall meet applicable requirements of NFPA, and UL.
- B. Housing and Canopy shall be made of die-cast aluminum.
- C. Door frame shall be cast or extruded aluminum, and hinged with latch.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 1. Electric LED exit light: maximum fixture wattage shall be 1 watt or less. Maintenance free Nickel-Cadmium battery with self-test/self-diagnostic features shall be provided integral with the unit.
 2. Inscription panels shall be cast or stamped aluminum a minimum of 2.25mm (0.090 inch) thick, stenciled with 150mm (6 inches) 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. The LED shall be rated minimum 20 years life.
 3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 4. 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. Voltages: Refer to Lighting Fixture Schedule.

2.5 LED LIGHT FIXTURES

- A. General:
 1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
 2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
 3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Operating Ambient Temperature range: -20° C. (-4° F.) to 50° C. (122° F.)

- c. Input Voltage: 120 - 277V ($\pm 10\%$) 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.
 - h. Drivers shall be accessible and serviceable from below the ceiling.
 - i. Where noted on the LIGHTING FIXTURE SCHEDULE or as shown on the drawings, provide with 0-10V dimming.
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 3500°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.
 - e. Modules and optic system/reflectors/lens shall be accessible and serviceable from below the ceiling.
- B. LED Downlights:
- 1. Housing, LED driver, and LED module shall be compatible and exchangeable if these components are from different manufacturers.
- C. LED Troffers:
- 1. Housing, LED driver, and LED module shall be compatible and exchangeable if these components are from different manufacturers.

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. 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 revamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.

4. Hardware for recessed fixtures:
 - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
 - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
5. 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.
- D. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- E. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- F. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- G. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the Resident Engineer/COR. Observe for visually detectable flicker over full dimming range.
- H. At completion of project, re-lamp/re-ballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Verify operation after installing luminaires and energizing circuits.

- - - END - - -

**SECTION 31 20 00
EARTH MOVING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Site preparation.
 2. Excavation.
 3. Filling and backfilling.
 4. Grading.
 5. Soil Disposal.
 6. Clean Up.

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 unstable material, including silts; and inorganic materials, including silts, too wet to be stable and any material with liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent optimum moisture content without going over at time of compaction, as defined by ASTM D 1557.
 2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proof-rolling, or similar methods.
 3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. When materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer (RE) approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by line located 1500 mm (5 feet) outside of principal building perimeter. Also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of line located 1500 mm (5 feet) 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. Percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1557.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill.
- 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 RE. 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 RE 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 will be paid on basis of Conditions of 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, or other man-made stationary features constructed above or below ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over excavated sub-grade in 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 contaminants as defined and determined by the RE or the Government's testing agency.
- S. Topsoil: Fertile, friable, natural topsoil of loamy character and characteristic of locality, capable of growing healthy horticultural crops of grasses.
- T. Pea gravel flower watering strip at columbarium and flower watering stations: washed aggregate to match gradation and color at the existing pea gravel flower water strip at columbarium court 2.
- U. Decomposed Granite: Aggregate to match gradation and color at the existing committal service shelter 2.

1.3 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.
- B. Classified Excavation: Removal and disposal of all material except that material not defined as Rock.
- C. Rock Excavation:
 - 1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material, firmly cemented, laminated, or foliated masses or conglomerate deposits, cannot be excavated with late-model, track-mounted hydraulic excavator; equipped with 1050 mm (42 inch) wide, short-tip-radius rock bucket; rated at minimum 103 kW (138 hp.) flywheel power with bucket-curling force of minimum 125 kN (28,090 lbf.) and stick-crowd force of minimum 84.5 kN (19,000 lbf.); measured according to SAE J-1179. Trenches in excess of 3000 mm (10 feet) wide and pits in excess of 9000 mm (30 feet) in either length or width are classified as open excavation.
 - 2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at minimum 157 kW (210 hp.) flywheel power and developing a minimum of

216 kN (48,510 lbf.) breakout force; measured according to SAE J-732.

3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 0.76 cubic meter (1 cubic yard) for open excavation, or 0.57 cubic meter (3/4 cubic yard) for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.
4. Definitions of rock and guidelines for equipment are presented for general information purposes only. Use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

1.4 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Nursery and Landscape Association (ANLA):
 1. 2004 - American Standard for Nursery Stock.
- C. American Association of State Highway and Transportation Officials (AASHTO):
 1. T99-15 - Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop.
 2. T180-15 - Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop.
- D. ASTM International (ASTM):
 1. D448-12 - Sizes of Aggregate for Road and Bridge Construction.
 2. D698-12 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/cu. ft. (600 kN m/cu. m.)).
 3. D1556-07 - Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 4. D1557-12 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2700 kN m/cu. m.)).
 5. D2167-15 - Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 6. D2487-12 - Soil for Engineering Purposes (Unified Soil Classification System).

7. D2922-12 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 8. D2940-15 - Graded Aggregate Material for Bases or Subbases for Highways or Airports.
- E. Society of Automotive Engineers (SAE):
1. J732-12 - Specification Definitions - Loaders.
 2. J1179-08 - Hydraulic Excavator and Backhoe Digging Forces.

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. Plot plan showing elevation.
 3. Blasting Plan: Determine blasting plan requirements. Obtain approval from all required local, state, and federal and forward to Architect/Engineer for review. Prepare and submit comprehensive blasting plan as follows:
 - a. Preblast survey.
 - b. Preblast meeting.
 - c. Test blast.
 - d. Typical controlled blasts showing perimeter control methods.
 - e. Changes in approved blasting plan, 21 days before planned blasting operations.
- C. Submit scale plan daily showing location, limits, and depths of excavated area.
- D. Samples:
1. Decomposed Granite.
 2. Pea Gravel for Columbarium Flower Strip.
- E. Test Reports: Certify each product complies with specifications.
1. Rock Excavation Report:
 - a. Excavation method.
 - b. Labor.
 - c. Equipment.
 - d. Land Surveyor's or Architect/Engineer's name and official registration stamp.
 2. Subbase Materials: ASTM D 2940.

3. Soil Materials: For each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill:
 - a. Classification: ASTM D2487.
 - b. Laboratory Compaction Curve: ASTM D 1557.
- F. Certificates: Certify each product complies with specifications.
 1. Rock quantities excavated.
- G. Qualifications: Substantiate qualifications comply with specifications.
 1. Manufacturer with project experience list.
 2. Fabricator with project experience list.
 3. Installer with project experience list.
- H. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.
 1. Show location and magnitude of loads applied to building structural frame.
 2. Identify deviations from details shown on drawings.

1.6 QUALITY ASSURANCE

- A. Manufacturer, Fabricator, Installer Qualifications:
 1. Regularly manufactures, fabricates, and/or installs specified products.
 2. Manufactured, Fabricated, and/or 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.
- B. Installer Qualifications: Product manufacturer. Manufacturer authorized representative.
 1. Regularly installs specified products.
 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- C. 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.
- D. Mockups:

1.7 FIELD CONDITIONS

- A. Existing Conditions: Document site features in the vicinity of structures with pre-excavation photographs and videotape, including surface finishes, cracks, or other structural blemishes that might misconstrued as damage caused by earthwork operations.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 SYSTEM PERFORMANCE**

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.
 - 1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by RE when deviations do not affect design concept and specified performance.
- B. Design the following:
 - 1. Temporary support of excavation system.
 - 2. Underpinning.

2.2 MATERIALS

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, 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.
 - 1. Dry Density: 1760 kg/cubic meter (110 pcf) minimum.
 - 2. Plasticity Index: 15 maximum.
 - 3. Liquid Limit: 40 maximum.
- C. Engineered Fill: Naturally or artificially graded mixture; ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or approved by the Architect/Engineer, or material with at least 90 percent passing a 37.5-mm (1 1/2 inch) sieve and maximum 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with

100 percent passing a 25 mm (1 inch) sieve and maximum 8 percent passing a 75-µm (No. 200) sieve.

- E. Drainage Fill: 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.
- F. Granular Fill:
 - 1. Under Concrete Slab: Crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), ASTM D2940.
 - 2. Bedding for Sanitary and Storm Sewer Pipe: Crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), ASTM D2940.
- G. Decomposed Granite: Match existing gradation and color located at committal shelter 2. Install at a compacted depth as shown on the drawings at committal service shelter 3 and walkway at burial sections 33A and 33B.
- H. Pea Gravel at Columbarium Flower Strip and Flower Watering Stations: Match existing gradation and color located at columbarium court 2. Pea gravel shall be free of fines. Install at a depth as shown on the drawings.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing:
 - 1. Clear within limits of earthwork operations as indicated on Drawings.
 - 2. Remove trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions.
 - 3. Remove materials from Cemetery Property.
- B. Grubbing:
 - 1. Remove stumps and roots 75 mm (3 inch) and larger diameter.
 - 2. Leave undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects minimum 900 mm (3 feet) below subgrade or finished embankment.
 - 3. Do not leave material within burial profile up to 2400 mm (8 feet) below finished grade.
- C. Trees and Shrubs:

1. Remove trees and shrubs, not shown for removal, within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines, when approved in advance by RE.
2. Remove materials from Cemetery Property.
3. Dig trees and shrubs with a ball of earth and burlap indicated to be relocated, according to "American Standard for Nursery Stock" of the American Association of Nurserymen, Inc.
4. Transplant trees and shrubs to a permanent or temporary position within two hours after digging.
5. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding liquid fertilizer semiannually with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus, and 5 percent potash.
6. Maintain plants moved to permanent positions as specified for plants in temporary locations until substantial completion.
7. Protect existing trees and shrubs. Trim, clean, and paint damaged existing trees and shrubs including roots, according to standard industry horticultural practice for the geographic area and plant species.
8. Do not store building materials closer to trees and shrubs to remain than farthest extension of their limbs.

D. Stripping Topsoil:

1. Strip topsoil within limits of earthwork operations.
2. Stockpile and protect topsoil as directed by RE.
3. Eliminate foreign materials larger than 0.014 cubic meter (1/2 cubic foot) in volume, from soil when stockpiled. Retain topsoil on station.
4. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading.
5. Do not do topsoil work on wet soil.
6. Test soil for chemicals, pesticides and fertilizers when topsoil is removed from formerly utilized farmland, to verify suitability for use in new lawn areas.

E. Concrete Slabs and Paving:

1. Score deeply or saw cut existing concrete slabs and paving to be removed in a neat, straight cut, sections where excavation or trenching occurs.

2. Extend pavement section, minimum 300 mm (12 inches) both sides of widest part of trench excavation. Provide parallel final score lines, unless otherwise indicated on Drawings.
 3. Remove material from Cemetery Property.
- F. Lines and Grades: Establish by Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS.
1. Grades: Conform to elevations indicated on Drawings, within the tolerances herein specified.
 - a. Establish grades free from irregular surface changes.
 - b. Comply with compaction requirements and grade cross sections, lines, and elevations indicated on Drawings. Establish grade based on interpolation of elevations between spot grades when indicated on Drawings, while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
 2. Locations of existing elevations indicated on Drawings, except spot elevations, are approximate based on site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Notify RE of any differences between existing elevations indicated on Drawings and those encountered on site by Architect/Engineer. Notify RE of any differences between existing or constructed grades, as compared to those indicated on the Drawings.
 3. Subsequent to establishment of lines and grades, provide additional cut and fill required for site grading to conform to elevations indicated on Drawings.
 4. Finish grading specified in Section 32 90 00, PLANTING.
- G. Disposal:
1. Removed materials from site and disposed of at legally approved site.
 2. Comply with applicable Federal, State and local regulations.
 3. Do not burn materials on site.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose banks of excavations or to an angle acceptable by the RE, to protect workmen, banks, adjacent paving, structures, and utilities.
1. Begin construction of excavation system support after review by RE.

2. Extend shoring and bracing minimum 1500 mm (5 feet) below bottom of excavation. Shore excavations carried below elevations of adjacent existing foundations.
 3. When foundation bearing material is disturbed by excavation, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, underpin existing foundation, install concrete fill support, comply with Section 31 23 23.33, FLOWABLE FILL, under disturbed foundations, as directed by RE. Do not remove shoring until permanent work IS inspected and approved by RE.
- B. Excavation Drainage:
1. Operate pumping equipment, and/or provide other materials, means and equipment to keep excavation free from water and subgrade dry, firm, and undisturbed until permanent work is approved by RE.
 2. Obtain approval from RE before placement of permanent work on subgrades.
- C. Subgrade Protection:
1. Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation.
 2. Reroute surface water runoff from excavated areas a. Do not use excavated trenches as temporary drainage ditches.
 3. Remove disturbed material to firm undisturbed material after water is brought under control, when subgrade for foundations is disturbed by water.
 4. Replace disturbed subgrade in trenches with concrete or material approved by RE.
- D. Blasting: Blasting of materials classified as rock is permitted only when authorized by RE. Comply with all federal, state, and local requirements.
- E. Perform blasting with explosives of quantity and power, fired in sequence and locations not to injure personnel, damage or crack adjacent structure, property, or existing work or other portions of new work.
- F. Proofrolling:
1. Proofroll exposed subgrade with fully loaded dump truck to check for pockets of soft material.
 2. Proofroll subgrade at least two complete passes, one pass in a direction perpendicular to first one. Remove areas that deflect,

rut, or pump excessively during proof rolling, or fail to consolidate after successive passes to suitable soils. Replace with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

G. Building Earthwork:

1. Excavate foundation excavations to solid undisturbed subgrade.
2. Remove loose or soft materials to a solid bottom.
3. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
4. Do not tamp earth for backfilling in footing bottoms.
5. Slope grades to direct water away from excavations and to prevent ponding.

H. Trench Earthwork:

1. Utility Trenches (Except Sanitary and Storm Sewer):
 - a. Excavate to width required for sheeting and bracing and proper performance of Work.
 - b. Grade bottom of trenches with bell holes scooped out to provide uniform bearing.
 - c. Support piping on undisturbed earth unless mechanical support is indicated on Drawings.
 - d. Length of open trench in advance of piping laying not be greater than authorized by RE.
2. Sanitary and Storm Sewer Trenches:
 - a. Trench Width:
 - 1) Below Point 150 mm (6 inches) Above Top of Pipe:
 - a) Pipe up to 300 mm (12 inches): 600 mm (24 inches) maximum diameter.
 - b) Pipe Larger than 300 mm (12 inches): Four-thirds pipe diameter plus 200 mm (8 inches).
 - 2) Trench Width Above 150 mm (6 inches): Pipe size as required for sheeting and bracing and proper performance of the Work.
 - b. Bed Bottom Quadrant of Pipe:
 - 1) Undisturbed Soil: Bell holes no larger than required for jointing. Backfill with clean earth, placed and tamped by hand, maximum 300 mm (12 inches) above top of pipe.
 - 2) Granular Fill: Depth of fill minimum 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 excess backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bed where rock or rocky materials are excavated.

I. Site Earthwork:

- 1. General: Earth excavation includes pavement excavation and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; including soil, boulders, and other materials not classified as rock or unauthorized excavation. Perform excavation as indicated on Drawings and as follows:
 - a. Excavate to elevations and dimensions indicated on Drawings within a tolerance of plus or minus 25 mm (1 inch).
 - b. Extend excavations of sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and inspections. Comply with OSHA requirements.
 - c. Remove and replace unsuitable subgrade materials as determined by RE.
 - d. When unsuitable material is encountered and removed, contract price and time will be adjusted according to Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments will be based on volume in cut section only.
- 2. 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 25 mm (1 inch).
 - 3) Pavements: Plus or minus 13 mm (1 inch).
 - d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with 3000 mm (10 foot) straightedge.

3.3 FILLING AND BACKFILLING

- A. General: Fill or backfill when all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. Use excavated and borrow for fill and backfill, as applicable. Supply borrow materials. 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 in contact with backfill have been installed, and work inspected and approved by RE.
- B. Placing: Place materials in horizontal layers maximum 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and maximum 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 full length each structure. Do not place material on muddy, frozen, or with frost surfaces.
- C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other equipment (hand or mechanized) well to suit soil compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of RE. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to minimum 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 according to 95 percent.
 - b. Curbs, Curbs and Gutters: 95 percent.
 - c. Under Sidewalks: Scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material according to 95 percent.
 - d. Landscaped Areas Top 400 mm (16 inches): ASTM D1557 85 percent.

- e. Landscaped Areas Below 400 mm (16 inches) of Finished Grade:
ASTM D1557 90 percent.
- 2. Natural Ground (Cut or Existing):
 - a. Under Building Slabs, Steps and Paved Areas, Top 150 mm (6 inches): ASTM D1557 95 percent.
 - b. Curbs, Curbs and Gutters, Top 150 mm (6 inches): ASTM D1557 95 percent.
 - c. Under Sidewalks, Top 150 mm (6 inches): ASTM D1557 95 percent.

3.4 GRADING

- A. General: Uniformly grade areas within limits specified below, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between points and existing finished grades. Provide 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 with minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as indicated on Drawings, to level, uniform slope and leave clean.
- E. Finished grade minimum 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is indicated on Drawings.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped and leveled, 150 mm (6 inches) thick, unless otherwise indicated on Drawings.
- G. Finish subgrade in condition acceptable to RE at least one day in advance of paving operations. Maintain finished subgrade in smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade before further construction when approved compacted subgrade is disturbed by subsequent operations or adverse weather.
- H. Tolerances:
 - 1. Subgrade and Base Course Final Grade for Paved Areas: Plus or minus 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 off Cemetery property.
- B. Disposal: Transport surplus satisfactory soil to designated storage areas on Cemetery property. Stockpile or spread soil as directed by RE.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of Cemetery property.
- C. Place excess excavated materials suitable for fill and/or backfill on site where directed by RE.
- D. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- E. Segregate all excavated contaminated soil designated by the RE from all other excavated soils, and stockpile on site on two 0.15 mm (six 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.

3.6 CLEANING

- A. Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Clean site, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Cemetery Property.

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**SECTION 31 23 19
DEWATERING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Implementation of Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. Provide all labor, materials, tools, equipment, power, and services necessary for care of water and erosion control. Begin excavation work before the approved Erosion and Sedimentation Control Plan is in place.

1.2 RELATED REQUIREMENTS

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Erosion Control: Section 01 57 23, TEMPORARY STORM WATER POLLUTION CONTROLS.

1.3 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show drawings and data with method employed in dewatering excavated areas, 30 days before commencement of excavation.
 - 2. Show location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey water from site to adequate disposal. Show details of the dewatering facilities, including equipment and erosion protection. Include facilities and procedures for insuring discharge water quality according to the applicable provisions of

Erosion Control Plan or SWPPP or NPDES requirements, Section 01 57 23, TEMPORARY STORM WATER POLLUTION CONTROLS.

3. Include written report outlining control procedures to be adopted when a dewatering problem arises.
 4. Submit materials in format acceptable to all regulatory agencies.
- C. Inspection Reports.
- D. All required permits.
- E. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.
1. Identify deviations from details shown on drawings.

1.4 QUALITY ASSURANCE

- A. Permitting Requirements: Comply and obtain required Federal, State, and County permits where Work is performed.
- B. Comply and provide information to Resident Engineer (RE), all conditions of regulating permits. Obtain written approval from RE before discontinuing operation of dewatering system.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Dewatering: Lower and control ground water table levels and hydrostatic pressures and control surface water.

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.
1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by RE when deviations do not affect design concept and specified performance.
- B. Design dewatering system complying with specified performance:
1. Size and Capacity: At least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench.
 2. Reduce hydrostatic head below excavation surface minimum 300 mm (1 foot) until backfill has been completed at least 300 mm (1-foot) above the initial observed groundwater level.
 3. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
 4. Maintain stability of sides and bottom of excavation.

5. Construction operations are performed in the dry subgrade.
6. Control of surface and subsurface water as part of dewatering requirements. Maintain adequate control.
 - a. Stabilize excavated and constructed slopes not adversely affected by saturated soil.
 - b. Control erosion.
 - c. Flooding of excavations or damage to structures does not occur.
 - d. Surface water drains away from excavations.
 - e. Protect excavations of becoming wet from surface water before additional work is undertaken.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install dewatering system to lower and control ground surface water to permit excavation, construction of structure, and placement of backfill materials in dry conditions. Make dewatering system adequate to pre-drain the water-bearing strata above and below bottom of structure foundations, utilities and other excavations.
- B. Reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, minimum 300 mm (1 foot) below prevailing excavation surface.
- C. Operation:
 1. Place dewatering system in operation before excavation below ground water table. Operate system continuously 24 hours a day, 7 days a week until construction work below existing ground water level is complete.
 2. Place adequate weight of backfill material to prevent buoyancy before discontinuing operation of the system.
- D. Water Disposal:
- E. Dispose water removed from excavations in such a manner as:
 - a. Avoid endanger portions of work under construction or completed.
 - b. Avoid inconvenience to Government or to others working near site.
 - c. Comply with permit regulations for disposal of water.
 - d. Control Runoff: Control runoff in work areas including but not limited to excavations, access roads, parking areas, laydown, and staging areas. Provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to

divert, collect, and remove all water from the work areas.

Remove water from work areas and dispose according to applicable permits.

2. Excavation Dewatering:

- a. Divert, collect, control, and remove water from construction work areas and excavations.
 - b. Arrange drainage features and alter as required to avoid degradation of the final excavated surfaces.
 - c. Utilize all necessary erosion and sediment control measures to avoid construction related degradation of natural water quality.
3. Remove and dispose surface and ground water entering excavations, trenches, and work areas during construction. Keep excavation dry during subgrade preparation and until construction is complete and pipe is installed to avoid damage from hydrostatic pressure, flotation, or other cause will result.

F. Standby Equipment:

1. Install complete standby equipment for immediate operation, as required to maintain de-watering on a continuous basis and in the event that all or any part of the system become inadequate or fail.

G. Corrective Action:

1. Perform work necessary to restore foundation soil and damaged structure resulting from failure of dewatering system.

H. Damages:

1. Immediately repair damages to adjacent facilities caused by dewatering operations.

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**SECTION 31 23 23.33
FLOWABLE FILL**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cementitious slurry used as fill or backfill in lieu of compacted earth.

1.2 DEFINITIONS

- A. Flowable Fill: Ready-Mix Controlled Low Strength Material used as an alternative to compacted soil, and is also known as controlled density fill, and several other names, some of which are trademark names of material suppliers. Flowable fill (Controlled Low Strength Material) differs from Portland Cement concrete as it contains low cementitious content to reduce strength development for possible future removal. Design strength for this permanent type flowable fill is 2.1 MPa (300 psi) minimum compressive strength at 28 days. Chemical admixtures may also be used in flowable fill to modify performance properties of strength, flow, set and permeability.
- B. Excavatable Flowable Fill: Flowable fill designed with compressive strength that will allow excavation as either machine tool excavatable at maximum compressive strength of 1.5 MPa (200 psi) at 1 year, or hand tool excavatable at maximum compressive strength of 0.7 MPa (100 psi) at 1 year.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Concrete Institute (ACI):
1. 229R-13 - Report on Controlled Low-Strength Materials.
- C. ASTM International (ASTM):
1. C33/C33M-16 - Concrete Aggregates.
 2. C39/C39M-16 - Compressive Strength of Cylindrical Concrete Specimens.
 3. C150/C150M-16 - Portland Cement.
 4. C260/C260M-10a - Air-Entraining Admixtures for Concrete.
 5. C494/C494M-15a - Chemical Admixtures for Concrete.
 6. C940-16 - Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 - 1. Required Participants:
 - a. Resident Engineer (RE).
 - 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.
 - 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. Submit according to Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Pre-Approval Procedures: Use of flowable fill during any part of project is restricted to those incidences where, due to field conditions, Contractor has made RE aware of conditions for which he recommends use of flowable fill, and RE has confirmed those conditions and approved use of flowable fill, in advance. During submittal process, prepare and submit various flowable fill mix designs corresponding to required conditions or if flowable fill is desired for economic reasons. Obtain RE approval of flowable fill strength through submittal process, when Contractor desires, or is required, to use flowable fill at specific locations within project. Before beginning

field operations, establish procedures to maintain optimum working conditions and coordinate this work with related and adjacent work.

- C. Flowable Fill Mix Design: Provide mix design containing cement and water. At Contractor's option, it may also contain fly ash, aggregate, or chemical admixtures in any proportions such that final product meets specified strength and flow consistency and shrinkage requirements.
- D. Certificates: Certify products incorporated in flowable fill, following achievement of the required strength, do not represent a threat to groundwater quality.
- E. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer with project experience list.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.

1.7 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.

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. Environment:
 - 1. Weather Limitations: Install flowable fill only when approved in advance by RE and when existing and forecasted weather conditions are within limits established by manufacturer of materials and products used.

1.10 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 SYSTEM DESCRIPTION**

- A. Flowable Fill: Fluid that sets within required time and, after curing, obtains desired strength properties as evidenced by laboratory testing of specific mix design, at locations shown on drawings or as directed by RE, in writing/. Flowable fill for use as structural fill to remain easily excavatable using a backhoe as would be utilized for adjoining earth.

2.2 PRODUCTS

- A. Provide each product from one manufacturer. If not otherwise specified, comply with ACI 229R recommendations.
1. Portland Cement: ASTM C150/C150M, Type 2. Meeting California State DOT standards.
 2. Mixing Water: Fresh, clean, and potable. Meeting California State DOT standards for use as mix-water for cast-in-place concrete.
 3. Air-Entraining Admixture: ASTM C260/C260M.
 4. Chemical Admixtures: ASTM C494/C494M.
 5. Aggregate: ASTM C33/C33M.

2.3 MIXES

- A. Flowable Fill Mix: Provide minimum cementitious materials and water. Cementitious materials to be portland cement, pozzolanic materials, or other self-cementing materials, or combinations thereof, at Contractor's option, provided certification of no degradation of groundwater quality has been submitted. Flowable fill mix design may also contain, fine aggregate or filler, and chemical admixtures in any proportions for final product to meet specified strength, flow consistency and shrinkage requirements.
1. Mix Design: Consistency that at time of placement does not require manual means for placement.
 2. Minimum Strength: 2.1 MPa (300 psi) according to ASTM C39/C39M at 28 days after placement.
 3. Minimum Subsidence and Bleed Water Shrinkage: Bleed water evaporation to result in maximum 10.4 mm per m (1/8 inch per foot) shrinkage of flowable fill depth (for mixes containing high fly ash content), as measured in ASTM C940 Section 10.
 4. Flowable Fill Unit Weight: 115-145 lbs/cu. yd. measured at point of placement after 60-minute ready-mix truck transport. If strength

data is not submitted, maximum cementitious content to be
150 lbs/cu. yd.

- B. In-Place Yield: Minimum 98 percent of design yield for permanent type;
Maximum 110% of design yield for removable types at 1 year.
- C. Provide equipment as recommended by manufacturer and comply with
manufacturer's instructions for addition of additives, at production
plant or before placement at project site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.

3.2 FLOWABLE FILL APPLICATION

- A. Secure tanks, pipes and other members to be encased in flowable fill.
Ensure that no exposed metallic pipes, conduits, or other items will be
in contact with flowable fill after placement. If so, replace with
non-metallic materials or apply manufacturer's recommended coating to
protect metallic objects before flowable fill placement. Replacement or
protection of metallic objects is subject to RE approval.

3.3 PROTECTION

- A. Protect exposed surfaces of flowable fill from premature drying, wash
by rain or running water, wind, mechanical injury, and excessively hot
or cold temperature, by curing method subject to RE approval.

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SECTION 31 32 23
PRESSURE GROUTING SOIL STABILIZATION

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Lime slurry application into ground at specified intervals within (10 feet) on either side of new road for entire length of new road.

1.2 APPLICABLE PUBLICATIONS**A. Comply with references to extent specified in this section.****B. ASTM International (ASTM):**

1. C977-10 - Quicklime and Hydrated Lime for Soil Stabilization.

C. D1586-11 - Standard Penetration Test (SPT) and Split-Barrel Sampling.**1.3 PREINSTALLATION MEETINGS****A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.****1. Required Participants:**

- a. Resident Engineer (RE).
- b. Architect/Engineer.
- c. Inspection and Testing Agency.
- d. Contractor.
- e. Installer.
- f. Manufacturer's field representative.

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.

1.4 SUBMITTALS

- A. Submit according to 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. Application instructions.
- D. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.

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.
- B. Preconstruction Testing:
 - 1. Engage independent testing laboratory to perform tests and submit reports.

1.6 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 SYSTEM DESCRIPTION**

- A. Lime slurry application to chemically transform unstable soils to provide strong and stable base in road construction.

2.2 LIME SLURRY

- A. Lime Slurry: Pumpable suspension of hydrated lime in water.
 - 1. Water: May not contain dissolved material in sufficient quantity and/or nature injurious nor objectionable for the purpose intended.
 - 2. Solids: Hydrated lime of quality and fineness sufficient to meet ASTM C977, for chemical composition and residue.

- B. Proportion: 300 to 350 kilograms per cubic meter (2-1/2 to 3 pounds per gal.) hydrated lime to water. Check specific gravity of slurry with Ertco Hydrometer No. 2545 or equivalent. Specific gravity readings to range from 1.14 to 1.16, which is dimensionless ratio of fluid's density to standard reference density.
- C. Surfactant: Include wetting agent approved by testing lab in lime slurry, according to manufacturer's recommendations, but in no case less than one part per 5.7 cubic meters (1500 gallons) of water.

2.3 EQUIPMENT

- A. Equipment: Suitable for work, as approved by the testing lab, constructed to provide positive seal to prevent slurry from flowing out onto ground, with controls and gauges for setting and determining pressure.
- B. Packers: Acceptable type and length, minimum 100 mm (4 inches) diameter, to prevent slurry from flowing out onto ground surface.
- C. Mixer Tanks: Approved by the testing lab and continuously agitated to ensure uniformity of mixture.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shape subgrade rough to designed grades and scarified or plowed so excess slurry will be trapped within specified limits.
- B. Pre-drill holes to accommodate inflatable packers to 900 mm (3 feet). Provide injection spacing maximum 1500 mm (5 feet) on center in each direction and extend minimum 3000 mm (10 feet) beyond limits of new asphalt road and concrete curb and gutter.
- C. Set and inflate packer or seal holes.

3.2 LIME SLURRY APPLICATION

- A. Inject each hole through packer at minimum 350 kPa (50 psi) pressure and maximum 1400 kPa (200 psi) pump pressure, adjusted to disperse maximum slurry volume, and continue to inject slurry to refusal, as defined by testing lab.
- B. Continuously agitate lime slurry to ensure mixture uniformity. Make specific gravity checks at both mixer tanks and injectors at rate of no less than one test per four hours agitation.
- C. Apply excess lime slurry evenly across scarified or plowed sub-grade during stabilization process. Scarify excess slurry ponded on ground

surface into soil and soil-lime mixture re-compacted to sub-grade specifications before fill placement, if required.

3.3 FIELD QUALITY CONTROL

- A. Field Inspections: Testing lab representative will inspect the work, measure mixture specific gravity, determine suitable equipment operation, and determine injection refusal point.
- B. Acceptance of soil stabilization will be on basis of continuous on-site inspection and testing by testing lab representative. At testing lab's discretion, on-site testing may include before and after testing of sub-grade soils to evaluate stabilization process. Post installation tests will typically be performed seven days after injection to ensure interaction of lime and soil mixture. Typical tests may include standard penetration tests according to ASTM D1586 or similar test as considered applicable by testing laboratory. More than one lime slurry injection may be required at portions of the site to meet testing lab approval.
- C. Submit weight certification to testing lab for all lime delivered to site for use in stabilization.

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**SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Site work concrete.
2. Integrally Colored Concrete:
 - a. Columbaria Court
 - b. Cortege Lane
3. Curb, gutter, and combination curb and gutter.
4. Pedestrian Pavement: Walks, flower/water stations, wheelchair curb ramps, plaza areas and steps.
5. Equipment Pads: Transformers, 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. C94/C94M-16 - Ready-Mixed Concrete.
 2. C143/C143M-15a - Slump of Hydraulic Cement Concrete.
 3. C979/C979M-16 - Pigments for Integrally Colored 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. Resident Engineer (RE).
 - 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, and traffic markings.
 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. Samples:
 1. Submit pigment manufacturer's color chart or chip set for color selection and approval; indicate pigment number and required dosage rate.
 2. Colored Concrete Panel: As specified in Section 09 06 00, SCHEDULE FOR FINISHES, with mix data.
 3. Construct 2.4 m by 2.4 m by 100 mm (8 feet by 8 feet by 4 inch) sample panel of integrally colored concrete pavement on project site, demonstrating materials, workmanship, scoring, stamping and curing methods to be used throughout project. Accepted sample panel provides visual standard for work of this section. Remove sample panel when no longer required for comparison with finished work.
 4. Cast in Place Truncated Domes:

- a. Product Data: Submit manufacturer's literature describing products, installation procedures and routine maintenance.
 - b. Samples for Verification Purposes: Submit two (2) tile samples minimum 12"x12" of the kind proposed for use.
 - c. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, south on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.
 - d. Material Test Reports: Submit complete test reports from qualified accredited independent testing laboratories to qualify that materials proposed for use are in compliance with requirements and meet or exceed the properties indicated on the specifications. All tests shall be conducted on a Cast In Place Detectable/Tactile Warning Surface Tile system as certified by a qualified independent testing laboratory.
 - e. Maintenance Instructions: Submit copies of manufacturer's specified installation and maintenance practices for each type of Detectable Warning Surface Tile and accessory as required.
- E. Test Reports: Certify products comply with specifications.
- 1. Job-mix formula.
 - 2. Select subbase materials.
- F. Certificates: Certify products comply with specifications.
- 1. Expansion joint filler.
 - 2. Reinforcement.
 - 3. Curing materials.
 - 4. Concrete protective coating.
- G. Qualifications: Substantiate qualifications comply with specifications.
- 1. Installer with project experience list.
 - 2. Land surveyor.
- H. Concrete mix design.
- I. 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, color, 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 C, 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.
- E. Fiber Reinforcement: Polypropylene fibers designed for use in concrete pavement, complying with ASTM C1116/C116M, Type III, 13 to 38 mm (1/2 to 1 1/2 inches) long. Include 2.27 kg (5 lbs.) per .76 cu. m (1 cu. yd.) of concrete in batch.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase: Select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.
1. Materials meeting other gradations than that noted will be acceptable whenever gradations are within tolerance of three to five

percent, plus or minus, of single gradation established by job-mix formula.

- B. Subbase Material: Compacted, dense-graded course, meeting specified density requirement.

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 and approved by pigment manufacturer for use with colored concrete.

2.6 EXPANSION JOINT FILLERS

- A. Expansion Joint Filler: AASHTO M213.

2.7 ACCESSORIES

- A. Equipment and Tools: Obtain RE'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.
- D. Cast in Place truncated domes
 - 1. Provide Cast In Place Detectable/Tactile Warning Surface Tiles and accessories as produced by a single manufacturer with a minimum of

five (5) years' experience in the manufacturing of Cast In Place Detectable/Tactile Warning Surface Tiles.

2. Installer's Qualifications: Engage an experienced Installer certified in writing by Cast In Place Detectable/Tactile Warning Surface Tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.
3. Americans with Disabilities Act (ADA): Provided Surface Applied Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA STANDARDS FOR ACCESSIBLE DESIGN, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES.
4. California Code of Regulations (CCR): Provide only approved DSAAC detectable warning products as provided in the California Code of Regulations (CCR) Title 24, Chapter 2, Section 202 definition of "Detectable Warning". Section 11B-247 and 11B-705 "Detectable Warnings and Detectable Directional Texture"
5. Vitrified Polymer Composite (VPC) Cast In Place Detectable/Tactile Warning Surface Tiles shall be an epoxy polymer composition with ultra violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2" height, 0.9" base diameter, and 0.45" top diameter, spaced center-to-center 2.35" to 2.40" as measured "In Line". For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 40 - 90 degree raised points 0.045" high, per square inch.
 - a. Dimensions: Cast In Place Detectable/Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:
 - Length and Width: [36x48] [36x60] nominal
 - Depth: 1.375 (1-3/8") (+/-) 5% max.
 - Face Thickness: 0.1875 (+/-) 5% max.
 - Warpage of Edge: 0.5% max.
 - Embedment Flange Spacing: shall be no greater than 3.1"
 - b. Water Absorption of Tile when tested by ASTM D 570-98 not to exceed 0.05%.

- c. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficients of Friction not to be less than 0.80 on top of domes and field area.
- d. Compressive Strength of Tile when tested by ASTM D 695-02a not to be less than 28,000 psi.
- e. Tensile Strength of Tile when tested by ASTM D 638-03 not to be less than 19,000 psi.
- f. Flexural Strength of Tile when tested by ASTM D 790-03 not to be less than 25,000 psi.
- g. Chemical Stain Resistance of Tile when tested by ASTM D 543-95 (re approved 2001) to withstand without discoloration or staining - 10% hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10% ammonium hydroxide, 1% soap solution, turpentine, Urea 5%, diesel fuel and motor oil.
- h. Abrasive Wear of Tile when tested by BYK - Gardner Tester ASTM D 2486-00 with reciprocating linear motion of 37± cycles per minute over a 10" travel. The abrasive medium, a 40 grit Norton Metallite sand paper, to be fixed and leveled to a holder. The combined mass of the sled, weight and wood block is to be 3.2 lb. Average wear depth shall not exceed 0.060 after 1000 abrasion cycles when measured on the top surface of the dome representing the average of three measurement locations per sample.
- i. Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion per ASTM C501-84 (re approved 2002) shall not be less than 500.
- j. Salt and Spray Performance of Tile when tested to ASTM B 117-03 not to show any deterioration or other defects after 200 hours of exposure.
- k. AASHTO HB-17 single wheel HS20-44 loading "Standard Specifications for Highways and Bridges". The Cast In Place Tile shall be mounted on a concrete platform with a ½" airspace at the underside of the tile top plate then subjected to the specified maximum load of 10,400 lbs., corresponding to an 8000 lb individual wheel load and a 30% impact factor. The tile shall exhibit no visible damage at the maximum load of 10,400 lbs.
- l. Embedment flange spacing shall be no greater than 3.1" center to center spacing.

2.8 COLORED CONCRETE MATERIALS

- A. A. General - Products to comply with ASTM C979 Pigments for Integrally Colored Concrete
- B. Integral Dry Pigment Ready Mix Color Manufacturers:
 - 1. Colorflo by Solomon Colors
 - 2. Davis Colors
 - 3. Chromix by Scofield
 - 4. Prism Corporation
 - 5. Or approved equal.
- C. Colors: Provide selection from Manufacturer's full range of iron oxide based colors. Color locations as noted on the plans.
 - 1. Independent Slab/Field Color: Solomon Color - SGS Integral Color 920 Onyx.
 - a. Color is obtained using one 25 lb. bag per one yard of concrete.
- D. Proportions required by other listed manufacturers may vary and should be provided for.

2.9 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 SELECT SUBBASE (WHERE REQUIRED)

- A. Mixing: Proportion select subbase by weight or by volume in quantities so final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, to produce uniform blend.
- B. Placing:

1. Place mixed material on prepared subgrade in uniform layer to required contour and grades, to maximum 200 mm (8 inches) loose depth that, when compacted, will produce layer of required thickness.
2. When required compacted thickness exceeds 150 mm (6 inches), place subbase material in equal thickness layers. Remove unsatisfactory areas and replace with satisfactory mixture, or mix material in placement area.
3. Adding thin layers of material to top layer in order to meet grade will not be permitted.
4. When subbase elevation is 13 mm (1/2 inch) or more below grade, excavate top layer and replace with new material to minimum 75 mm (3 inches) compacted thickness.

C. Compaction:

1. Perform compaction with approved hand or mechanical equipment well suited to material being compacted.
2. Moisten or aerate material as required to provide moisture content that will readily facilitate obtaining specified compaction with equipment used.
3. Compact each subbase layer to minimum 95 percent or 100 percent of maximum density as specified by AASHTO T180 or AASHTO T99, respectively.

D. Tolerances:

1. Test completed subbase for grade and cross section with straight edge.
2. Surface Variation: Maximum 10 mm (3/8 inch) each layer.
3. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).

E. Protection:

1. Maintain finished subbase in smooth and compacted condition until concrete is placed.
2. When subsequent construction operations or adverse weather disturb approved compacted subbase, excavate and reconstruct subbase with new material meeting specified requirements, at no additional cost to Government.

3.3 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. Slip Form Curb:

1. Perform slip form curbing operation with adequate size equipment and forming shoe.

D. 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.

3.4 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 RE's approval of reinforcement placement before placing concrete.
- E. Synthetic Fiber in Flatwork: Uniformly disperse in concrete mixture at 3 kg/cu. m (5 lbs./cu. yd.) minimum rate.

3.5 MIXING PIGMENTS

- A. Mix pigments according to manufacturer's instructions. Mix until pigments are uniformly dispersed throughout mixture and bags disintegrated.

3.6 PLACING CONCRETE - GENERAL

- A. Preparation:
 - 1. Obtain RE'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.

3.7 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.

3.8 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 RE'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.

3.9 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.

3.10 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, gutter, and combination curb and gutter to be free of blemishes, form marks, and tool marks, and uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks, Flower Water Stations, 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, or as shown on plans.
 - 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.

3.12 CONCRETE FINISHING - VEHICULAR PAVEMENT

- A. 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.
- B. 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.

- C. 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.
- D. 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).
- E. Finish pavement edges and joints with edging tool.
- F. 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.
- G. Align finish surfaces where new and existing pavements abut.

3.13 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.

3.14 SPECIAL FINISHES

- A. Colored Concrete: Add integral color pigment to the pedestrian concrete paving mix at the batch plant. Introduce sufficient quantities of

mineral oxide pigment to produce the color specified in Section 09 06 00, SCHEDULE FOR FINISHES.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 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.

3.20 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 RE.
- 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.

3.21 CONCRETE PROTECTIVE COATING

- A. Apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against concrete exterior improvements to protect the concrete against deicing materials.
- B. Complete backfilling and curing operation before applying protective coating.
- C. Dry and thoroughly clean concrete before each application.
- D. Apply two coats, with maximum coverage of 11 sq. m/L (50 sq. yds./gal.) for first coat, and maximum 16 sq. m/L (70 sq. yds./gal.) for second coat, except apply commercially prepared mixture according to manufacturer's instructions.
- E. Protect coated surfaces from vehicular and pedestrian traffic until dry.
- F. Do not heat protective coating, and do not expose the protective coating to open flame, sparks, or fire adjacent to open containers or applicators. Do not apply material at temperatures lower than 10 degrees C (50 degrees F).

3.22 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.

3.23 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.

3.24 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 RE.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
1. When directed by RE, replace concrete containing cracking, fractures, spalling, and other defects within joint boundary, at no additional cost to Government.

- - - E N D - - -

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composition, mixing, and construction on prepared subgrade and protection of hot asphalt concrete pavement.
2. Cold milling.

1.2 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

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

1. 2016 - Standard Specifications for Transportation Materials and Methods of Sampling and Testing, and AASHTO Provisional Standards.
2. M320-10 - Performance-Graded Asphalt Binder.
3. T283-14 - Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage.

C. Asphalt Institute:

1. Specification SS2.

D. ASTM International (ASTM):

1. C29/C29M-16 - Bulk Density ("Unit Weight") and Voids in Aggregate.
2. C977-10 - Quicklime and Hydrated Lime for Soil Stabilization.
3. D3786/D3786M-13 - Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
4. D4355/D4355M-14 - Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
5. D4632/D4632M-15a - Grab Breaking Load and Elongation of Geotextiles.
6. D6390-11 - Draindown Characteristics in Uncompacted Asphalt Mixtures.

E. National Asphalt Paving Association (NAPA):

1. PS-33 (2009) - Porous Asphalt Pavements.

1.3 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:

- a. Resident Engineer (RE).

- 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 grading and subgrade installer, and utility 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.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Test Reports: Certify products comply with specifications.
 - 1. Aggregate Base Course.
 - 2. Porous Asphalt and Asphalt Base/Surface Course.
 - 3. Job-mix formula.
- C. Certificates: Certify products comply with specifications.
 - 1. Asphalt prime and tack coat material complying with State Highway Department requirements.
 - 2. Asphalt cement complying with State Highway Department requirements.
 - 3. Job-mix certification that mix equals or exceeds State Highway Specification (Type A; CSS Section 39-2 (Caltrans, 2010)).
- D. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer .
 - 2. Land Surveyor.

- E. One copy of State Highway Department Specifications (Latest Edition).

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
- B. RE to have access to all parts of material producing plants to check mixing operations and materials and adequacy of equipment.
- C. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- D. Preconstruction Testing:
 - 1. Engage independent testing laboratory to perform tests and submit reports.
 - 2. Asphalt Base Course:
 - a. Test sources, gradation, liquid limit, plasticity index, percentage of wear, and other properties required by State Highway Department.
 - 3. Job Mix Formula:
 - a. Test required by State Highway Department.

1.6 FIELD CONDITIONS

- A. Environment:
 - 1. Do not begin asphaltic concrete material placement when atmospheric temperature is below 10 degrees C (50 degrees F), nor during fog, rain, or other unsuitable conditions.

1.7 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 ASPHALT PAVING AGGREGATES

- A. Aggregates: Crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase Aggregate: Maximum 38 mm (1-1/2 inches).
- C. Base Aggregate Maximum Size:
 - 1. Base course over 152 mm (6 inches) thick: 38 mm (1-1/2 inches).

2. Other base courses: 19 mm (3/4 inch).

D. Asphaltic Base Course:

1. Maximum Particle Size: 25 mm (1 inch).
2. In conflicts between this specification and requirements in latest version of State Highway Specifications, State Specifications take precedence.

E. Aggregates for Asphaltic Concrete Paving: Mixture of sand, mineral aggregate, and liquid asphalt in proportions with percentage by weight within the following:

| Sieve Sizes | Percentage Passing |
|---------------------|--------------------|
| 19 mm(3/4 inch) | 100 |
| 9.5 mm(3/8 inch) | 67 to 85 |
| 6.4 mm(1/4 inch) | 50 to 65 |
| 2.4 mm(No. 8 mesh) | 37 to 50 |
| 600 µm(No. 30 mesh) | 15 to 25 |
| 75 µm(No. 200 mesh) | 3 to 8 |

1. Plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of combined dry aggregates.

2.2 NON-WOVEN GEOTEXTILE FABRIC

A. Fabric: Needled nonwoven polypropylene fibers with the following properties:

1. Grab Tensile Strength (ASTM D4632) \geq 55 kg (120 lbs.).
2. Mullen Burst Strength (ASTM D3786) \geq 1550 kPa (225 psi).
3. Flow Rate (ASTM D4491) \geq 360 l/min/0.09 sq. m (95 gal/min/sq. ft.).
4. UV Resistance after 500 hours (ASTM D4355) \geq 70 percent.
5. Heat-set or heat-calendared fabrics are not acceptable.

2.3 ASPHALTS

A. Comply with Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60.
2. Prime coat: Cut-back type, grade MC-250.
3. Tack coat: Uniformly emulsified, grade SS-1H.

2.4 ANCILLARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by EPA. Provide in granular, liquid or wettable powder form.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Land Surveyor to establish and control pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on Drawings.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - 1. Temperature leaving plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
 - 2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. Fill depressions developed under rolling with acceptable material and re-roll area.
- C. Remove soft areas, fill with acceptable materials and re-roll area.
- D. If subgrade becomes rutted or displaced before the placing of subbase, rework subgrade to bring to line and grade.
- E. Proof-roll subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by RE. If pumping, pushing, or other movement is observed, rework area to provide stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase:
 - 1. Spread and compact to thickness shown on drawings.
 - 2. Begin rolling at sides, continue toward center, and continue until there is no movement ahead of roller.
 - 3. After completion of subbase rolling, no hauling is permitted over subbase, except top course material delivery.
- B. Base:
 - 1. Spread and compact to thickness shown on Drawings.
 - 2. Begin rolling sides, continue toward center, and continue until there is no movement ahead of roller.
 - 3. After completion of base rolling, no hauling is permitted over base except top course material delivery.

- C. Thickness Tolerance: Compacted thicknesses shown on Drawings within minus 0.0 mm (0.0 inches) to plus 12.7 mm (0.5 inch).
- D. Smoothness Tolerance: Lines and grades shown on Drawings within 5 mm in 3 m (3/16 inch in 10 feet).
- E. Moisture Content: Only amount required to achieve specified compaction.

3.5 ASPHALTIC CONCRETE PAVING PLACEMENT

- A. Remove all loose materials from compacted base.
- B. Apply prime coat, and tack coat where required, and allow to dry according to manufacturer's instructions as approved by Architect.
- C. Receipt of Asphaltic Concrete Materials:
 - 1. Do not accept material unless covered with tarpaulin until unloaded, and unless material is minimum 130 degrees C (280 degrees F).
 - 2. Do not begin asphaltic concrete material placement when atmospheric temperature is below 10 degrees C (50 degrees F), nor during fog, rain, or other unsuitable conditions.
- D. Spreading:
 - 1. Spread material with minimal handling.
 - 2. For finished paving 76 mm (3 inches) or less, spread in one layer.
- E. Rolling:
 - 1. After material has been spread to proper depth, roll until surface is hard, smooth, unyielding, and true to thickness and elevations shown on drawings.
 - 2. Roll in minimum two directions until no roller marks are visible.
 - 3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. Maximum deviation: 3 mm in 1.8 m (1/8 inch in 6 feet).

3.6 COLD MILLING

- A. Clean existing pavement surface of loose or deleterious material immediately before cold milling. Remove existing asphalt pavement to grades and cross sections indicated on Drawings.
 - 1. Mill to 1-1/2 inches.

3.7 PATCHING

- A. Hot Mix Asphalt Pavement: Sawcut patch perimeter and excavate existing pavement to sound base. Excavate rectangular or trapezoidal patches, extending 300 mm (12 inches) into adjacent sound pavement, unless otherwise indicated on drawings. Cut excavation faces vertically.

Remove excavated material. Recompact existing aggregate base course to provide new subgrade.

- B. Tack Coat: Apply uniformly to vertical and horizontal surfaces abutting area to receive new hot mix asphalt paving at rate of 0.2 to 0.7 L/sq. m. (0.05 to 0.15 gal./sq.yd).
 - 1. Allow tack coat to cure before applying hot mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, remove spillage and clean affected surfaces.
- C. Patching: Fill excavated pavement with hot mix asphalt base mix for full thickness of patch; while still hot, compact flush with adjacent pavement surface.

3.8 CLEANING

- A. Remove debris, rubbish, and excess material from project site.

3.9 PROTECTION

- A. Protect asphaltic concrete paved areas from traffic until sealer is set and cured and does not pick up under foot or wheeled traffic.
- B. Repair damage.

- - - E N D - - -

SECTION 32 12 43
POROUS FLEXIBLE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Porous pavement system.

1.2 RELATED SECTIONS

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 00, EARTH MOVING.
B. Planting: Section 32 90 00, PLANTING.
C. Landscape Irrigation: Section 32 84 00, PLANTING IRRIGATION.

1.3 REFERENCES

- A. ASTM F 1951-08 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
B. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
C. ASTM C 33 Standard Specification for Concrete Aggregates
D. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete

1.4 SUBMITTALS

- A. Shop Drawings: Submit design detail showing proper cross-section.
- B. Samples: Submit manufacturer's sample of Grasspave 10" x 10" section of Grasspave material.
- C. Installation Instructions: Manufacturer's printed installation instructions. Include methods for maintaining installed products.
- D. Certificates:
1. Manufacturer signed certificate stating the product is made in the USA.
 2. Submit Material Certificates for base course and sand (or USGA mix) fill materials
 3. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Grasspave units.
 4. ISO Certificate certifying manufacturer's quality management system is currently registered to ISO 9001:2008 quality standards.
- E. Manufacturer's Material Certification: Product manufacturers shall provide certification of compliance with all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted by the purchasing agency no later than the date of order placement.
- F. Product manufacturers shall also have a minimum of 30 years' experience producing products for porous pavement systems.
- G. Manufacturer Quality Certification: ISO Certification certifying manufacturer's quality management system for its Grasspave system is currently registered to ISO 9001:2008 quality standards. Any alternate materials submitted shall provide a certification that their porous pavement

system manufacturing process is part of an ISO program and a certification will be required specifically stating that their testing facility is certified and in accordance with ISO.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect Grasspave units/rolls from damage during delivery and store rolls upright, under tarp, to protect from sunlight, when time for delivery to installation exceeds one week.
- C. Store Hydrogrow in a dark and dry location
- D. Handling: Protect materials during handling and installation to prevent damage

1.7 MAINTENANCE SERVICE

- A. Installer responsible for maintenance of grass plants - water/irrigation, fertilizing, mowing - for one growing season. DO NOT AERATE. See *Manufactures Maintenance Guide*

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.
- C. Install turf when ambient air temperatures is at least 55 degrees F (13 degrees C).
- D. In cold weather, do not use frozen materials or materials mixed or coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.
- E. Protect partially completed paving against damage from other construction traffic when work is in progress.
- F. Adequately water sod or grass seed to assure germination of seed and growth of root system.
- G. Grass coverage on the sand-filled Grasspave rings must be completed within one week: See *Part 3 Execution*.
- H. DO NOT DRIVE, PARK ON, or use Grasspave system for two or three mowing cycles until grass root system has matured (about 3 to 4 weeks for sod or 6 to 8 weeks for seeded areas). Any barricades constructed must still be accessible by emergency and fire equipment during and after installation.

1.9 LIMITED WARRANTY

- A. Warrant all products furnished will be free from defects in material and/or workmanship.
- B. This warranty shall be extended for a period of five (5) years following the date of shipment.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Basis of Design Manufacturer: Invisible Structures, Inc., which is located at: 1600 Jackson St. Suite 310 ; Golden, CO 80401; Toll Free Tel: 800-233-1510; Tel: 303-233-8383;

2.2 GRASSPAVE**A. Composition:**

1. Manufactured in the USA.
2. High density polyethylene (HDPE): 100 percent recycled materials.
3. Color: black
4. Color Uniformity: Uniform color throughout all units rolls.
5. Carbon Black for ultraviolet light stabilization.
6. Hydrogrow soil amendment and fertilizer for sodded areas only, provided by manufacturer with Grasspave.

B. Performance Properties:

1. Maximum Loading Capability: 15,940 psi (2.29 million psf, 109,906 kPa) when filled with sand.
2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
3. Wheelchair Access testing for ADA Compliance: Passing Rotational Penetrometer testing.
4. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
5. System Permeability (Grasspave2, sand, base course): 2.63 to 38.55 inches of water per hour.
6. Effective Imperviousness (E.I.): 10%.

C. Dimensions (individual units are assembled and distributed into rolls):

1. Roll area: From 108 sq ft (10 sq m) to 538 sq ft (50 sq m), in 108 sq ft (10 sq m) increments
2. Roll Widths: From 3.3 ft (1 m) to 8.2 ft (2.5 m), in 1.6 ft (0.5 m) increments.
3. Roll Lengths: From 32.8 ft (10m) to 65.6 ft (20 m), in 3.3 ft (1 m) increments.
4. Roll Weights: From 41 lbs (19kg) to 205 lbs (93kg), in 41 lbs (19 kg) increments.
5. Unit Nominal Width by Length: 20 inches by 20 inches (0.5 m by 0.5 m) or 40 inches by 40 inches (1 m by 1 m).
6. Nominal Depth: 1 inch (2.5 cm) – for rolls and individual units.
7. Unit Weight: 18 oz (510 g) or 5 lbs. (2.27 kg).
8. Volume Solid: 8 percent.

2.3 SYSTEM MATERIALS

- A. Base Course: Sandy gravel material from local sources commonly used for road base construction (recycled materials such as crushed concrete or crushed asphalt are NOT acceptable).

1. Conforming to the following sieve analysis and requirements:

- a. 100 percent passing sieve size 1 inch (25 mm).
 - b. 90-100 percent passing sieve size 3/4 inch (19 mm).
 - c. 70-80 percent passing sieve size 3/8 inch (9 mm).
 - d. 55-70 percent passing sieve size #4.
 - e. 45-55 percent passing sieve size #10.
 - f. 25-35 percent passing sieve size #40.
 - g. 3-8 percent passing sieve size #200.
2. Provide a base course material nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.
 3. Material may be either "pit run" or "crusher run." Avoid using clay based crusher run/pit run. Crusher run material will generally require coarse, well-draining sand conforming to AASHTO M6 or ASTM C 33 to be added to mixture (20 to 30 percent by volume) to ensure long-term porosity.
 4. Alternative materials such as crushed shell, limerock, or crushed lava may be used for base course use, provided they are mixed with sharp sand (20 to 30 percent) to ensure long-term porosity, and are brought to proper compaction. Without added sand, crushed shell and limerock set up like concrete and become impervious.
 5. Alternative size and/or composition of base course materials should be submitted to Invisible Structures, Inc. (Manufacturer) for approval.
- B. Sand Fill for Rings and Spaces Between Rings: Clean sharp sand (washed concrete sand).
1. Coarse, well-draining sand, such as washed concrete sand conforming to AASHTO M6 or ASTM C-33.
- C. Grass
1. Sod: See section 32 90 00
- D. Mulch
1. Mulch: See section 32 90 00

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine subgrade and base course installed conditions. Do not start porous paving installation until unsatisfactory conditions are corrected. Check for improperly compacted trenches, debris, and improper gradients.
- B. Start of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact RE for resolution.

3.2 PREPARATION

- A. Subgrade Preparation:
 1. Verify subgrade in accordance with porous paving system manufacturer's instructions.
 2. Proper subgrade preparation will enable the Grasspave rolls/units to connect properly and remain level and stationary after installation.
 3. Excavate area allowing for unit thickness, the engineered base depth (where required), and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable).

4. Provide adequate drainage from excavated area if area has potential to collect water, when working with in-place soils that have poor permeability.
 5. Ensure in-place soil is relatively dry and free from standing water.
 6. Uniformly grade base.
 7. Level and clear base of large objects, such as rocks and pieces of wood.
- B. Base Preparation:
1. Verify engineered base is installed in accordance with porous paving system manufacturer's instructions.
 2. Coordinate base installation and preparation with subdrains
 3. If required, place a geotextile separation layer between the natural ground and the 'engineered base'.
 4. If required, install the specified sub-drain and outlet according to construction drawings.
 5. Coordinate base installation and preparation with irrigation and drip irrigation lines specified in Section 32 84 00
 6. Place engineered base in lifts not to exceed 6 inches (150 mm), compacting each lift separately to 95 percent Modified Proctor.
 7. Leave 1 inch (2.5 cm) of depth below final grade for porous paver unit and sand fill and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable).

3.3 ON-SITE MANUFACTURER'S FIELD REPRESENTATIVE

- A. If required, it will be the responsibility of the contractor to provide a qualified Manufacturer's field representative available for a pre-construction meeting via phone or in person and provide installation videos, design details, installation instructions, and the technical specifications.

3.4 HYDROGROW INSTALLATION

- A. Spread all Hydrogrow ,or approved equal, mix provided (spreader rate = 4.53 kg per 100 m² (10 lbs per 1076 ft²) evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader for areas to be sodded only.
- B. The Hydrogrow mix should be placed immediately before installing the Grasspave.

3.5 GRASSPAVE INSTALLATION

- A. Install the Grasspave units by placing units with rings facing up, and using snap-fit connectors, pegs and holes, provided to maintain proper spacing and interlock the units. Units can be easily shaped with pruning shears or knife. Units placed on curves, slopes, and high traffic areas shall be anchored to the base course, using 40d common nails with fender washer, as required to secure units in place. Tops of rings shall be between 6 mm to 13 mm (0.25" to 0.5") below the surface of adjacent hard-surface pavements.
- B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt

rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.

3.6 INSTALLATION OF GRASS

- A. Grass coverage on the sand-filled rings must be completed within one week. Sand must be re-installed and leveled and Grasspave checked for integrity if rings become exposed due to wind, rain, traffic, or other factors.
 - 1. Install thin sod directly over sand filled rings, filled no higher than the top of the rings. Sod strips should be placed with very tight joints. Sodded areas must be fertilized and kept moist during root establishment (minimum of 3 weeks). DO NOT DRIVE ON SYSTEM: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated and established well below the Grasspave units.
- B. Adequately water sod to assure growth of root system.

3.7 PROTECTION

- A. Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated below the Grasspave units.

3.8 FIELD QUALITY CONTROL

- A. Remove and replace segments of Grasspave2 units where three or more adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.
- B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

3.9 MAINTENANCE

- A. Maintain grass in accordance with manufacturer's instructions.
- B. Lawn Care: Normal turf care procedures should be followed, including de-thatching.
- C. DO NOT AERATE. Aerator will damage the Grasspave units. Aeration is not necessary in a sand root zone.

END OF SECTION

**SECTION 32 14 13
PRECAST CONCRETE UNIT PAVING**

PART 1 - GENERAL**1.1 SUMMARY**

Section Includes: Setting bed, and precast concrete unit pavers at columbarium court and committal service shelter.

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and aggregate base: Section 31 20 11, EARTH MOVING-SHORT FORM.
- C. Site work concrete: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS
- D. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.3 REFERENCES

- A. ASTM International, as referenced herein as ASTM.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.
- B. Source Quality Control:
 - 1. Submit 2 samples made up of actual unit pavers for each type, color and texture required. Include in each set of samples the full range of exposed color and texture to be expected in the completed Work.
 - 2. Submit testing certification showing capability of pavers proposed to comply with the specified strength requirement.
- C. Field Quality Control:
 - 1. During construction, submit field test reports in accordance with Article 3.8.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage an installer who has successfully completed within the past 3 years at least three unit paver applications similar in type and size to that of this Project and who will assign installers from these earlier applications to this Project, of which one will serve

as lead installer.

B. Mock-Up:

Construct a mock-up sample, 3 feet square minimum, of the paving system, including the materials, pattern and joint treatment required in actual construction. Make mock-up samples as required until acceptance by the Resident Engineer. Consider the accepted mock-up as a minimum standard of workmanship to be matched or bettered throughout the Project. The sample may be constructed as part of the Project and, if approved, will be accepted as part of the Work. Remove samples which fail to meet the Resident Engineer approval.

C. Engage an independent Testing and Inspection Agency to perform sampling and testing of aggregate base materials proposed for use in the Work as follows: Perform laboratory moisture density test: ASTM D1557.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging, Shipping, Handling and Unloading:

1. Deliver materials to the Project site in their original, unopened containers bearing label clearly identifying manufacturer's name and brand. Store materials under cover, clear of the ground and protected from the weather.
2. Protect unit pavers and aggregate during storage and construction against wetting by rain, snow or groundwater, and against soilage or intermixture with earth or other types of materials.
3. Handle pavers to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges of pavers with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slide.
4. Store pavers on wood skids or pallets. Place and stock skids and pavers to distribute weight evenly and to prevent breakage or cracking. Protect stored pavers from weather with waterproof non-staining covers or enclosures, but allow air to circulate around pavers.

1.7 WARRANTY

Warrant the finished area to be free of bumps and depressions, evenly graded to levels shown, and free of defects in materials and workmanship for a period of 3 year after substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mortar:

1. ASTM C270, Type S, cement-lime proportion specification mix.
Admixtures and Type N lime are not acceptable.
2. Hydrated Lime: ASTM C207 Type S.
3. Sand: ASTM C144.
4. Reinforcement: 2 inches by 2 inches - 16/16 welded galvanized wire mesh.
5. Portland Cement: ASTM C150/C150M.
6. Latex Additive: Acrylic resin or styrene-butadiene-rubber water mixture formulated for Portland cement mortar beds.
7. Coloring Pigments: Match precast concrete paver.

B. Concrete Pavers: Detectable Warning or ADA Truncated Dome Pavers

1. Color: Charcoal
2. Size: Nominal 12"x12"
3. Thickness: 2"
4. Surface Finish: Shot-blasted & Sealed
5. Edge Finish: 3/16" bevel on all four (4) sides
6. Weight: 22lbs per square foot
7. Cementitious Materials: Portland Cements: ASTM C595
8. Aggregates: ASTM C33 for normal weight concrete aggregate.
9. Cleaner: Liquid neutral chemical cleaner with pH factor between 7 and 8, of formulation recommended by sealer manufacturer for type of precast paver used.
10. Sealer: Colorless, slip and stain resistant penetrating or acrylic sealer with pH factor between 7 and 10 that does not affect color or physical properties of precast paver surface.
11. Other Constituents:
 - a. Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other additives: previously established as suitable for use in concrete and either conforming to ASTM standards where applicable, or shown by test or experience not to be detrimental to the durability of the concrete.
12. Compressive Strength:
 - a. Average not less than 8,000 psi with no individual unit less than 7,200 psi, as tested per ASTM C140.
13. Absorption:
 - a. Under freeze/thaw conditions, average no greater than 5%, with no

individual unit greater than 7%, as tested per ASTM C936.

14. Proven Field Performance:

- a. Satisfactory field performance is indicated when units similar in composition and made with the same manufacturing process as those to be provided for the Work do not exhibit objectionable deterioration after at least 3 years.
- b. The units used as the basis for proven field performance have been exposed to the same general type of environment, temperature range and traffic volume as is contemplated for the units to be provided for the Work.

15. Freeze-Thaw:

- a. No breakage and no greater than 1.0% loss in dry weight of any individual unit when subjected to 50 freeze-thaw cycles, as tested per ASTM C67.

16. Visual Inspection:

- a. Provide units which are sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Cracks or chipping resulting from handling in shipment, delivery and installation are deemed grounds for rejection.

17. Size:

- a. As indicated with a maximum tolerance 0.0625 inch in depth, width or length.

C. Grout: Custom Building Products Grout with admixture, or approved equal.

1. Color, match existing precast concrete paver. Submit samples for approval.

D. Bond Slurry: Custom Building Products, or approved equal.

E. Sealant: As specified in Section 07 92 00 JOINT SEALANTS

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:

1. Protect the work and adjacent construction against damage during progress of the Work.
2. Do not use construction equipment which will damage existing or new pavement.

3.2 INSTALLATION

- A. Mortar Bed: Installation of Mortar bed as per TCA F101. All materials used follow instructions of manufacturer for use in mortar method.
- B. Install precast concrete pavers and firmly set, tamp into bedding to ensure minimum 95% surface contact with mortar bed. Coat underside of each precast pavers unit with latex cement mortar. Grouting of pavers in strict accordance with grout manufacturer's directions and instructions. Use latex or acrylic additives from the same manufacturer as the grout.
- C. All expansion and Control joints shall be installed per TCA EJ171. Joint materials used shall follow manufacturer's directions and instructions.
- D. Field cut pavers with wet masonry saw in accordance with manufacturer's recommendations for methods, equipment and precautions.
- E. Remove, scrub & wash clean mortar stains and all other types of soiling from exposed paver surfaces.

3.3 REPAIR/RESTORATION

- A. Remove and replace pavers which are chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.
- B. Clean concrete pavers after setting is complete; use procedures recommended by producer for types of application indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Engage and independent Testing and Inspection Agency to perform field testing for quality control during construction as follows:
 - a. Field gradation analysis for setting bed and joint sand: ASTM D422.
 - b. Field density-in-place tests for aggregate base course. Make at least 4 tests in accordance with ASTM D2167 or other method approved by the Resident Engineer. Testing Agency report shall indicate location of each test.

3.5 CLEANING

- A. Remove excess mortar before fully set.
- B. Clean exposed precast concrete paver and mortar surfaces. Remove contaminants and stains.

3.6 PROTECTION

Provide final protection and maintain conditions which ensure paver

PRECAST CONCRETE UNIT PAVING

work being without damage or deterioration at time of substantial completion.

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**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Paint on pavement surfaces, in form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings.

1.2 RELATED REQUIREMENTS

- A. Paint VOC Limits: Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- B. Paint Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. Federal Specifications (Fed. Spec.):
 - 1. TT-P-1952F - Paint, Traffic and Airfield Marking, Waterborne.
- C. Master Painters Institute (MPI):
 - 1. No. 97 - Traffic Marking Paint, Latex.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show pavement marking configuration and dimensions.
 - 2. Show international symbol of accessibility at designated parking spaces.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Application instructions.
- D. Samples:
 - 1. Paint: 200 mm (8 inches) square, each type and color.
- E. Certificates: Certify products comply with specifications.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.

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.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight conditioned facility.
- B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

- A. Environment:
 - 1. Product Temperature: Minimum 13 degrees C (55 degrees F) for minimum 48 hours before installation.
 - a. Surface to be painted and ambient temperature: Minimum 10 degrees C (50 degrees F) and maximum 35 degrees C (95 degrees F).
- B. Field Measurements: Verify field conditions affecting traffic marking installation. Show field measurements on Submittal Drawings.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design paint complying with specified performance:
 - 1. Application: Fed. Spec. TT-P-1952F.

2.2 PRODUCTS - GENERAL

- A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Provide each product from one manufacturer and from one production run.

1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS for the following products:

- a. Paints and coatings.

2.3 SANDBLASTING EQUIPMENT

- A. Air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. Compressor to provide minimum 0.08 cu. m/s (150 cfm) of air at pressure of minimum 625 kPa (90 psi) at each nozzle used.

2.4 PAINT APPLICATOR

- A. Apply marking paint with approved mechanical equipment. Provide equipment constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in case of skip lines. Provide pneumatic spray guns for hand application of paint in areas where mobile paint applicator cannot be used.

2.5 PAINT

- A. Paint: MPI No. 97. For obliterating existing markings comply with Fed. Spec. TT-P-1952F. Provide minimum 18 L (5 gal.) containers.

2.6 NON-REFLECTIVE RAISED PAVEMENT MARKERS (RPM)

- A. Raised Traffic Markers: Ceramic, color: white, Non-reflective. Markers shall comply with U.S. Department of Transportation Federal Highway Department Administration – Roadway Delineation Practices Handbook (August 1994), for nonreflective ceramic markers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
 1. Allow new pavement surfaces to cure for minimum 14 days before application of marking materials.
- B. Protect existing construction and completed work from damage.
- C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or combination of these methods.

2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by (Resident Engineer (RE)).
3. Application of paint conforming to Fed. Spec. TT-P-1952F is an option to removal of existing paint markings on asphalt pavement. Apply black paint in as many coats as necessary to completely obliterate existing markings.
4. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application.
 - a. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through new paint.
5. Pavement marking to follow as closely as practicable after surface has been cleaned and dried, but do not begin any marking until RE has inspected surface and gives permission to proceed.

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 RE consideration.

3.3 PAINT APPLICATION

- A. Apply uniformly painted pavement marking of required colors, length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with details shown on drawings and established control points.
 1. Skip Markings Line Tolerances:
 - a. Length: Plus or minus 75 mm (3 inches).
 - b. Width: Plus or minus 3 mm (1/8 inch).
 - c. Length of intervals exceeding line length tolerance are not acceptable.
 2. Apply paint at wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat.
 3. At the direction of RE, apply additional coats at markings showing light spots.

4. Comply with paint manufacturer's maximum drying time requirements to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic.
5. If any deficiency in marking drying occurs, discontinue paint operations until cause of slow drying is determined and corrected.
6. Remove and replace marking applied at less than minimum material rates, deviates from true alignment, exceeds stipulated length and width tolerances, or shows light spots, , smears, or other deficiencies or irregularities. Remove marking so that surface to which marking was applied will not be damaged by carefully controlled sand blasting, approved grinding equipment, or other approved method.

3.4 DETAIL PAVEMENT MARKING

- A. Apply Detail Pavement Markings in locations indicated on drawings. Apply International Handicapped Symbol where indicated in parking spaces. Color as shown on drawings. Apply paint for symbol using suitable template that will provide pavement marking with true, sharp edges and ends. Place detail pavement markings of colors, widths and lengths, and design pattern at locations shown on drawings.

3.5 NON-REFLECTIVE RAISED PAVEMENT MARKERS (RPM)

- A. Installation of RPM's to asphalt pavement shall comply to U.S. Department of Transportation Federal Highway Department Administration – Roadway Delineation Practices Handbook (August 1994) and manufacturer's recommendation.

3.6 CLEANING

- A. Remove excess paint before paint sets.
- B. Remove all debris, rubbish and excess material from project site.

3.7 PROTECTION

- A. Protect pavement markings from traffic and construction operations.
 1. Protect newly painted markings track free.
 2. Place warning signs to alert traffic from both directions.
 3. Place small flags or other similarly small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
- B. Repair damage.

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**SECTION 32 33 00
SITE FURNISHINGS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gravesite Layout Markers at specified locations.
2. Flower-watering stations, including trash and flower vase receptacles and water spigot.
3. Planter.
4. Benches.
5. Double Barrier Bar Gate.

1.2 RELATED REQUIREMENTS

- A. Materials product data and samples: Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product and Finish Color: Section 09 06 00 - SCHEDULE FOR FINISHES.
- C. Concrete footings: Section 033000 - CAST-IN-PLACE-CONCRETE.
- D. Water Utilities: Section 331000 - Water Utilities

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
 1. ASTM A53/A53M-12 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. B221-14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 3. B61-15 - Steam or Valve Bronze Castings.
 4. B62-15 - Composition Bronze or Ounce Metal Castings.
- C. American Welding Society (AWS):
 1. D1.1-2006 - Structural Welding Code - Steel.
 2. D1.2-2014 - Structural Welding Code - Aluminum.
- D. National Association of Architectural Metal Manufacturers (NAAMM):
 1. AMP 500-06 Metal Finishes Manual.

1.4 SUBMITTALS

- A. Submittals 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 floral regulations decal content, lettering color and background color.
- C. Manufacturer's Literature and Data:
 1. Description of each product.
 2. Installation instructions.
 3. Warranty.
- D. Samples:
 1. Each Product: 6 inch square, each type and color.
 - a. Submit quantity required to show full color and texture range.
 2. Trash Receptacle, Markers, Benches, Flower Vase Receptacles: Full sized, complete assembly.
 3. Approved samples may be incorporated into work.
- E. Qualifications: Substantiate qualifications comply with specifications.
 1. Manufacturer with project experience list.
 2. Fabricator with project experience list.
 3. Installer with project experience list.
 4. Welders and welding procedures.

1.5 QUALITY ASSURANCE

- A. Manufacturer, Fabricator, Installer Qualifications:
 1. Regularly manufactures, fabricates, and installs specified products.
 2. Manufactured, Fabricated, 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) Photographs, drawings and other documents showing character and quality of final installation.
- B. Installer Qualifications: 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) Photographs, drawings and other documents showing character and quality of final installation.
- C. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M. & AWS D1.2/D1.2M.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
 - 1. Manufacturer's Warranty: Warrant benches, Flower-watering stations, including trash and recycling receptacles, water spigot, and flower vase container, and planters.
against material and manufacturing defects.
 - 2. Warranty Period: Three years from final acceptance. Warranty shall not apply to damage resulting from accident, alteration, misuse, tampering, negligence or abuse.

PART 2 - PRODUCTS - GENERAL**2.1 PRODUCTS - GENERAL**

- A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Provide each product from one manufacturer.

2.2 GRAVESITE LAYOUT MARKERS

- A. General: Gravesite layout markers for this project shall consist of Gravesite Grid Monuments.
 - 1. Gravesite Grid Monuments: Aluminum (match existing) survey marker (monument marker) set into cast-in-place concrete base or precast concrete base field set in concrete (match existing).
 - a. Materials:
 - 1) Monument Base: Match existing: Cast-in-place, which shall be a minimum of 24.1 MPa (3,500 psi) @ 28 days, reinforcement and dimensions as indicated on Drawings.

- 2) Monument Marker: Domed-top, 89 mm (3 1/2") diameter, aluminum concrete survey marker (match existing) with integral locator magnet, and flared anchor post for concrete installation.
- B. Text and Cross-hairs: Top text as indicated on Drawings.
1. Text: All caps, 4.75 mm (3/16 inches) high.
 2. Cross hairs: Field engrave as indicated on Drawings. Align gravesite grid and engrave based on Contractor surveyed location data.

2.3 FLOWER WATERING STATIONS

- A. General: Materials, finishes and colors shall fully comply with the specifications and Contract Drawings or be deemed as an approved equal.
- B. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the existing product is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the existing product, they must be identified in the submittal. If the differences result in a product that is deemed less than the existing, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted with a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

2.4 TRASH RECEPTACLE

- A. Materials: Match existing, regularly manufactured for VA Cemeteries use.
1. Steel Body Construction:
 - a. Vertical Bar: Solid steel, 3/8 x 1 inch.
 - b. Horizontal Bands: Solid steel, 1/4 x 2-1/2 inches.
 - c. Support Bars: Steel 3/8 x 3 inches.
 - d. Top Ring: Solid steel, 5/8 inch.
 - e. Leveling Feet: 3/8 inch diameter threaded steel shaft.
 - f. Joints: Fully welded, grind smooth.
 2. Capacity: 36-gallon.
 3. Inner Liner: High-density plastic inner liner, 6 lbs. maximum weight.
 4. Lids: Manufacturer's standard high strength plastic, tapered formed lid and dome, secured with stainless steel aircraft cable and attachments, with self-closing door.

5. Mounting Plate: Standard (1) anchor bolt hole.
6. Identification: Identify trash receptacle with the word "TRASH", material, finish, color, letter style and size shall match existing as indicated on Drawings.
7. Galvanized-Steel:
 - a. Prior to powder coating, units shall receive hot-dip galvanizing. Hot-dip galvanizing includes an aggressive pre-treatment and immersion in a tank of charged liquid zinc at or around 860°F (460°C). All galvanizing shall be performed by an experienced qualified firm. Provide qualifications as part of the submittal review process.
8. Powder Coat Finish:
 - a. Following galvanizing, all fabricated metal components are shot blasted, etched, phosphatized, preheated, and electrostatically polyester with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are then fully cured to coating manufacturer's specifications. The thickness of the resulting finish averages 8-10 mils (200-250 microns).
 - b. Color: To match existing. Approval required during submittal review process. Contractor to refer to Section 09 06 00 Schedule of Finishes for color information.

2.5 FLOWER VASE RECEPTACLE

- A. Materials: Match existing, Regularly manufactured for VA Cemeteries use, with special lightweight hinged lid.
 1. Size: As indicated on Drawings.
 2. Finish and Color: Same as trash receptacle, except as follows:
 - a. Identification: Identify flower vase receptacles with the word "FLOWER VASES" as indicated on Drawings.
 - b. Decal: "Floral Regulations" decal, factory applied pressure sensitive vinyl on top of receptacle lid as indicated on Drawings. Contents and colors to be approved during the shop drawing process.

2.6 PLANTER

- A. Materials: Match existing.
 1. Size: As indicated on Drawings.

2. Finish and Color: Same as trash and flower vase receptacle.

2.7 WATER SPIGOT ASSEMBLIES

- A. Water spigots shall be constructed as indicated on the drawings. The water spigot shall be an ADA compliant spigot – Haws spigot, Model 6252EHLF bib faucet, with paddle handle and male ½" NPT thread or approved equal.
1. The faucet (also called spigot) shall be attached to the post using tamper proof attachment with a bronze escutcheon plate and materials that are compatible with the materials of the spigot. The mounting of the spigot shall be such that it requires tools designed for removal of tamper resistant screws or other means in order for the spigot to be removed from the post to which the spigot is mounted.
 2. The flow through the spigot needs to be controlled to reduce the flow when the spigot is fully opened to 1 gpm or less, and the pressure entering the spigot shall be reduced to a maximum of 15psi.
 3. The pressure reducing valve shall be accessible for removal and replacement without digging up the installation to reach the valve and replace it.
 4. The pipe assembly shall be made using a combination of threaded and soldered connections so the spigot, flow restrictor, and pressure regulator valve can be removed and replaced without the use of soldering equipment. The threaded connections shall be used to disassemble and reassembly after the specific piece of equipment is replaced.
 5. The pipe feeding the spigot and any needed appurtenances or fittings, as required shall pass through the post, and the openings at the ends of the post through which the materials pass, shall be closed up and secured with tamper resistant materials.
 6. The post shall match existing materials, color and finish.
 7. The post shall be protected from staining by the fixture and appurtenances and fittings, by using insulating materials at the connection to the post to keep corrodible materials from staining the posts.
- B. The assembly shall be installed with a pressure regulating valve and isolation valve installed in the irrigation box as indicated on the drawings. The spigot assembly shall contain all pipes, fittings, attachments, and any other ancillary materials or equipment to produce a fully functional water spigot assembly, as indicated on the drawings,

from the connection to the supply water system at the isolation valve for the spigot.

- C. All of the materials to be used in the construction and installation of the water spigot assembly shall be provided in the submittal process and the assemblies shall not be ordered or fabricated without the approval of the submittals.

2.8 BENCHES

- A. Materials: Match existing, regularly manufactured for VA Cemeteries use.
 - 1. Description: Front welds ground and polished to form continuous surface from top tubular section to each vertical steel slat. Steel seat members reverse contoured; solid steel bar end sections, welded and ground; end arm rests standard integral welded configuration, with no center armrests.
 - 2. Galvanized Steel:
 - a. Prior to powder coating, units shall receive hot-dip galvanizing. Hot-dip galvanizing includes an aggressive pre-treatment and immersion in a tank of charged liquid zinc at or around 860°F (460°C). All galvanizing shall be performed by an experienced qualified firm. Provide qualifications as part of the submittal review process.
 - 3. Powder Coat Finish:
 - a. Following galvanizing, all fabricated metal components are shot blasted, etched, phosphatized, preheated, and electrostatically polyester with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are then fully cured to coating manufacturer's specifications. The thickness of the resulting finish averages 8-10 mils (200-250 microns).
 - b. Color: To match existing, as indicated on Drawings. Approval required during submittal review process.
- B. Locations, sizes and quantities as indicated on the Drawings.
- C. Mounting Hardware: Tamper resistant Stainless steel acorn nut is required. Exposed bolt ends or flat bolt heads are not acceptable.
- D. Warranty:
 - 1. All benches shall be free from defects in material and/or workmanship for a minimum period of three years, from final

acceptance. Warranty shall not apply to damage resulting from accident, alteration, misuse, tampering, negligence or abuse.

2.9 DOUBLE BARRIER BAR GATE

- A. Sentinel 30' Manual Dual Swing Barrier Gate or approved equal. Gate size shall be as identified within the construction documents.
 - 1. Galvanized gate and post tubing
 - 2. Two Receiver Posts
 - 3. 180 degree swing gate
 - 4. Latch and lock per manufacture recommendations for both gate and receiver posts.
 - 5. Finish: Galvanized steel with powder coat finish. See Section 090600 SCHEDULE FOR FINISHES.

2.10 ACCESSORIES

- A. Primers:
- B. Welding Materials: AWS D1.1/D1.1M, type to suit application.
- C. Fasteners: Tamper resistant Stainless steel acorn nut.
- D. Anchors:
- E. Galvanizing Repair Paint: MPI No. 18.
- F. Touch-Up Paint: Match shop finish.
- G. Concrete Footing: Comply with SECTION 033000 - CAST-IN-PLACE CONCRETE.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect planned installation materials and locations. Notify RE of any discrepancies in conditions.
 - 1. Verify materials are damage free and compliant with Drawings. Report non-compliance to RE.

3.2 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Correct substrate deficiencies.
 - 1. Fill.
 - 2. Grind.
 - 3. Level.
- D. Stake alignment and locations for approval by COR. Verify elements "fit" within location provided.

3.3 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 RE consideration.
 - 2. Install items rigid and plumb as indicated on Drawings.
- B. Gravesite Grid Monuments and Markers:
 - 1. Install at locations indicated on Drawings.
- C. Flower Watering Stations:
 - 1. Stake flower watering station location. Obtain RE approval before forming concrete pad. Install concrete pad according to SECTION 033000 - CAST-IN-PLACE CONCRETE.
 - 2. Anchor flower vase container as indicated on Drawings and manufacturer's instructions.
- D. Trash Receptacle:
 - 1. Anchor receptacle as indicated on Drawings and manufacturer's instructions.
- E. Water Spigot:
 - 1. Install water spigot assemblies according to manufacturer's instructions, including post, pipe, isolation valve, fittings, pressure reducing valve and valve boxes. Install washed stone for splash area.
- F. Benches:
 - a. Benches shall be shipped assembled.
 - b. Install benches as recommended by manufacturer.
- G. Double Barrier Bar Gate
 - 1. Install posts, gates, locking devices and receiver posts as indicated on the Drawings and manufacturer's recommendations.
 - 2. Provide latching mechanism for gate and receiver post with provisions for padlocking for double gate. All fittings shall be galvanized and painted black to match gate color.

3.4 CLEANING

- A. Clean exposed surfaces. Remove contaminants and stains.
- B. Remove excess material and debris. Clean above ground portions of receptacles and other site improvements.

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**SECTION 32 84 00
PLANTING IRRIGATION**

PART 1 - GENERAL**1.1 DESCRIPTION**

A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, revisions to the existing central control system and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

1. Procurement of all applicable licenses, permits, and payment of required fees.
2. Coordination of Utility Locates public and private ("Call Before You Dig").
3. Maintenance period.
4. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK

- A. Section 26 ELECTRICAL
- B. Section 32 90 00 PLANTING

1.3 QUALITY ASSURANCE

- A. Contractor:
1. Irrigation Contractor must have demonstrated, using person directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed PVC pipe (3-inch and larger); centralized control systems; electrically operated remote control valves and large radius rotary sprinklers (minimum 1-inch inlet with swing joint).
 2. Contractor and project superintendent must be certified by control system manufacturer as a certified contractor for installation of control system wiring and grounding systems. Provide documentation from control system manufacturer regarding certification.
 3. Key personnel employed by the contractor must provide proof of Irrigation Association Certified Irrigation Contractor.
 4. Contractor must be licensed in California.

5. Provide documentation of contractor qualifications with equipment submittals.
- B. Equipment Manufacturer:
 1. Manufacturer regularly and presently manufactures the item as one of their principal products.
- C. System Requirements:
 1. Full and complete coverage as described herein and presented in the drawings is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
 2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

- A. Make submittal and provide number of copies per Specification Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for contractor qualifications, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, control system components, and control system communication including radio test if radio is the communication option used. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Equipment submitted must conform to the Buy American Act. Provide manufacturing location of items submitted.
- E. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper

installation, their relative locations, and critical dimensions.

Note modifications to the installation detail.

F. Testing:

1. Document the occurrence of all tests on the Daily Report. Indicate which test was conducted and whether or not it was successful.
2. Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.

G. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.

H. Colored Irrigation Controller Charts: Submit information listed in Part 3 of these specifications.

I. Record Drawings: Submit information listed in Part 3 of these specifications.

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. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

C. American National Standard Institute (ANSI):

B40.1 Gauges-Pressure Indicating Dial Type Elastic Element

D. American Society of Agricultural Engineers (ASAE):

S398 Sprinkler Testing and Performance Reporting

E. American Society of Civil Engineers (ASCE):

Manual and Reports on Engineering Practice No. 108, "Pipe Design for Installation by Horizontal Directional Drilling" (2005)

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

B61-02 Steam or Valve Bronze Castings

B62-15 Composition Bronze or Ounce Metal Castings

D1785-12 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

| | |
|---|--|
| D2241-15 | Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series) |
| D2287-12 | Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds |
| D2464-15 | Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| D2466-15 | Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| D2564-12 | Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings |
| D2855-96(2010) | Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| D3350-14 | Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |
| F714-13 | Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter |
| F477-14 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| F1962-11 | Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings |
| F2164-13 | Field Leak Testing of Polyethylene Pressure Piping Systems |
| B209-14 | Aluminum and Aluminum-Alloy Sheet and Plate |
| G. American Water Works Association (AWWA): | |
| C110-12 | Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch for Water and Other Liquids |
| C111-12 | Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings |
| C115-11 | Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges |
| C151-09 | Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids |
| C153-11 | Ductile-Iron Compact Fittings, 3-Inch Through 12-Inch for Water and Other Liquids |

- C500-09 Gate Valves for Water and Sewerage
- C504-10 Rubber Sealed Butterfly Valves
- C600-10 Installation for Ductile-Iron Water Mains
and Their Appurtenances
- C901-08 Polyethylene (PE) Pressure Pipe and Tubing,
½ In. (13 mm) Through 3 In. (76 mm), for
Water
- H. Irrigation Association (IA):
Technical Resources, Irrigation Best Practices & Standards
- I. Manufacturers Standardization Society (MSS):
SP70-2011 Cast Iron Gate Valves, Flanged and Thread
Ends
- J. National Electrical Manufacturers Association (NEMA):
250-2014 Enclosures for Electrical Equipment (1000
Volts Maximum); Revision 1, May 1986
- K. National Electric Code: (latest edition 2014)
- L. North American Society for Trenchless Technology (NASTT):
Mini-Horizontal Directional Drilling
Horizontal Directional Drilling Good Practices
- M. Plastics Pipe Institute
Chapter 12 Horizontal Directional
- N. Uniform Plumbing Code: (latest edition 2015)

1.6 RULES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete and independent estimate of quantities and wastage.

1.7 DEMOLITION

- A. Operate existing remote control valves identified on the drawings to demonstrate that existing control wiring functions properly.

Document that all remote control valves and control wiring associated with the controllers impacted by this project operate properly. Immediately notify Contracting Officer Representative if remote control valve and/or control wire does not operate properly. Proceeding with renovation without notifying Contracting Officer Representative implies that all components are operating properly. It is the responsibility of the Contractor to replace any component not operating properly at the completion of renovation.

- B. Remove/salvage existing irrigation components as indicated on the drawings. Remove items in a manner that minimizes damage to components. Deliver only salvageable components to Cemetery. Properly dispose of other removed items off site.
- C. Abandon existing irrigation pipe in place. If existing pipe is encountered during installation of new irrigation pipe, cut and remove two (2) feet of existing irrigation pipe on either side of the new irrigation pipe. Properly dispose of removed pipe.
- D. Reuse existing control wiring as indicated on drawings. Cut existing control wiring at remote control valves and permanently label end of wire with existing station number. Protect existing control wiring during construction of new irrigation system.

1.8 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies. After the contractor has installed the new point of connection to the existing mainline, water will be available for flushing and testing of the new irrigation system. The contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer Representative, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.9 TESTING

- A. Notify the Contracting Officer Representative five working days in advance of testing.
- B. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Contracting Officer Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test – Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.
 - 3. Subject mainline pipe to 90 PSI for two hours. Maintain constant pressure.
 - 4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
 - 5. Testing pump must provide a continuous 90-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 90-PSI at end of test.
 - 6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
 - 7. Subject mainline pipe to the anticipated operating pressure of 100 PSI for two hours. Maintain constant pressure. The amount of additional water pumped in during the test will not exceed:
 - a. 0.41 gallons per 100 joints of 3-inch diameter pipe
 - b. 0.54 gallons per 100 joints of 4-inch diameter pipe
 - c. 0.81 gallons per 100 joints of 6-inch diameter pipe
 - d. 1.08 gallons per 100 joints of 8-inch diameter pipe
 - 8. Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$
Where: L = Allowable Leakage (gph)
 N = Number of Joints
 D = Nominal Diameter of Pipe (inches)
 P = Average Test Pressure (psi)
 - 9. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

10. Cement or caulking to seal leaks is prohibited.
 11. Contractor may sub-contract testing to pipeline testing company approved by Contracting Officer Representative.
- F. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:
1. Subject pipe to a hydrostatic pressure equal to the anticipated operating pressure of 90 PSI for 30 minutes.
 2. Cap all sprinkler risers.
 3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 5. As an alternative to the visual inspection described in Item 4. above, the Contracting Officer Representative may request that a pressure drop test be performed:
 - a. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.
 - b. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.
 - c. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
 6. Cement or caulking to seal leaks is prohibited.
 7. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
- G. Operational Test – Remote Control Valves, Lateral Piping and Sprinklers:
1. Activate each remote control valve in sequence from each controller using the irrigation controller remote control. Manual operation of the valves is not an acceptable method of activation. The Contracting Officer Representative will visually observe operation, water application patterns, and leakage.
 2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.

3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral pass all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Contracting Officer Representative.

H. Distribution Uniformity (DU):

1. Irrigation Audits

- a. Performed by an Irrigation Association Certified Landscape Irrigation Auditor.
- b. Complete an irrigation audit, to include 10 "representative" irrigation zones/test areas.
- c. Identify the areas to be tested based on cemetery site conditions in consultation with the cemetery foreman and/or irrigation personnel, irrigation auditor, NCA National Irrigation Specialist and Contracting Officer Representative.

2. Sprinkler Characteristics

- a. Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site.

3. Final determination of the areas to be tested will be based on the recommendation of the Contractor and their understanding of the purpose and goals of performing these irrigation audits with final approval by the NCA National Irrigation Specialist. Submit a map indicating the locations of the zones to be tested.

4. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.

- a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.

1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.

2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when

- the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
- 3) If a site is being audited that consistently has winds above 10 mph, then the Contractor and National Irrigation Specialist will determine the best course of action to proceed as to the effect of the wind on the audits.
5. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.
- a. Supply all data in a digital (MS Excel format) as well as paper report format to NCA via Contracting Officer Representative.
 - b. Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
 - c. Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.
6. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the irrigation system is to be audited in its current condition. However, pressure is to be checked at the pressure regulating device on each valve tested by using a Schrader valve compatible connection and liquid filled pressure gauge. If there is no pressure regulating valve, the closest sprinkler to the RCV will be checked using a pitot tube and liquid filled pressure gauge.
7. Based on the area being audited, the Contractor shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
8. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
- a. Number of catch cans used
 - b. Size of the area tested
 - c. Number of sprinklers tested
 - d. Site conditions

- 1) Spacing shall be consistent and in a square pattern throughout each testing area.
9. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
10. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.
11. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
 - a. Rotor type sprinklers - a minimum of 10 minute run time and a maximum of a 30 minute run time;
12. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
13. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
 - a. Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
 - b. No flow meter information provided
 - c. Reason - no flow meter present on site
 - d. Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
14. On a copy of the irrigation plan accurately (within 1-foot) show the following:
 - a. All sprinklers and associated valves for each test area;
 - 1) Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
 - 2) All catch cans (numbered per the worksheets) and associated data collected.
15. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location

audited along with associated worksheets filled out as specified above.

16. If any conclusions can be drawn based on the area tested, distribution uniformity or precipitation rate, they should be explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.
17. Submit Entire audit report to Contracting Officer Representative within 10 working days of the completed field work.

I. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each controller pedestal door and via a written report. Documentation should include controller name or number, date of test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the Contracting Officer Representative.

I. Control System Grounding:

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resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.

4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the Contracting Officer Representative.

J. Acceptance Test Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
2. Coordinate start of Acceptance Test with Contracting Officer Representative.
3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from Contracting Officer Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. If the fault is found to be due to factors outside of the contractor's control (for example, mainline pipe break in area not being renovated) the evaluation period will continue. The time required to make the repair shall not be included in the evaluation period.
5. When the system has operated for 14 days without fault, contact the Contracting Officer Representative to schedule Final Inspection. Substantial completion consideration is only given after the 14 day test has been accepted.

1.10 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.

1. Schedule reviews for irrigation system layout or testing with the Contracting Officer Representative as required by these specifications.
2. Impromptu reviews may occur at any time during the project.
3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.11 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
- B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from the date of acceptance by Contracting Officer Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from Contracting Officer Representative.
- C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Contracting Officer Representative. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.

- B. Install irrigation components in landscaped areas only.
- C. Construction cannot proceed unless staking of irrigation mainline, isolation gate valve locations, quick coupling valve locations, remote control valve locations, sprinkler, and controller locations are reviewed and accepted by the Contracting Officer Representative.

PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Contracting Officer Representative must approve equipment prior to construction. The Contractor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes and pressure ratings referenced in the construction documents are a minimum and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeve beneath hardscape for irrigation pipe and wiring. Provide separate sleeve beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.
- D. Size sleeves are as shown on the drawings. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

- A. Mainline Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.

2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer and meets NSF standard 14 and 61. Acceptable manufacturer for ductile iron fittings is Leemco or approved equal.
4. Provide joint restraint harness at valves, changes of direction and as recommended by the manufacturer. For joint restraints on PVC pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536 and ASTM F1674.
5. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length. Acceptable manufacturer for casing spacers is Ford Meter Box Company or approved equal.

B. Lateral Pipe and Fittings:

1. Fittings, use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Schedule 40 IPS pipe conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
2. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic

pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

C. Joint Restraint Harness:

1. Provide joint restraint harness on gasketed pipe at valves and changes of pipe direction. Restrain length of pipe as presented in the installation details and as recommended by the joint restraint manufacturer.
2. Use restraint harness consisting of grip rings, restraint rods, bolts and nuts. Use ductile iron grip rings conforming to ASTM A536 and F1674 and meeting the requirements of UNI-B-13-94. Grip ring serrations to be machined. Cast serrations are not permitted. Restraint rods, bolts, and nuts to be low alloy steel meeting AWWA/ANSI C111/A21.11. Acceptable manufacturer and model are HARCO 820000 Series, Ford Meter Box Uni-Flange Series or approved equal.

2.5 MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure and mechanical joint ends meeting AWWA Standard C509. Acceptable manufacturers are NIBCO, Clow, Kennedy, Mueller or approved equal.
3. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

B. Air-Vacuum Relief Valve Assembly:

1. As presented in the installation details.
2. Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 2 PSI to 230 PSI. Use a continuous acting combination air and vacuum and air release valve. Acceptable manufacturer is Bermad, Crispin, Fresno, Waterman or approved equal.
3. Stainless Steel Ball Valve: Full-port blow-out proof stem, stainless steel ball valve and stem, threaded end connections. Use

a valve rated to 1000 PSI. Acceptable manufacturer is Nibco or approved equal.

4. Valve Box: Use plastic jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
5. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with purple locking cover. Acceptable manufacturer and model is Rain Bird 44-NP to match and be compatible with existing.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco or approved equal.
4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor or swing joint integrated anchor. Acceptable manufacturers are Harco, Lasco, Spears, or approved equal.
5. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

D. Blow off Valve:

1. As presented in the installation details.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. As presented in the installation details.
2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm will be of nylon reinforced nitrile rubber. The valve will have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valves internal bleed will prevent flooding of the valve box. The valve will house a fully encapsulated, one-piece solenoid. The solenoid will have a

captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. Use 24 VAC 50/60 Hz solenoid that is compatible with a low voltage control wire 2 wire decoder control system. Valve must have a flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve must open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve will have a self-cleaning stainless steel screen designed for use in dirty water applications.

Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. Valve must have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture and model is Rain Bird PESB-PRS-D to match and be compatible with existing.

3. Shut-off Valve: Use an angle valve AWWA C135 rated, ductile iron epoxy coated with stainless steel valve mechanism and restraint system. Acceptable manufacturers are Leemco LV212/218.
4. PVC Union: Use a Schedule 80 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
5. Valve Box: Use plastic large valve box with black lid or combination of standard and round valve boxes with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
7. Install assembly over gravel sump as presented in the installation details.
8. Wire connectors: Use 3M DBR/Y-6.
9. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

B. Pop-Up Rotor Sprinkler Assembly:

1. As presented in the installation details.
2. Rotary Sprinkler: Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish part circle sprinklers with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Nozzle must be tested per ASAE S398.1 and be verified to deliver Distribution Uniformity of 80% or more and a

Scheduling Coefficient of 1.2 or less at the specified offset spacing. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10 feet of elevation. Minimum pop-up height is 3 ½-inches. Acceptable manufacturer and model is Hunter I-25-06SS to be compatible with existing.

C. Pop-Up Spray Sprinkler Assembly:

1. As presented in the installation details.
2. Spray Sprinkler: Use a spray sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish sprinkler with pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Hunter Pro Spray 30 to match and be compatible with existing.
3. Swing Joint: Use pre-manufactured triple swing joint with ½-inch inlet. Acceptable manufacturer is Rain Bird, Spears, Lasco or approved equal.
4. Use 4-inch pop-up height for bubblers, use 12-inch pop-up height for shrub beds.

C. Root Well Assembly

1. As presented in the installation details.
2. Acceptable manufacturer is Rootwell, model Pro-318 or equal.

2.7 CONTROL SYSTEM COMPONENTS

A. Existing Control System (For Contractor Information): The existing control system components include a central controllers and field satellite controllers.

1. Central Controller: Calsense with hardwire communication and RRe-TRAN radio remote.
2. Satellite Controllers: Calsense ET2000e with conventional wiring. Unused stations on existing controllers will be used for new irrigation system. Stations on the existing controllers are reused for new irrigation system.

B. New Satellite Control Units:

1. Description: Field control units, pedestal mounted, compatible with the existing central control system Calsense CS3000-2W-CS3-2W--CS#-

SR with CS3-2W-OPT to be compatible with the existing control system.

2. Basic Capabilities:

- a. 100% solid state electrical components with heavy duty, additional, surge protection for input and output circuits.
 - b. Large capacity terminal block.
 - c. 24 VAC transformer capable of operating nine solenoids simultaneously.
 - d. Surge protection backed by 3-year lightning warranty.
 - e. Battery backup of at least 14 days.
 - f. Soil moisture sensor compatible.
 - g. Spread spectrum communication ready.
 - H. Data access: Comm-5YR-M prepaid data service plan.
 - f. Remote activation of each station from hand held radio.
 - g. Minimum number of stations as shown on the drawings.
 - h. AG 2401 surge/lightning protection on power side
 - i. Maximum surge protection by manufacturer on station side
 - j. Stainless steel enclosure
3. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
4. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
5. Lightning protection: Provide one 12"x36"x0.0625" ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, two 6-inch plastic round valve boxes, and one CADWELD connector at each satellite or satellite controller group.

C. Power Wire:

- 1. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type TC Round Jacketed multi conductor cable with ground, direct burial, UL listed, rated at 600 volts. Power wires shall be black, white, and green in color. Contractor is responsible for ensuring the power wire sizes are compatible and adequate for the control system being used.
- 2. Splices: Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for wye splices.

3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
4. Warning tape to be installed above all power wire and communication cable, use non-detectable marking tape 4.0 mil thickness, linear low-density polyethylene, specifically formulated for extended use underground. The legend shall continually repeat a minimum of every three feet. The tape tensile strength shall be in accordance with ASTM D882 and not be less than 4100 MD and 3650 TD. Elongation properties shall be in accordance with ASTM D882 and be greater than 550% at break point. Tape flexibility shall be in accordance with ASTM D671 and shall remain pliable. Tape composition shall be of virgin LLDPE/LDPE. The tape color shall be red. The legend shall read "Caution Electric Line Buried Below". The tape width shall be 3-inch. Manufacturer T. Christy Enterprises, or approved equal.

D. Controller Wire:

1. Use American Wire Gauge (AWG) E200279, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
2. Splices: Use 3M #3570G-N splices as recommended by control system manufacturer.
3. Splice Box: Use plastic standard rectangular valve with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
4. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

E. Antenna: Calsense SR-STICK, and cable LRM-400-DB.

2.8 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION**3.1 INSPECTIONS AND REVIEWS**

- A. Site Inspections:
 - 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer Representative prior to beginning work.
 - 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig"):
 - 1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 - 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Contracting Officer Representative one week in advance of review.

3.2 LAYOUT OF WORK

- A. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- B. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer Representative.
- C. Sprinklers in Pre-Placed Crypt Sections:
 - 1. After pre-placed crypts are installed by prior to the pre-placed crypts being covered with soil, visually inspect, identify and stake sprinkler locations inside the pre-placed crypt section as identified on the drawings.
 - 2. Confirm monumentation offset with Cemetery staff.

3. As presented in the installation details, each sprinkler must be located such that after installation, each sprinkler is centered between the monummentation.
4. Record the location of each sprinkler using a method that cannot be altered during the backfill process for the pre-placed crypts. Use a permanent stake, GPS coordinates or other method so each sprinkler is installed at the proper location, centered between the monummentation.
5. Prior to staking, inform Contracting Officer Representative of recording method to be used for sprinkler locations.

3.3 EXCAVATION, TRENCHING, BACKFILLING AND HORIZONTAL BORING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Existing Survey Markers:
 1. Protect markers during construction.
 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.
- C. Existing Monummentation and Gravesites: At no time shall soil be allowed to pile on or around the existing gravesites and monummentation. Use a tarp when excavation trenches in burial sections. Trenches in burial sections may not be open longer than 24 hours. Backfill material spoils must be removed immediately and not allowed to remain in burial sections after backfill is complete. Sod to be installed over all trenches within 4 days of trench backfill.
- D. Excavation Equipment - All equipment used for trenching, pipe pulling and directional boring must be equipped with turf tires.
- E. Installation Methodology:
 1. Mainline:
 - a. Open trench to install PVC mainline pipe.
 - b. Mainline pipe has been routed to avoid conflicts with existing trees. Do not install mainline pipe within drip line of any existing tree. Immediately contact Contracting Officer Representative if a conflict between mainline pipe routing and an existing field condition is identified.
 2. Lateral Pipe in Burial Sections:
 - a. Open trench to install PVC lateral pipe.

3. Lateral Pipe in Non-Burial Areas:
 - a. Open trench to install PVC lateral pipe.
 - b. As an alternative to trenching, a vibratory plow device specifically manufactured for pipe pulling may be used to install lateral pipe in non-burial areas. Maintain minimum burial depth. Roll trench after pulling pipe.
- F. Minimum cover:
 1. 36-inches over irrigation mainline pipe in landscaped areas.
(distance from top of pipe to finish grade)
 2. 22- to 28-inches over irrigation lateral pipe to sprinklers in pre-placed crypt field. Lateral pipe must be installed 4-inches below crypt lid. (distance from top of pipe to finish grade)
 3. 26-inches over irrigation lateral pipe to sprinklers in in-ground cremain burial sections. (distance from top of pipe to finish grade)
 4. 18-inches over irrigation lateral pipe to sprinklers in non-burial areas. (distance from top of pipe to finish grade)
 5. 24-inches over low voltage control wire when not in common trench with mainline or lateral piping, Control wire run independent of mainline will be installed in electrical conduit. (distance from top of control wire to finish grade)
 6. 6-inches vertical separation between mainline pipe and lateral pipe installed in a common trench.
 7. 6-inch minimum horizontal separation between pipes and wiring in a common trench Tuck wiring underneath and to one side of the mainline.
 8. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
- G. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer Representative.
- H. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- I. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the Contracting Officer Representative.
- J. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, and stones larger than

2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

- K. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 - 1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- L. Backfill mainline, lateral pipe and wiring in turf areas in the following manner:
 - 1. Backfill the trench and directional boring excavations by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.
- M. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer Representative.
- N. Resod all trenches and areas disturbed by construction of the irrigation system. See installation details installation procedure description.
- O. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer Representative for trench depth adjustments.
- P. Horizontal Boring:
 - 1. Use horizontal directional drilling techniques as recommended by NASTT, ASTM F1962, ASCE and in accordance with accepted industry practices.
 - 2. Locate and stake bore pit locations. Contact Contracting Officer Representative to confirm that bore pit locations are acceptable.
 - 3. Dispose of excess directional boring slurry legally off-site.
 - 4. Backfill bore pits to original grade. Backfill by depositing the backfill material in 6-inch layers and compacting to the density of surrounding soil. Remove excess backfill to on-site location as direction by the Contracting Officer Representative.
 - 5. Resod bore pit if located in existing turf area.

3.4 SLEEVING

- A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.

- B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw cut.
- C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe are a minimum of twice the diameter of the pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

A. General:

- 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
- 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
- 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

| Size | Radius | Offset Per 20' Length |
|------|--------|--------------------------|
| 1 ½" | 25' | 7'-8" |
| 2" | 25' | 7'-8" |
| 2 ½" | 100' | 1'-11" |
| 3" | 100' | 1'-11" |
| 4" | 100' | 1'-11" |
| 6" | 150' | 1'-4" |
| 8" | 200' | 1'-0" |

B. Mainline Pipe and Fittings:

- 1. PVC Rubber-Gasketed Pipe:
 - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Ductile iron fittings will not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:
 - a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
 - c. Snake pipe from side to side within trench.
2. Fittings: The use of cross type fittings is not permitted.
3. Lateral Pipe and swing joints installed in Pre-Placed Crypt sections:
 - a. Lateral pipe and fittings may be installed prior to backfill over pre-placed crypts to ensure correct placement and depth.
 - b. Contractor responsible for locating the correct tee or el fitting locations in pre-placed crypt areas by using GPS survey grade equipment or installing the pipe and measuring the distance from the crypt ends prior to backfill. All tee locations to be staked and approved by Contracting Officer Representative.
 - c. Cap all swing joint ends prior to backfill.
 - d. Mark swing joint locations prior to backfill and final grade using 30-inch length of 1-inch PVC pipe or other approved method. Submit alternate method with submittal review if applicable. Note that grid markers are typically set after the final grade and will typically not be available for reference in location sprinkler locations in pre placed crypt sections.
- D. Specialized Pipe and Fittings:
 1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
 2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.
- E. Joint Restraint Harness:

1. Restrain length of pipe at valves and changes in pipe direction as presented in the installation details and per the joint restraint manufacturer recommendations.
 2. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
 3. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.
- F. Thrust Block: As presented in the details.

3.6 INSTALLATION OF MAINLINE COMPONENTS

- A. Isolation Gate Valve Assembly:
1. As presented in the installation details, per manufacturer's instructions.
 2. Install where indicated in the irrigation plans.
 3. Brand "GV" in 2-inch high by 3/16-inch deep letters on valve box lid.
- B. Air/Vacuum Relief Valve Assembly:
1. As presented in the installation details, per manufacturer's instructions.
 2. Install where indicated in the irrigation plans.
 3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.
- C. Quick Coupling Valve Assembly:
1. As presented in the installation details, per manufacturer's instructions.
 2. Install where indicated in the irrigation plans.
 3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.
- D. Blow off Valve Assembly
1. As presented in the installation details, per manufacturer's instructions.
 2. Install where indicated in the irrigation plans.
 3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS**A. Mainline Pipe Flushing:**

1. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
2. Identify service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
3. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations or erode site.
4. Use a volume of water such that the velocity in the largest pipe flushing to this point is a minimum of 3 FPS.
5. Multiple points may be flushed simultaneously.
6. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
7. Contracting Officer Representative will review the flushing operation and clarity of water before stopping the flushing operation.
8. Disconnect pipe from service tee(s) and install remote control valve(s).

B. Remote Control Valve Assembly:

1. Install per manufacturer's recommendations where indicated on the drawings.
2. Adjust valve to regulate the downstream operating pressure to 70 PSI for pop-up rotary sprinklers and 35 PSI for spray sprinklers.
3. Wire connectors and waterproof sealant will be used to connect low voltage control wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
4. Install only one remote control valve to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas. Group valve boxes together where possible equidistant from the adjacent valve boxes.
5. Attach ID tag with controller station number to control wiring at solenoid.
6. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Pop-Up Rotor Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install rotary sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 2-foot square piece of sod around all rotary sprinklers in areas to be seeded.

D. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install spray sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing pipe and fittings per manufacturer's recommendations.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

D. Root Well Assembly:

1. Install with cap mounted flush to finish grade and vertical.
2. Install halfway between rootball and planting pit in new installation. For existing trees install halfway between trunk and canopy drip line.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Satellite Controller:

1. Install new satellite controller(s) at location(s) shown in the construction documents.

2. Add data to central control computer program required to operate the satellites via central control and use the central control features available such as but not limited to learned flow and ET adjusted run times.
3. Perform radio test prior final installation of new irrigation controllers.
4. Install electrical connections per control system manufacturer's recommendations. Electrical connections are to be completed by control system manufacturer's trained representative.
5. Lightning protection: Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections.
6. Attach wire markers to the ends of low voltage control wire cable inside controller. Label cable with the identification number per irrigation plan.
7. Install permanent receiver for hand held radio if not factory installed.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box. Brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 2-inches below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer Representative.

8. Connect wire to power source.

C. Control Wire:

1. Route low voltage control cable in mainline trench.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box or valve-in-head sprinkler.
3. If a cable must be spliced, make splice with waterproof connectors and sealant installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
4. Unless noted on plans, install wire parallel with and below mainline pipe.
5. Protect wire not installed with pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

3.9 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide one 4-hour training session to operating personnel on proper operation and maintenance of the new irrigation system. Training session should cover aspects maintaining, operating and repairing the new irrigation system components.
2. Submit per Section 1.4. Include table of contents and index sheet. Provide sections that are indexed and labeled for the following information:

- a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
- b. Manufacturer's Operation and Maintenance manuals.
- c. Manufacturer's Technical Service Bulletins.
- d. Manufacturer's Warranty Documentation.
- e. Recommended routine maintenance inspections for weekly, monthly and annual inspections, recommended actions for the inspections, recommended method for recording the findings of the inspections and proper winterization techniques.
- f. Predictive schedule for component replacement.
- g. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.
- B. Control System Programming:
 1. Provide the necessary operating data for the new irrigation system to Contracting Officer Representative such that operating personnel can reprogram the existing central control system. Data to be supplied by the Contractor must include station number, sprinkler equipment, flow rate, calculated precipitation rate based on the Distribution Uniformity test, calculated peak season run time and recommended turf establishment run time(s).
 2. Calculate the peak season run time for each new station using the precipitation rate results of the Distribution Uniformity test(s).
 3. Verify operation of program with operating personnel and Contracting Officer Representative.
- C. Colored Controller Charts:
 1. Prepare a map diagram showing location of all valves, piping, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared. Map diagram can be constructed using AutoCAD or PDF computer software. Adjacent lateral pipes to be of different color, use four different colors for lateral pipe.
 2. Include legend listing components used for the controller. Include a separate sprinkler table listing station number, sprinkler

- manufacturer and model, zone capacity, and number of sprinklers on the zone.
3. Provide one colored full sized controller chart for each irrigation plan sheet showing the area covered by the controller. Provide four 11"x17" reduced colored charts of the actual "as-built" drawing. Chart must be readable at the reduced size.
 4. Laminate one 11"x17" sized colored chart and place laminated chart in lid of each controller.

3.11 PROJECT RECORD DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, two complete sets of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded on Project Documents.
- B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Special attention must be given to pipe routing and controller stationing.
- C. At completion of installation, Contractor must hire a Professional Licensed Surveyor to survey/document locations of all sprinklers, irrigation components enclosed within a valve box, controllers, wire splice boxes and "coordination points". If necessary, Contractor must flag sprinklers for Surveyor. Surveyor must use "SPR" as attribute data for sprinklers, the branding in the valve box lid (for example "GV", "AV", "QC") as the attribute data for components enclosed within a valve box, "CTLR" as the attribute data for controllers, "WS" for wire splice boxes and "CP" for coordination points. Contracting Officer Representative will provide AutoCAD file for Surveyor showing coordination points to produce "Survey Drawing". Surveyor is to use the AutoCAD files to develop and provide an AutoCAD file and PDF file of the Survey Drawing.
- D. Prior to project completion, Contractor must provide the project redline drawings and the "Survey Drawing" AutoCAD files to Contracting Officer Representative for delivery to VA's A/E representative. A/E will prepare "Record Drawings" by compiling the information on the Contractor redlines drawings and the "Survey

Drawing". Provision of this information prerequisite for Final Inspection.

3.12 MAINTENANCE

- A. Operate and maintain irrigation system for a duration of 30 calendar days from Final acceptance. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

3.13 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

- - - E N D - - -

**SECTION 32 90 00
PLANTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants, soils, turf, and landscape materials and accessories.

1.2 RELATED REQUIREMENTS

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 00, EARTH MOVING.
- B. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Erosion control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- D. Protection of Tress and Plantings: Section 02 41 10, DEMOLITION AND SITE CLEARING.
- E. Topsoil Placement and Compaction Test: Section 31 20 00, EARTH MOVING.
- F. Landscape Irrigation: Section 32 84 00, PLANTING IRRIGATION.
- G. Transplanting Exterior Plants: 32 96 00, TRANSPLANTING EXTERIOR PLANTS

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI) Publications:
 - 1. ANSI Z60.1-2014 - Nursery Stock.
 - 2. ANSI Z133.1-2012 - Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.
- C. ASTM International (ASTM):
 - 1. C33/C33M-16-Concrete Aggregates.
 - 2. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
 - 3. D698-12 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 4. D977-13e1 - Emulsified Asphalt.
 - 5. D2028/D2028M-15 - Cutback Asphalt (Rapid-Curing Type).
 - 6. D2103-15 - Polyethylene Film and Sheeting.
- D. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- E. National Cemetery Administration (NCA):
 - 1. Handbook 3410 - Integrate Pest Management.
 - 2. Handbook 3420-11 - Turfgrass Maintenance.
- F. Turfgrass Producers International (TPI):

1. 2006 Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA):
 1. Federal Seed Act-2011 - Rules and Regulations of the Secretary of Agriculture.
- H. United States Environmental Protection Agency (EPA):
 1. 40 CFR Part 503-1993 - Biosolids Rule.

1.4 PREINSTALLATION MEETINGS

- A. Conduct pre-installation meeting at project site minimum 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Resident Engineer (RE).
 - b. Architect/Engineer (A/E).
 - c. Contractor.
 - d. Installer.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Inspection of planting materials.
 - b. Installation schedule.
 - c. Installation sequence.
 - d. Preparatory work.
 - e. Protection before, during, and after installation.
 - f. Installation.
 - g. Inspecting.
 - h. Environmental procedures.
 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. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the Resident Engineer for approval:
 1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
 2. Fertilizers

3. Gypsum
4. Elemental Sulfur
5. Compost
6. Seed
7. Sod

C. Manufacturer's Literature and Data:

1. Description of each product.
 - a. Soil amendments.
 - b. Antidesiccant.
 - c. Erosion control materials.
 - d. Hydro mulch.
 - e. Non-Asphaltic Trackifier.
 - f. Pre-emergent Herbicide.
 - g. Weed Control.
 - h. Mulches.
2. Warranty.

D. Samples: Submit before beginning Work of this section:

| | |
|--|--|
| Inert Mulch | 2.3 kg (5 lb.) of each type to be used. |
| Organic Mulch | 2.3 kg (5 lb.) of each type to be used. |
| Imported Topsoils | 2.3 kg (5 lb.) of each type to be used. |
| Organic Amendments | 2.3 kg (5 lb.) of each type to be used. |
| All pesticides required such as pre-emergence or post emergence herbicides, insecticides, or fungicides. | EPA approved labeling and MSDS sheet for each such product selected for use. |
| Edging Materials | Manufacturer's standard size |

E. Test reports: Certify products comply with specifications.

1. Imported Topsoil: Provide 2.3 kg (5 lbs.) representative sample from each proposed source for testing, analysis, and approval. Deliver

samples to acceptable testing laboratory and have testing report sent directly to RE. Testing reports to include following tests and recommendations according to Association of Official Agricultural Chemists standards:

- a. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) performed by public extension service agency, State Land Grant College, or certified private testing laboratory. Percentages of clay and silt to be determined by hydrometer.
 - b. Percent of organics to be determined by loss on ignition of oven-dried samples. Test samples to be oven-dried to constant weight at 110 degrees C (230 degrees F), plus or minus 5 degrees C (41 degrees F).
 - c. Macro and micro nutrient fertility tests as determined by Chemical analysis to include Macro and micro nutrient fertility tests as determined by pH, Salinity (EC), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Soluble Copper, Zinc, Manganese, Iron, Saturation Extract Boron, Aluminum, Soluble Salts, Exchangeable Sodium Percentage (ESP), Sodium Adsorption Ratio (SAR), and Cation Exchange Capacity (CEC).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH to be performed by testing laboratory retained by National Cemetery Administration as described in Section 01 45 29, TESTING LABORATORY SERVICES.
 - e. Include recommendations for soil additives to correct soils deficiencies, as necessary, and for fertilizing and to adjust soil pH to optimum range for cool season turfgrass liming applications to support successful turfgrass growth.
2. Organic Soil Amendment:
- a. Testing: Provide testing by an independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
 - b. Soil Amendment Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil

testing laboratory to test representative samples of compost and provide compost analysis report for the following parameters:

- 1) Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
 - 2) Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur s.
 - 3) Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
 - 4) Maturity Indicator. Provide bioassay results. Provide Carbon-Nitrogen ratio.
 - 5) Stability Indicator: Provide respiration test results.
3. Amended Soil (in place): Following incorporation of amendments and additives, provide minimum six (6) samples per 3,700 sq. m (40,000 sq. ft.), 150 mm (6 inch) depth by 75 mm (3 inch) diameter core samples of amended soil taken from project site for testing, analysis, and approval. Locate each samples as directed by COR from areas designated to be planted in turfgrass. Deliver samples to testing laboratories and have testing report sent directly to COR. Obtain amended soil sample acceptance before seeding or hydroseeding.
- F. Certificates: Certify products comply with specifications.
- G. Before delivery, submit notarized certificates for approval to RE attesting that following materials meet specified requirements:
1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
 2. Fertilizers: Four certificates of analysis for each type of fertilizer.
 3. Lime.
 4. Gypsum.
 5. Elemental Sulfur.
 6. Compost
 7. Humates.
 8. Mycorrhizae.
 9. Peat.
 10. Seed: Include guaranteed percentages of purity, weed content and germination of seed, and net weight and date of shipment.

11. Sod.
12. Membranes.
13. M-Binder.
14. Hydro Mulching: Number of kilograms (pounds) of materials to be used per liter (gallon) of water.

H. Maintenance Data:

1. Care instructions for each plant material.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified materials and 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.
 - b. A member with good standing of either the Professional Landcare Network (PLANET) the AmericanHort.
 - c. Maintain an experienced full-time supervisor on Project site when work is in progress.
 - d. Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the RE:
 - e. Certified Landscape Technician (CLT) - Exterior, with installation , designated CLT-Exterior.
 - f. Certified Ornamental Landscape Professional designated COLP.

B. Licenses: Submit licenses to RE:

1. Arborist: One copy.
2. Pesticide Applicator: License in state of project, commercial.

1.7 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.
- D. 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. Protect products from weather.

2. Install erosion control materials to prevent erosion or displacement of bulk products.
- E. Notify RE of delivery schedule five days in advance, minimum. RE will inspect materials upon arrival. Remove unacceptable plant materials from project site immediately.
- F. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.
- G. Protect trees during transport by covering root balls and tying branches.
- H. Machine dug plants are permitted provided root balls are sized according to ANSI Z60.1 and tops are protected from damage.
- I. Protect sod from drying out.

1.8 STORAGE AND HANDLING

- A. Store seeds, soil amendments, fertilizers, and packaged materials in dry locations away from contaminants.
- B. Keep sod moist and protect from exposure to wind and direct sunlight.
- C. Store plants not installed on day of arrival at project site as follows:
 1. Shade and protect plants from wind when stored outside.
 2. Heel in bare root plants.
 3. Protect plants by covering roots with moist wood chips, shredded bark, peat moss, or similar mulching material.
 4. Keep plants moist including those in containers, by watering with fine mist spray until planted.

1.9 FIELD CONDITIONS

- A. Perform landscape planting operations within following dates, but not before irrigation system installed, tested, and approved.
 1. Spring Planting: March 1st to May 1st
 2. Fall Planting: September 1st to October 30th
 3. Planting of trees and shrubs may occur during winter months, between November 1st and February 28th, if weather conditions do not adversely affect materials or soil conditions. Planting during winter months must be approved by the RE prior to commencing planting activities.
- B. Perform turfgrass installation operations within following dates, but not before irrigation system installed, tested, and approved.
 1. Spring Planting: March 1st to May 1st.

2. Fall Planting: September 1st to November 10th.

- C. Restrictions: Do not plant when ground is frozen, snow covered, saturated or in otherwise unsuitable condition for planting. Special conditions may exist that warrant variance in specified planting dates or conditions. Submit written request for approval to RE stating special conditions and proposal variance.

1.10 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Comply with "Warranty" requirements in Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
1. One Year Plant and Turfgrass Warranty: Warranty begins when Government accepts plants and turfgrass but not before end of Landscape Plant and Turfgrass Establishment Period.
 2. Replace any dead plant material and any areas void of turfgrass immediately during warranty period and during an active growing season. One year warranty for replaced plants and turfgrass begins on day replacement work is completed and accepted.
 3. Replacement of relocated plants, not furnished, is not required unless they die from improper handling and care. Loss due to improper handling, care, or negligence requires replacement in kind and size.
 4. Government will inspect replacement plants and turfgrass at end of Warranty period. Replace any dead, missing, or defective plant material and turfgrass immediately and during growing season. Warranty ends on date of this inspection provided work specified in this section is complied.
 5. Remove stakes, guys wires/straps at end of one year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product from one source or manufacturer.
- B. Plant and Turf Grasses: Comply with the varieties specified or shown in plant list.
- C. Warrant plants are true to botanical name as listed in Hortus Third.
- D. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.2 ORGANIC SOIL AMENDMENT

- A. Organic Soil Amendment: Dark brown or black and capable of enhancing plant growth. Ninety-eight percent of material passes 1 inch screen. No admixture of refuse (i.e. noticeable inert contamination) or materials toxic to plant growth are permitted, free of all woody fibers, seeds, leaf structures, plastic, petroleum products, and toxic and non-organic matter.
1. Acceptable Organic Soil Amendments: Peat moss, humus or peat, and commercially available combinations thereof.
 2. Acceptable Compost: Natural organic sources such as food or animal residuals, or yard trimmings.
 3. Unacceptable Sole Sources of Organic Matter: Untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
- B. Minimum Material Requirements:

| Test Parameter | Acceptable Ranges |
|--------------------------------|--|
| Organic Matter | 27 to 80 percent |
| pH | 5.5 to 8.5 |
| Ash | 20 to 65 percent |
| Nitrogen | 0.4 to 3.5 percent |
| Phosphorus | 0.2 to 1.5 percent |
| Potassium | 0.4 to 1.5 percent |
| C: N Ratio | 25 to 30: 1 |
| CEC | 50 to 150 meq/100 g |
| Heavy Metals | Less than max. limits established by EPA 40 CFR Part 503 |
| Inert Contents | Less than 1 percent by weight |
| Water-Holding Capacity | 150 to 200 percent |
| Pathogen/Weed Seed Destruction | Proof of EPA minimum heating requirements |

- C. Topsoil stripped and stockpiled on project site is acceptable provided, after testing and addition of necessary additives, meets above specification. Provide additional Organic Soil Amendment as required to complete work.

- D. Provide organic soil amendment in areas with organic matter content below 4 percent that will be seeded, sodded or sprigged after grading activities are completed to create satisfactory topsoil horizon.
- E. Spread and incorporate organic soil amendment into finished subgrade at depths indicated on drawings to raise soil organic content to minimum four percent and maximum six percent. Allow for additional depth of organic soil amendment to bring all grades to required finished grades as shown on grading plans.

2.3 PLANTS

- A. Plants: ANSI Z60.1, except as otherwise stated in this section or shown on drawings. Where drawings or specifications are in conflict with ANSI Z60.1, drawings and specification will prevail.
 - 1. Provide well-branched and formed planting stock, sound, vigorous, and free of disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems.
 - 2. Provide single stemmed trees, with a single leader, unless otherwise indicated.
 - 3. Provide trees and shrubs of uniform, symmetrical growth, with straight boles or stems, free from objectionable disfigurements, and with branch spread of branches typical of variety.
 - 4. Provide ground cover plants with number and length of runners for size, and proper age for grade of plants specified. Provide well established plants in removable containers, integral containers, or formed homogeneous soil sections.
 - 5. Provide plants grown under climatic conditions similar to those in project locality.
- B. Minimum acceptable sizes of all plants, measured with branches in normal position, to conform to plant list and ANSI Z60.1. Larger plants with RE's approval, at no additional cost to the Government. Increase ball of earth or spread of roots according to ANSI Z60.1 when larger plants are provided.
- C. Do not handle plants by trunk or stem. Trees must be moved by lifting root ball, box or container.
- D. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.

- E. When existing plants are to be relocated, ball sizes to conform to ANSI Z60.1 requirements for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.4 LABELS

- A. Legibly tag each plant, or group and bundles or containers of the species, variety, and size of plant with durable, waterproof and weather-resistant label indicating correct plant name and size specified in plant list. Labels to be securely attached and not removed until acceptance by the Government.

2.5 TOPSOIL

- A. Topsoil: Provide well-graded soil of good uniform quality, natural, friable soil representative of productive soils in project vicinity. Topsoil to be free of subsoil, foreign matter, objects larger than 1 inch in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and have pH value of minimum 6.0 and maximum 7.0, and be best suited to region, climate and plant material specific to project.
- B. Obtain material from stockpiles established under Section 31 20 00, EARTH MOVING, subparagraph, Stripping Topsoil that meet general requirements stated above. Amend topsoil not meeting pH range specified by the addition of pH adjusters.
- C. When sufficient topsoil is not available on project site to specified depth, provide additional topsoil. Minimum 10 days before topsoil delivery, notify RE of sources from which topsoil will be furnished. Obtain topsoil meeting general requirements stated above and comply with requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting pH range specified by adding pH adjusters.

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: Agricultural limestone, minimum 90 percent calcium and magnesium carbonates. Grind lime fineness, minimum 90 percent passes No. 8 mesh and minimum 25 percent passes No. 100 mesh. Maximum moisture, 10 percent.
 - 1. Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate), minimum of 20 percent calcium and 11 percent magnesium and as follows:

- a. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; minimum 30 percent passing through No.325 sieve. Provide lime in form of granulated, prilled, dolomitic limestone.
2. Calcitic Lime: Natural, agricultural limestone (calcium carbonate), minimum of 36 percent calcium and as follows:
 - a. Screen Analysis: minimum of 100 percent passing through No. 10 sieve; minimum of 80 percent passing through No. 100 sieve. Provide lime in form of granulated, prilled, limestone.
3. Agricultural Gypsum: Finely ground, minimum of 90 percent calcium sulfate, or 85 percent calcium sulfate dihydrate.
4. Sulfur: Granular, biodegradable, minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
5. Iron Sulfate: Granulated ferrous sulfate minimum of 20 percent iron and 10 percent sulfur.
6. Aluminum Sulfate: Commercial grade, unadulterated.
7. Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.
8. Humates: Derived from mined Gypsum and with guaranteed minimum analysis; Calcium Sulfate dihydrate ($\text{CaSO}_4 \bullet 2\text{H}_2\text{O}$) 35.00%; Calcium (Ca) 7.00%; Sulfur s 5.00%, plus Humic Acids 1.5% derived from Leonardite. Pelletized product used for ease of application.
9. Mycorrhizae: Endomycorrhizal powder inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: Glomus intraradices, Glomus mosseae, Glomus aggregatum, and Glomus etunicatum. Minimum 100,000 spores/propagules per pound. The powder particle size shall be less than 300 microns (100 percent passing the #50 screen).

2.7 ORGANIC SOIL AMENDMENTS

- A. Peat: Natural product of sphagnum moss peat derived from fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Shred and granulate peat to pass 1/2 inch mesh screen and condition in storage piles for minimum six months after excavation.
- B. Perlite: Horticulture grade.
- C. Vermiculite: Horticultural grade, free of any toxic materials.

- D. Organic Matter: Commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

- A. Ornamental Plantings: Planting soil mixture composed of 3 parts topsoil and 1 part 1 part U.S. Composting Council Seal of Testing Assurance approved compost.
- B. Native Plantings: 100 percent native on-site soil free of clods and subsoil. Do not amend soils intended for native planting.

2.9 PLANT FERTILIZERS

- A. Provide commercial grade plant fertilizer of uniform composition and complying with applicable state and federal regulations.
- B. For new plant material, provide uniform free-flowing granular complete analysis fertilizer based on recommendations of soils reports, containing minimum 16 percent by weight nitrogen, 20 percent by weight phosphoric acid and potash, 50 percent by weight humus and 15 percent by weight humic acid.
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing manufacturer's warranted statement of analysis. Granular fertilizer to contain minimum 10 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 10 percent available phosphoric acid, and 10 percent potash.

2.10 TURFGRASS FERTILIZER

- A. Provide commercial grade granular fertilizer, free flowing, uniform in composition, and complying with applicable state and federal regulations. Submit fertilizer manufacturer's warranted statement of analysis. Fertilizer contain minimum 12 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 20 percent available phosphoric acid, and 0 percent potash. Liquid starter fertilizer for hydro mulch slurry, commercial type with 50 percent of nitrogen from controlled release source.

2.11 MULCH

- A. Mulch: Free of deleterious materials and stored to prevent inclusion of foreign material.
- B. Mulch for planting beds shall be double shredded hardwood mulch (match existing) or approved equal. Nuggets are not permitted.

1. Chemistry:
 - a. Acid reaction: Max pH 5.0
 - b. Maximum ash: 7% based on dry weight.
 - c. Minimum Moisture: 35% at time of delivery based on fresh weight.
- C. Straw Fiber Mulch (For Native Grass Seed Mix Only):
 1. Hydrostraw by Pelletized Straw or equal. Straw Hydroseed w /tackifier mulch shall be composed of processed grass straw with no growth or germination inhibiting substances. Mulch shall be manufactured in such a manner that all the ingredients are contained in a single bag and when thoroughly mixed with water in the proportions specified, will form a homogenous slurry which is capable of being sprayed to form porous mat. The fiber shall have a temporary green dye and shall be accompanied by certificate of compliance stating that the fiber conforms to these specifications and have the physical properties listed below:
 - a. Moisture Content 10% +/- 2.0%
 - b. Organic Matter 96% +/- 3.0%, pH 6.8 +/-0.5
 - c. Water Holding Capacity 584 Saturation 309 Water Holding % Wt/WT
 - d. Carbon/Nitrogen Ratio 39:1 +/- 2.0%
 - e. Soluble Salts 1.7 +/- .4%
- D. Wood Fiber Mulch
 1. Conwed or Canfor Wood Fiber Mulch with Tacking Agent by PROFILE Products LLC, Canfor or equal with the following characteristics:
 - a. Materials: 100% wood fiber, dark green marker dye, polymer tackifier.
 - b. pH Range: 4.8%+-2
 - c. Moisture Content: 12+-3% percent maximum
 - d. Wood Fiber: 97%
 - e. Organic Content: 96.2%+- .4
 - f. Tackifier: 3% Tacking Agent 3
 - g. Ash Content: .8%+- .4
 - h. Water Holding Capacity: 1350% percent minimum
 - i. Packaging: 50 pound UV resistant bags, with UV resistant pallet cover.
 2. Water: Clean, fresh and free of substances or matter that could inhibit vigorous grass growth.

2.12 PRE-EMERGENT

- A. As approved by the RE's Technical Representative, to prevent annual weed development in hydroseed applications.
- B. Pre-emergent weed control for Native Grassland Seeding will only be part of maintenance program, not installation as it will kill the new seed.

2.13 EROSION CONTROL

- A. Erosion Control Blanket: Cellulose fiber blanket bonded to 1/4 inch square plastic net weighing 20 lbs./1000 sq. ft. in 50 inch wide rolls.

2.14 FUNGICIDE

- A. 26/36 Fungicide by Cleary Chemical or approved equal broad spectrum fungicide registered for use in California.

2.15 STAKES AND GUYING STRAPS

- A. Tree Support Stakes: Lodgepole pine treated with copper naphthanate, free of knots, rot, cross grain, or other defects that impair strength. 2-1/2 inches diameter by 8 feet long and pointed at one end.
- B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.
- C. Flags: White surveyor's plastic tape, 6 inches long, fastened to guying wires or cables.
- D. Guying Straps: Fabric designed specifically to guy newly planted trees. Wire will not be permitted.
- E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes.
- F. Eye Bolts: Galvanized or cadmium plated steel with 1 inch diameter eye and minimum 1-1/2 inches screw length.
- G. Deadmen: 4 inch by 8 inch rectangular, or 8 inch diameter by 36 inch long sound wood.
- H. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

2.16 EDGING

- A. Machine Cut Divot Edge: 'V'-shaped trench used as separation between lawn and mulched planting beds. Fill machine cut divot edge with planting bed mulch as detailed in the drawings.

2.17 WATER

- A. Water: Contains no elements toxic to plant life, obtained from the existing cemetery water supply as specified in Section 01 00 01, GENERAL REQUIREMENTS, Paragraph, Temporary Services. Availability and use of utility services at no cost to the owner.

2.18 ANTIDESICCANT

- A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.19 TURF SEED MIX

- A. Seed: State-certified seed of latest season's crop delivered in original sealed packages, bearing producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label complying with USDA Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Onsite seed mixing will only be acceptable in presence of RE. Apply turfgrass seed separate from and before mulch material application.
- B. Minimum Acceptable Seed Quality Standards: Purity 95 percent, Germination 85 percent, Weed Seed Content less than 0.5 percent, Noxious Weeds 0.0 percent, Inert Material less than 3 percent, Germination Test Date no older than 6 months.
- C. All turfgrass seed mixtures, or sod composition, to conform to species and cultivar requirements detailed here. Seed mixtures listed below are representative of an almost endless list of acceptable seed mixtures that roughly approximate these guidelines.
 - 1. 80% Triple Dwarf Type Fescue - Blend of three types from the five varieties listed below:
 - a. Bonsai '3000'
 - b. 2nd Millennium
 - c. Finesse II
 - d. Focus
 - e. Mustang III
 - 2. 10% Common Kentucky Bluegrass - One type from the two varieties listed below:
 - a. Rugby
 - b. Brooklawn

3. 10% Perennial Ryegrass - One type from the two varieties listed below:
- a. Manhattan 4
 - b. Pizzazz
- D. Seeding rate shall be 8 lbs. per 1,000 square feet or per supplier's recommendation, whichever is greater.
- E. Obtain approval of RE and NCA Pacific District Agronomist and/or NCA Chief Agronomist for deviations from these turfgrass species requirements.

2.20 NATIVE SEED MIX

- A. Native Seed Mix shall be as shown below:

| <u>Species/Common Name</u> | <u>***LBS/ACRE</u> |
|--|--------------------|
| Hordeum californicum/California Barley | 6.0 |
| Nassella pulchra/Purple Needlegrass | 4.0 |
| Nassella cernua/Nodding Needlegrass | 4.0 |
| Melica californica/California Oniongrass | 3.0 |
| Poa secunda/Native Pine Bluegrass | 3.0 |
| Leymus triticoides, var. Yolo/Native Creeping Wildrye - Yolo | 2.0 |
| Achillea millifolium | 0.5 |
| Lupinus nanus/Sky Lupine - inoculated * | 2.0 |
| Eschscholzia californica, CA Poppy | 1.5 |
| Castilleja exerata, Purple Owls Clover | 0.25 |
| Sisyrinchium bellum, Blue eyed grass ** | 0.75 |
| Grindelia camphorum, Gumplant | 1.0 |
| Lotus purishianus, Spanish Clover - inoculated * | 2.0 |
| Total | 30.0 |

* Seed shall be inoculated.

** Shall have been tested within 3 months and shall have a percentage of germination greater than the percent dormant seed.

*** Pounds of Pure Live Seed per Acre.

- B. Seed shall be noxious weed free, fresh, re-cleaned, Grade A, new crop seed, crop and weed seed shall be less than 2.5 and .75 percent, respectively and consisting of the percentages of mix specified. Shall be delivered in unopened individually tagged and bagged seed bags. Seed shall be labeled in accordance with the California State Seed Law, U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.
- C. Seed shall be provided from a California Crop Improvement Approved Certified Seed Conditioner. Seed mixture be labeled with manufacturer's guaranteed analysis, including germination rate, and purity and original seed tests for each lot shall be provided 10 days before seeding.
- D. Seed shall be mixed on the Project site in the presence for the Contracting Officer's Technical Representative.

2.21 SOIL INOCULANT (FOR NATIVE GRASS SEED MIX ONLY) :

- A. Mycorrhizal Inoculant:
 - 1. Mycorrhizal inoculant shall consist of spores, mycelium, and mycorrhizal root fragments in a solid carrier suitable for handling by hydro-seeding or dry seeding equipment. The carrier shall be material in the inoculum was originally produced, and may include organic materials, perlite, calcite clay or other approved materials consistent with mechanical application and with good plant growth. Each mycorrhizal inoculum shall carry a supplier's guarantee of number of propagules per unit weight or volume of bulk material. Mycorrhizal inoculum shall be applied at the rate of 8,900,000 live propagules per hectare (3,600,000 per acre) based on the guarantee of the supplier or an analysis returned by an independent laboratory. Inoculum shall be AM 120 cultured by RTI, Salinas CA or equal.

2.22 FERTILIZER (FOR NATIVE GRASS SEED MIX ONLY) :

- A. Biosol 7-2-3, Shall conform to the requirements of the California Food and Agriculture Code, and shall have guaranteed analysis for nitrogen, phosphorus and potassium. Fertilizer shall have been tested and demonstrate a nearly linear release curve.

2.23 SOD

- A. Sod: Nursery grown, certified sod as classified in TPI "Guideline Specifications to Turfgrass Sodding." Sod must also conform to turfgrass species limitations as outlined in seeding mixtures above.

2.24 HERBICIDES AND OTHER PESTICIDES

- A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

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. Examine areas to receive planting for compliance with requirements and other conditions affecting performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Stake plant material locations and bed outlines for RE's approval before any plant pits or beds are dug. RE may make adjustments to plant material locations to meet field conditions.
- F. Identify and review all underground utility locations before commencing work and exercise caution when working close to utilities. Notify RE of apparent conflicts with construction and utilities to plan adjustment before installation.

3.2 FINE GRADING AND ORGANIC AND INORGANIC SOIL AMENDMENT INCORPORATION

- A. Obtain RE's written approval of previously completed rough grading work before incorporating organic soil amendments.
- B. Immediately before dumping and spreading approved organic soil amendment, clean subgrade of stones larger than 2 inches and debris or rubbish and remove from project site. Before spreading organic soil amendment, rip subgrades too compact to drain water or based upon compaction tests with claw 12 inches deep, pulled by bulldozer 24 inches on center, both directions, then regrade surface.
- C. Place and uniformly spread soil amendment materials over approved sub-grades. Apply inorganic soil amendments as recommended by soils report. Apply organic amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling,

specified minimum settled depth conform to lines, grades and elevations indicated on drawings. Incorporate soil amendment by disc harrowing, rototilling or other means in uniform manner. Incorporate upon organic matter deep enough to produce finished soil with organic matter content of between 4 and 6 percent. Provide additional organic soil amendment material, after in-place testing and approval, as required for organic matter content and finished grades at no additional cost to Government.

- D. Spread organic soil amendment material minimum 4 inches deep to finished grade at disturbed areas outside project limits.
- E. Do not handle subsoil or organic soil amendment material when wet or frozen.
- F. Set sufficient number of grade stakes to check finished grades. Set stakes in bottom of swales and at top of slopes. Connect contours and spot elevations with even slope.
- G. After incorporating soil amendments material into subsoil, prepare by scarifying or harrowing and hand raking. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 1-1/2 inch diameter from amended soil bed. Amended soil also to be free of smaller stones in excessive quantities as determined by RE.

3.3 EXCAVATION FOR PLANTING

- A. Compact whole surface with roller or by other suitable means to achieve 88 to 85 percent maximum dry density according to ASTM D698. During compaction process, fill all depressions caused by settling or rolling with additional organic soil amendment. Regrade and roll surface until presenting smooth and even finish corresponding to required grades. Acceptable finished soil grade condition for all new turfgrass and native grass areas is "fine textured and firm." Satisfactory firmness test requires surface soil not be fluffy or powdery and able to support weight of average adult person without creating visible depression.
- B. Verify location of underground utilities before plant pit or bed excavation. Repair damaged utility lines. Where lawns have been established before planting, cover and protect before beginning excavations. Protect existing trees, shrubbery, and beds with barricades during project construction.
- C. Remove rocks and other underground obstructions to depth necessary to permit proper planting according to Drawings. Where underground

utilities, construction, or solid rock ledges are encountered, RE may select other locations for plant material.

- D. Dig plant pits by approved method to provide vertical sides and flat bottoms. When sides of pit become glazed, scarify glazed surface.
- E. Where ground cover and planting beds occur in existing turfgrass and/or native grass areas, remove turfgrass and/or native grass to depth that will ensure removal of entire root system. Prepare bed as follows:
 - 1. Where existing soil is to be used in place, till beds 4 inches deep. Spread U.S. Composting Council Seal of Testing Assurance approved compost uniformly over bed 50 mm (2 inches) deep and thoroughly incorporate into existing soil 4 inches deep using a roto-tiller or similar equipment to obtain uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till soil to necessary depth to support growth of new planting. Remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to smooth and even surface to comply with established grades.
- F. In newly grading areas where existing soil will be removed and replaced to prepare new planting beds, remove 4 inches of existing soil and replace with topsoil. Bring plant beds to smooth and even surface to comply with established grades. Till 2 inches of U.S. Composting Council Seal of Testing Assurance approved compost into topsoil as specified.
- G. Form earth saucers around plants with topsoil. Provide 50 mm (2 inch) high basins for shrubs and 4 inch high basins for trees.
- H. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved pre-emergence granular ornamental herbicide. Apply herbicide at 200 lbs./acre before both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.4 SETTING PLANTS

- A. Move container-grown plants only by supporting container. Remove container, taking care to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around roots or ball. Set plants with root crown 1 inch above

surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.

- B. Backfill container-grown plants with native soil removed from planting hole to approximately half ball depth, then tamp and water. Use native soil to backfill hole. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil.

3.5 STAKING AND GUYING

- A. Stake and guy plants as indicated on drawings and as specified.
- B. Drive stakes vertically to depth of 2-1/2 to 3 feet into ground outside plant pit, unless otherwise shown on drawings Do not injure root ball.
- C. Place deadmen minimum 18 inches below ground surface, unless otherwise indicated on drawings.
- D. Install iron anchors according to manufacturer's instructions.
- E. Fasten flags securely to each guy strap approximately 2/3 of the distance above ground level.
- F. Remove stakes and guy straps after one year.

3.6 EDGING PLANT BEDS

- A. Uniformly edge beds using machine to provide clear cut "V"-shaped trench between planted area and adjacent turfgrass and/or native grass. Fill trench with mulch. Do not use any type of manufactured edging material. The properly mowed and maintained turfgrass and/or native grass will serve as edging for all landscape beds.

3.7 MULCHING PLANTS

- A. Apply approved pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben and mulch within 48 hours after planting. Apply at 200 lb per acre before both early spring and early fall weed seed germination.
- B. Placing Organic Material: Spread wood-base mulch to uniform 3 inch thickness (unless otherwise stated on the drawings). Rake smooth. Flush mulch with adjacent lawn, curbs and paving.
- C. Keep mulch out of shrub crowns, away from tree trunks, and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Do not prune new plants unless otherwise directed by arborist and approved by the RE. Prune indicated existing plant material as follows:
 - 1. Remove dead, broken and crossing branches.

2. Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
 3. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
 4. Remove trimmings from project site.
 5. Do not apply tree wound dressing to cuts.
- B. Prune existing trees as indicated on Drawings. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 1/2 inch diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.9 FERTILIZATION OF EXISTING TREES

- A. Apply fertilizer to existing trees shown on drawings at rate recommended by soil test. Apply in 4 inch to 8 inch deep holes 1-1/2 to 2 inches in diameter, made by an earth auger, distributed evenly at maximum 2 feet on center throughout outer half of branch spread zone of each tree. Fertilize to within 4 inches of surrounding grade. Use topsoil to bring surface up to surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply according to manufacturer's instructions.

3.10 TILLAGE FOR LAWN AREAS

- A. Thoroughly rip subgrades minimum 6 inches deep by scarifying, disking, harrowing, or other approved methods. Remove debris and stones on surface larger than 1 inch on surface after tillage. Do not till areas of 3: 1 slope ratio or greater. Scarify these areas to 1 inch depth and remove debris and stones.

3.11 FINISH GRADING

- A. After ripping subgrade for topsoil/subsoil bonding, spread topsoil evenly to minimum 6 inches deep. Incorporate topsoil at least 2 to 3 inches into subsoil to avoid soil layering. Spread additional topsoil as required to meet finish grades. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished lawn areas from damage by

vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.12 APPLICATION OF FERTILIZER, GYPSUM, ELEMENTAL SULFURE AND COMPOST FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer at rate that will deliver 1 pound of nitrogen per 1000 sq. ft. and adjust soil acidity as recommended by soil test results. Add soil conditioners as specified for suitable topsoil in PART 2.
- B. Spread gypsum, elemental sulfur and compost as recommended by soil test results.
- C. Incorporate gypsum, elemental sulfur and compost into soil to minimum 4 inches deep in finish grading operation. Lightly mix starter fertilizer with top 1/2 inch of soil. Immediately restore soil an even condition before seeding or sod placement.

3.13 MECHANICAL SEEDING

- A. Broadcast seed with approved equipment rate as outlined in "Seed" article above. Plant turfgrass and native grass seed before application of mulch material. Uniformly distribute seed in 2 directions at right angles to each other. Drag seeded area using approved device.
- B. Immediately after dragging, firm entire area with roller maximum 150 lbs./ft. of roller width.
- C. Immediately after preparing seeded area, evenly spread organic straw mulch by hand or by approved mechanical blowers at 2 tons/acre. Application shall allow some sunlight to penetrate and air to circulate but also reduce soil and seed erosion and conserve soil moisture. Anchor mulch with a tackifier.

3.14 HYDRO-MULCHING

- A. Hydro-Mulching: Mix slow release starter fertilizer and approved wood cellulose mulch material, and tackifier in required amount of water to produce homogenous slurry. Uniformly apply slurry under pressure to deliver recommended quantity of fertilizer per 1000 sq. ft.

3.15 SODDING

- A. Place sod according to TPI Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at bottom of slope.

- B. Finishing: After sodding, blend edges of sod smoothly into surrounding area. Roll with lightweight roller to eliminate air spaces between sod and firmed soil.

3.16 WATERING

- A. Watering: Start watering turfgrass and native grass areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 2 inches deep. Supervise watering operation to prevent run-off. Supply necessary pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass and native grass plants are well established.
- B. Deep water all trees and shrubs twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by RE. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

3.17 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material on designated areas as defined in the Stormwater Pollution Prevention Plan. Prepare, fertilize and vegetate areas to be covered, before erosion material is placed. Immediately following planting operations, lay erosion control material evenly and smoothly and in contact with soil throughout. Omit straw mulch from all seeded areas receiving erosion control material.
- B. For waterways, unroll erosion control material in direction of water flow. When two or more strips are required to cover ditch area, overlap strips minimum 4 inches. For strips to be spliced lengthwise, overlap ends minimum 6 inches with upgrade section on top.
- C. On slopes, place erosion control material either horizontally or vertically to slope with edges and ends of adjacent strips butted tightly against each other.
- D. Staple each erosion control strip in three rows (each edge and center with center row alternately spaced) with staples spaced maximum 4 feet longitudinally. For two or more strips side by side on slopes, install common row of staples on adjoining strips. Staple all end strips at 12 inch intervals at end. Firmly embed staples in underlying soil.
- E. Provide erosion control maintenance to repair damage by erosion, wind, or any other cause. Maintain, protect, repair, or replace erosion control material until Termination of the Plant and Warranty Period.

3.18 LANDSCAPE PLANT, TURFGRASS AND NATIVE GRASS ESTABLISHMENT PERIOD

A. Landscape plant, turf, and native grass Establishment Period: Begins immediately after installation, with RE's approval, and continues through growing season sufficiently long for turfgrass, native grass and landscape plant materials to become establish and provide satisfactory to the Pacific District Agronomist and NCA. Conditions and appearance are as follows:

1. Turfgrass and native grass has obtained minimum of 98 percent generally weed-free surface cover.
2. Landscape Plant Materials are fully rooted, actively growing and healthy and planting beds generally weed-free.
3. Maintain plant material, turfgrass and native grass during establishment period.
4. Plants, turfgrass, and native grass will not be accepted until completion of acceptable establishment period.
5. During Landscape Plant, Turfgrass, and native grass Establishment Period complete the following:
 - a. Water plants, turfgrass and native grass to maintain moist soil surface until plants, turfgrass and native grass are well established. Quantity of applied water required to achieve and maintain these conditions determined on site by the Pacific District Agronomist in consultation with RE.
 - b. Prune plants and replace mulch as required.
 - c. Replace and restore stakes, guy straps, and eroded plant saucers as required.
 - d. Remove grass, weeds, and other undesired vegetation, including root growth, before they reach 3 inches high in plant bed and saucers. After all unwanted vegetation has been removed, apply approved preemergence herbicides and remulch.
 - e. Spray with approved insecticides and fungicides to control pests and ensure plant survival in healthy growing condition, as directed by RE in coordination with the Pacific District Agronomist.
 - f. Provide the following during turfgrass and native grass establishment:
 - 1) Eradicate weeds. Water, fertilize, overseed, and perform other operation necessary to promote growth of turfgrass and native grass.

Mow turfgrasses as often as necessary to maintain NCA specified mowing height for each type of turfgrass before final acceptance. Begin mowing when cool season turfgrass is 4 inches high. For warm season turfgrasses, mow at appropriate heights for species and cultivar as directed by RE in consultation with the Pacific District Agronomist. Final mowing height is 3.0 inch for cool season turfgrasses and as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.

- g. Replace dead, missing or defective plant material during establishment period and an active growing season. Immediately replace each plant with one of same size and species.
- h. Replant areas void of turfgrass and native grass during an active growing season only.
- i. Sod will be evaluated for species and health thirty (30) days after laying last piece and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from sod operation will be living sod, uniform in color and leaf texture. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces to be tight and free of weeds and other undesirable growth.
- j. Seeding will be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from seeding operation will be 98 percent coverage uniform in color and leaf texture. Bare spots to be maximum 2 sq. inches. Reseed unsatisfactory areas within seven days during an active growing season.
- k. Complete remedial measures as directed by RE in consultation with District Agronomist to ensure plant, turfgrass and native grass survival.
- l. Repair damage caused while making plant, turfgrass, and native grass replacements.

3.19 LANDSCAPE PLANT, TURFGRASS AND NATIVE GRASS ACCEPTANCE

- A. Landscape plant, turfgrass and native grass acceptance will occur after completion of LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. Contractor to have completed, located, and installed all plants, turfgrass and native grass according to drawings and specifications. All plants, turfgrass and native grass are expected to be living and in healthy condition at time of inspection and acceptance. Make written request two weeks before final inspection of landscape plants, turfgrass and native grass. Upon inspection, when work is found to not meet specifications, PLANT AND TURFGRASS ESTABLISHMENT PERIOD will be extended at no additional cost to Government until work has been satisfactorily completed, inspected and accepted.
- B. Criteria for Acceptance of landscape plants:
1. Planter beds and earth mound water basins are properly mulched and free of weeds.
 2. Tree support stakes, guys, and turnbuckles are in good condition.
 3. Total plants on site as required by specifications and required replacements have been installed.
 4. Remedial measures directed by RE have been completed.
- C. Criteria for acceptance of turfgrass and native grass:
1. Sod: Living sod grass plants uniform in color and leaf texture and well rooted into soil below so that gentle pulling of turfgrass leaves by hand does not dislodge sod. Bare spots to be maximum 2 sq. inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 2. Seed: Living turfgrass and native grass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.5 sq. ft.

3.20 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass and native grass areas have been damaged or scarred, restore disturbed areas to original condition.
- C. In areas where planting, turfgrass and native grass work have been completed, clear the area of all debris, spoil piles, and containers.
- D. Maintain minimum one paved pedestrian access route and one paved vehicular access route to each building clean at all times.

- E. Clear other paved areas when work in adjacent areas are completed.

3.21 PROTECTION

- A. Protect plants, turfgrass and native grass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

3.22 ENVIRONMENTAL PROTECTION

- A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

- - - E N D - - -

**SECTION 32 96 00
TRANSPLANTING EXTERIOR PLANTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants, soils, and landscape materials and accessories.

1.2 RELATED REQUIREMENTS

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 00, EARTH MOVING.
- B. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- D. Protection of Tress and Plantings: Section 02 41 10, DEMOLITION AND SITE CLEARING.
- E. Topsoil Placement and Compaction Test: Section 31 20 00, EARTH MOVING.
- F. Planting: Section 32 90 00, PLANTING
- G. Landscape Irrigation: Section 32 84 00, PLANTING IRRIGATION.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI) Publications:
 - 1. ANSI Z60.1-2014 - Nursery Stock.
 - 2. ANSI Z133.1-2012 - Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.
- C. ASTM International (ASTM):
 - 1. C33/C33M-16-Concrete Aggregates.
 - 2. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
 - 3. D698-12 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 4. D977-13e1 - Emulsified Asphalt.
 - 5. D2028/D2028M-15 - Cutback Asphalt (Rapid-Curing Type).
 - 6. D2103-15 - Polyethylene Film and Sheeting.
- D. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- E. National Cemetery Administration (NCA):
 - 1. Handbook 3410 - Integrated Pest Management.
 - 2. Handbook 3420-11 - Turfgrass Maintenance.
- F. Turfgrass Producers International (TPI):

1. 2006 Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA):
 1. Federal Seed Act-2011 - Rules and Regulations of the Secretary of Agriculture.
- H. United States Environmental Protection Agency (EPA):
 1. 40 CFR Part 503-1993 - Biosolids Rule.

1.4 PREINSTALLATION MEETINGS

- A. Conduct pre-installation meeting at project site minimum 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Resident Engineer (RE).
 - b. Architect/Engineer (A/E).
 - c. Contractor.
 - d. Installer.
 - e. Additional parties directly affecting work of this section including, but not limited to, irrigation and landscaping installer.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Tour, inspect, and discuss conditions of planting materials.
 - b. Review planting schedule and maintenance.
 - c. Review required inspections.
 - d. Review environmental procedures.
 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. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the Resident Engineer for approval:
 1. Fertilizers
 2. Gypsum
 3. Elemental Sulfur
 4. Compost
- C. Manufacturer's Literature and Data:

1. Equipment
 - a. A listing of equipment to be used for the transplanting operation, including size model, year and type of mechanical tree transplanting equipment.
 2. Description of each product.
 - a. Soil amendments.
 - b. Anti-desiccant.
 - c. Staking Material
 - d. Pre-emergent Herbicide.
 - e. Mulches (Topdressing).
 3. Warranty.
- D. Photographs: Submit before beginning work of this section:
1. Clear 4 inch by 6 inch minimum size color photograph of the plant material to be relocated. Trees must be documented by an individual photograph of each showing the entire height and spread of the tree. Photographs must indicate the date, species, caliper size, height and spread of each plant on the back or front of each photograph.
- E. Transplanting Plan: Submit before beginning work of this section:
1. Transplanting plan shall be submitted showing existing and proposed locations of transplanted material. The plan must delineate methods, dates, and times for root pruning, digging, balling, removing, storing, transporting, planting, watering, and maintenance to ensure survivability. The plan shall also include equipment and anti-desiccant to be used. A listing of plant material to be transplanted must be provided by common name and botanical name as listed under "Nomenclature" in ANSI Z60.1; classification; caliper; and height.
- F. Test reports: Certify products comply with specifications.
1. Soil Test: Soil test of current growing area; soil test of proposed area; provide soil test location map.
 2. Percolation Test: Percolation test of current growing area; percolation test of proposed area.
- G. Certificates: Certify products comply with specifications.
- H. Before delivery, submit notarized certificates for approval to RE attesting that following materials meet specified requirements:
1. Fertilizers: Four certificates of analysis for each type of fertilizer.
 2. Lime.
 3. Gypsum.

4. Elemental Sulfur.
5. Compost
6. Humates.
7. Mycorrhizae.
8. Peat.

I. Maintenance Data:

1. Care instructions for each plant material.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. State Landscape Contractor's License and Tree Relocation References:
 - a. Contractor shall be a professional tree moving company holding a landscape contractor's license in the State of California and have a minimum of 10 years tree relocating experience. Submit a copy of license and 3 references of tree relocation work in the past five years.

B. Soil Test

1. Commercial test from an independent test laboratory according to the Organic Carbon, 6A, Chemical Analysis Method including basic soil groups (sand, silt, clay, pH (ASTM D4972), soluble salts, secondary nutrient groups (calcium, manganese, iron, copper). Soil required for each test must include a maximum depth of 18 inches of approximately one quart volume for each test. The location of the sample areas should be noted and marked on the Transplanting Plan.

C. Percolation Test

1. Immediately following rough grading operation, identify a typical location for one of the largest trees and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, must be measured by the contractor and verified by the Resident Engineer. Within six hours of the time the water has drained from the pit, the Contractor, with the Resident Engineer present, must again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination must be made and submitted by the Contractor and verified and approved by the Resident Engineer, whether a drainage system or a soil penetrant will be required for each tree being transplanted.

1.7 SOIL CONDITIONERS DELIVERY AND STORAGE

- A. Soil conditioners must be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil conditioners may be furnished in bulk. A chemical analysis must be provided for bulk deliveries. Store in dry locations and away from contaminants.

1.8 STORAGE AND HANDLING

- A. Plant Material Identification
 - 1. Plant material to be transplanted shall be tagged with durable, waterproof labels and weather-resistant ink or imprinted tags, stating the correct botanical and common plant name and size.
- B. Inspection of Materials
 - 1. Materials must be inspected for compliance with paragraph PRODUCTS and paragraph PLANT MATERIAL IDENTIFICATION. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 1-1/2 inch diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material must be removed from the job site. The Contracting Officer reserves the right to refuse any unacceptable plant material. All rejected plant material must be removed from the job site on the day of rejection.
- C. Handling of Plant Materials
 - 1. Materials must not be dropped from vehicles. Plant material must be transported without scarring trunks or deforming crown branching. Materials found to be in unacceptable condition must be replaced at no additional cost to the Government.

1.9 TIME LIMITATION

- A. The time limitation from digging, removing, transporting, to installing transplanted plant material must be the same day. The time limitation between installing the plant material and placing the mulch must be a maximum 48 hours. If project conditions prevent the Contractor from transplanting and installing plant material on the same day, plant materials must be boxed or heeled in as required in a location approved by the RE. Plant material must be maintained and protected by the Contractor.

1.10 TRANSPLANTED PLANT MATERIAL TIME AND FIELD CONDITIONS

- A. Perform transplanting operations within following dates, but not before irrigation system installed, tested, and approved.
 - 1. Spring Transplanting: March 1st to May 1st
 - 2. Fall Transplanting: September 1st to October 30th
- B. Transplanting Conditions
 - 1. All transplanting operations must be performed only during periods when beneficial results can be obtained. Do not transplant when drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail. When special conditions warrant a variance to all transplanting operations, proposed transplanting times must be submitted to the RE for approval. The installing site for the plant material must be prepared and excavated prior to removing the plant material. See 1.9 TIME LIMITATION section if project conditions prevent the Contractor from transplanting and installing plant material on the same day.
- C. Underground Utilities
 - 1. The location of underground utilities and facilities at both the removal and installing sites must be verified and marked. Damage to underground utilities and facilities must be repaired at the Contractor's expense.
- D. Protection of Existing Vegetation
 - 1. When there are established turf at either the removal or installing sites, the turf must be protected during the operation. Existing trees, shrubs, and plant beds at the removal and or installing sites that are to be preserved must be barricaded and protected from damage by a tree protect as defined in the drawings. Damage to existing plant material must be mitigated by the Contractor at no additional cost to the Government. Damage must be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.
- E. Protection of Plant Material to be Transplanted
 - 1. Protect plant material slated for transplanting that is not transplanted at the beginning of construction operations. Prior to construction operations, tag plants to be transplanted as specified herein. Plants to be transplanted must be protected from root compaction and any other damage (with barrier of metal poles a maximum of 8 feet on center with plastic fluorescent netting) at a

minimum of 20 foot diameter from outside of the plant's trunk prior to the start of any construction operations. Where tree drip lines are greater than 10 feet from the tree's trunk, locate barrier fencing at the drip line of the tree. Plastic tape and barrier fencing must not be removed until transplanting operations are ready to begin and or instructed by the RE. Water and prune plant material as necessary to keep healthy and vigorous, particularly when water is shut off. Water existing plant material to be transplanted from the start of construction operations until the maintenance period is over or until regular irrigation service is in working order. Outside storage locations must be continually shaded and protected from the wind. Plants stored on the project must be protected from any drying at all times covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.

F. Protection of Plant Material During Transplanting

1. Plant material must be protected during transplanting to prevent desiccation and damage to the branches, trunk, and root system. Exposed branches must be covered during transport. Plant material must be undamaged, vigorous and healthy with a well-branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion after transplanting. Plant material showing desiccation, abrasion, sun scald injury or structural branching damage must be replaced at no cost to the government.

1.11 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Comply with "Warranty" requirements in Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
 1. One Year Plant: Warranty begins when Government accepts transplanted plants but not before end of Landscape Plant and Turfgrass Establishment Period.
 2. All transplanted plants that die or have 25 percent or more of their branches that die from improper handling, installation, care, and or negligence during the one year warranty must be replaced immediately in kind in relation to size and species. A one year warranty for

replaced plants begins on the day replacement work is completed and accepted.

3. Remove stakes, guys wires/straps at end of one year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product from one source or manufacturer.
- B. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.2 TOPSOIL

- A. Topsoil to be placed around root balls of transplanted material at new planting site must match topsoil of existing site where material is transplanted from, based on soil tests taken at both the current growing area and the proposed growing site. Minimum matching characteristics must include: ph, organic matter, soluble salts, percentages of silt, clay and sand. Soil conditioners may be added to topsoil to bring into compliance.

2.3 INORGANIC AND ORGANIC SOIL AMENDMENTS

- A. Provide singly or in combination as required to meet specified requirements for topsoil. Soil amendments shall be nontoxic to plants and comply with the requirements specified in Section 32 90 00, PLANTING.

2.4 MULCH

- A. Free from noxious weeds, mold, pesticides, or other deleterious materials and comply with the requirements specified in Section 32 90 00, PLANTING.

2.5 PLANTS

- A. Transplanted plants to conform to ANSI Z60.1 requirements for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.6 PRE-EMERGENT

- A. As approved by the RE's Technical Representative, to prevent annual weed development in mulching applications.

2.7 FUNGICIDE

- A. 26/36 Fungicide by Cleary Chemical or approved equal broad spectrum fungicide registered for use in California.

2.8 STAKES AND GUYING STRAPS

- A. Tree Support Stakes: Lodgepole pine treated with copper naphthanate, free of knots, rot, cross grain, or other defects that impair strength. 2-1/2 inches diameter by 8 feet long and pointed at one end.
- B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.
- C. Flags: White surveyor's plastic tape, 6 inches long, fastened to guying wires or cables.
- D. Guying Straps: Fabric designed specifically to guy newly planted trees. Wire will not be permitted.
- E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes.
- F. Eye Bolts: Galvanized or cadmium plated steel with 1 inch diameter eye and minimum 1-1/2 inches screw length.
- G. Deadmen: 4 inch by 8 inch rectangular, or 8 inch diameter by 36 inch long sound wood.
- H. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

2.9 WATER

- A. Water: Contains no elements toxic to plant life, obtained from the existing cemetery water supply as specified in Section 01 00 01, GENERAL REQUIREMENTS, Paragraph, Temporary Services. Availability and use of utility services at no cost to the owner.

2.10 ANTIDESICCANT

- A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.11 HERBICIDES AND OTHER PESTICIDES

- A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Execution shall conform in accordance with herein and requirements specified in Section 32 90 00, PLANTING, unless otherwise noted.

3.2 PREPARATION AND HANDLING

- A. Plant material designated for transplanting must be watered thoroughly several days before root pruning, digging or moving. Broken or interfering growth must be pruned. All canopy and specimen plant material specified as relocated on the drawings shall be spaded. Mark north side of plants prior to excavation. Relocate in new location with north facing same direction.
- B. Protect existing and proposed landscape features, elements, and sites from damage or contamination. Protect trees, vegetation, and other designated features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than the drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on Drawings.
- C. Verify that finish grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the transplanting operation.
- D. Relocate plant material as shown on drawings. Plant material locations may be adjusted to meet field conditions, only with RE approval. Provide on-site locations for excavated rock, soil, and vegetation.

3.3 EXCAVATION FOR TRANSPLANTING

- A. When obstructions above or below ground affect the work, shop drawings showing proposed adjustments to plant material location, and planting method must be submitted for Government approval.
- B. Do not disturb topsoil and vegetation in areas outside those indicated on Drawings. Where the installation operation occurs in an existing lawn area, the turf must be removed from the excavation area to a depth that will ensure the removal of the entire root system.
- C. Plant pits must be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits must be dug a minimum of 2 times the diameter of the root system to allow for root expansion. The pit must be constructed with sides sloping towards the base as a cone, to encourage well-aerated

soil to be available to the root system for favorable root growth. Cylindrical pits with vertical sides shall not be used. Pits must be dug immediately before plants are placed in the pit.

3.4 INSTALLATION

- A. Plant material must be set plumb and held in position until sufficient top soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material must be set even with the grade at which it was grown. The root system must be spread out and arranged in its natural position. Damaged or girdled roots must be removed with a clean cut. The beginning of the root flare must be visible at soil level when the tree is planted, since it is critical not to plant the tree too deep.
1. Plumb plant materials and backfill half of the hole with topsoil.
 2. Prior to backfilling, all metal, wood, and synthetic products must be removed.
 3. Water the hole to collapse air pockets.
 4. Backfill and gently firm topsoil.
 5. Clear soil mounded against trunk.
 6. An earth berm, consisting of backfill soil mixture, must be formed with a minimum 4 inch height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.
 7. A regular watering schedule must be established. Slow deep watering must be used. Plant pits and plant beds must be watered immediately after backfilling, until completely saturated. Run-off and puddling must be prevented. Watering of other plant material or adjacent areas must be prevented.

3.5 STAKING AND GUYING

- A. Trees over a minimum 8 feet height and less than a maximum 6 inch caliper must be held firmly in place with 3 bracing or ground stakes spaced at equal intervals around the tree. Ground stakes must be avoided in areas to be mowed. Stakes must be driven into firm ground outside the earth berm. The guying material must be firmly anchored at a minimum 1/2 tree height and must prevent girdling. For trees over a minimum 3 inch diameter at breast height, turnbuckles must be used on the guying material for tree straightening purposes. One turnbuckle must be centered on each guy line. Chafing guards must be used when metal is the guying material. Trees over a minimum 6 inch caliper must

be held firmly in place with wood deadmen buried a minimum 900 mm 3 feet in the ground or metal earth anchors. Multi-strand cable guying material must be firmly anchored at a minimum 1/2 tree height and must prevent girdling. Turnbuckles must be used on the guying material for tree straightening purposes. One turnbuckle must be centered on each guy line. Chafing guards must be used.

3.6 MULCHING PLANTS

- A. Apply approved pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben and mulch within 48 hours after planting. Apply at 200 lb per acre before both early spring and early fall weed seed germination.
- B. The placement of mulch must occur a maximum of 48 hours after planting. Mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, must be spread to cover the installed area with a minimum 3 inch uniform thickness.
- C. Keep mulch out of transplanted tree trunks.

3.7 PRUNING

- A. Do not prune new plants unless otherwise directed by arborist and approved by the RE. Prune indicated existing plant material as follows:
 - 1. Remove dead, broken and crossing branches.
 - 2. Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
 - 3. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
 - 4. Remove trimmings from project site.
 - 5. Do not apply tree wound dressing to cuts.
- B. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 1/2 inch diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.8 FERTILIZATION OF EXISTING TREES

- A. Apply fertilizer to all newly transplanted trees shown at rate recommended by soil test. Apply in 4 inch to 8 inch deep holes 1-1/2

to 2 inches in diameter, made by an earth auger, distributed evenly at maximum 2 feet on center throughout outer half of branch spread zone of each tree. Fertilize to within 4 inches of surrounding grade. Use topsoil to bring surface up to surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply according to manufacturer's instructions.

3.9 LANDSCAPE PLANT, TURF NATIVE GRASS ESTABLISHMENT PERIOD

- A. All transplanted plant materials shall conform to the requirements for plant establishment period specified in Section 32 90 00, PLANTING, unless otherwise noted herein.

3.10 LANDSCAPE PLANT, TURFGRASS AND NATIVE GRASS ACCEPTANCE

- A. All transplanted plant materials shall conform to the requirements for plant acceptance specified in Section 32 90 00, PLANTING, unless otherwise noted herein.

3.11 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass and native grass areas have been damaged or scarred, restore disturbed areas to original condition.
- C. In areas where planting, turfgrass and native grass work have been completed, clear the area of all debris, spoil piles, and containers.
- D. Maintain all paved pedestrian access routes and all paved vehicular access routes where work is being performed clean at all times.
- E. Clear all paved areas when work in adjacent areas are completed.

3.12 PROTECTION

- A. Protect plants, turfgrass and native grass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

3.13 ENVIRONMENTAL PROTECTION

- A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

- - - 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 purposes only when required due to Life Safety issues.

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 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 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- H. Section 09 91 00, PAINTING.
- I. Section 31 20 00, EARTH MOVING: Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing.
- J. Section 32 30 00, SITE FURNISHINGS: Flower Watering Spigot Assemblies.

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):

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 (PVC0) Pressure Pipe and Fittings |
| C651-2014..... | Disinfecting Water Mains |
| 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.
1. Piping.
 2. Fittings
 3. Gaskets.
 4. Valves.
 5. Meter.
 6. Vaults, frames and covers.
 7. Steps.
 8. Backflow Preventer
 9. Valve boxes.
 10. Corporation and curb stops.
 11. Curb stop boxes.
 12. Joint restraint.
 13. Disinfection products.
 14. Warning Tape
 15. Link/sleeve seals.
- 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. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

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 (RE).

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 Department of Environmental Quality 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, printed copies of these recommendations shall be furnished to the RE 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 RE for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the RE 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 RE 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 RE, 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 potable water 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 RE. 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 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 on Auto-Cad version 2017

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 RE 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 (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. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Provide flange joint pipe where shown on the drawings. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1,

- 861 kPa (125 psi) or 1724 kPa (250 psi) standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and as herein specified in paragraph LINK/SLEEVE SEALS.
 3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
 4. Rubber Ring Gaskets: Full face type, AWWA C111, 1.6 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.
 5. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.
- C. 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.
- D. 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.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. Class-Rated Polyvinyl Chloride (PVC) Pipe: 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.
1. PVC pipe and accessories 100 mm to 355 mm (4 inches to 14 inches) in diameter, AWWA C900, Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
 2. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D1785, Type 1, Grade 1. All

exposed piping shall be CPVC meeting requirements of ASTM F441/F441M.

B. Joints:

1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F477.
2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D2464) or solvent welded (ASTM D2672). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153. Mechanical joint fittings shall include retainer glands, unless otherwise noted.
2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. Solvent welded fittings shall conform to ASTM D2467. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.3 MECHANICAL JOINT RETAINER GLANDS

A. Restraint devices for mechanical joint fittings and appurtenances conforming to either AWWA C111 or AWWA C153, shall conform to the following:

1. Restraint devices for nominal pipe sizes 75 mm (3 inch) through 900 mm (36 inch) shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of AWWA C110.
2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
3. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 Brinell Hardness Number (BHN).
4. An identification number consisting of year, day, plant, and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body. All physical and chemical test results shall be recorded

- such that they can be accessed via the identification number on the casting. All components shall be manufactured in the United States.
5. Mechanical Joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 6. Mechanical joint restraints shall be listed by Underwriters Laboratories, and approved by Factory Mutual in the 75 mm (3 inch) through 300 mm (12 inch) sizes.
 7. All casting bodies shall be surface pretreated with a phosphate wash, rinse, and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester-based powder to provide corrosion, impact, and UV resistance.

2.4 COPPER PIPE AND TUBING

- A. Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8/A5.8M, Classification BCuP. Fittings for compression-type joint, ASME B16.26, flared tube type.

2.5 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.
- D. Pressure Reducing Valves: Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 pounds per square inch (psi) operating pressure on the inlet side, with outlet pressure set for 30 - 40 pounds per square inch (psi). The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be [threaded] [flanged]. Valve bodies shall be bronze, cast iron, or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.6 TRACER WIRE FOR NONMETALLIC PIPING

- A. Provide bare copper or aluminum 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.

2.7 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".

2.8 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.

2.9 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.

2.10 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 "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.

2.11 TAPPING SLEEVES

- A. Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, stainless steel or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings, and gaskets on each end of the sleeve. Construction

shall be suitable for a maximum working pressure of 1035 kPa (150 psi). Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 67.8 Newton-meters (50 foot-pounds).

2.12 PIPE SLEEVES

- A. Cast gray ductile iron or zinc coated steel.

2.13 SLEEVE-TYPE MECHANICAL COUPLINGS

- A. Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast iron; and the follower rings shall be of malleable or ductile iron. Cast iron, ASTM A48/A48M not less than Class 25. Malleable and ductile iron shall conform to ASTM A47/A47M and ASTM A536, respectively. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1 or with hex nuts, ASME B18.2.2. Bolts shall be 18 mm (5/8 inch) in diameter; minimum number of bolts for each coupling shall be four (4) for four (4) inch pipe, six (6) for six (6) inch pipe, and six (6) for eight (8) inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension

pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.14 BACKFLOW PREVENTER

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 103 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 24.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- D. Backflow preventers shall be approved by the Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR) of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous, or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance, and repair. Access and clearance shall require a minimum of 300 mm (1 foot) between the lowest portion of the assembly and grade, floor, or platform. Installations elevated more than 1500 mm (5 feet) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.15 CAST IRON FRAME AND COVER, STEPS, ETC.

- A. Frames and Covers: Shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181 Kg (400 lbs.). The word

"WATER" shall be stamped or cast into covers so that it is plainly visible.

- B. Manhole Steps: Plastic or rubber coated, pressure-molded to the steel. Plastic coating shall conform to ASTM D4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs are prohibited. Steps are not required in manholes less than 1.2 m (4 feet) deep.

2.16 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.17 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.

2.18 LINK/SLEEVE SEALS

- A. The seal assemblies shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and have the following properties as designated by ASTM: 1) coloration shall be throughout elastomer for positive field inspection; 2) each link shall have a permanent identification of the size and manufacturer's name molded into it.
1. For Standard Service Applications: EPDM = ASTM D2000 M3BA510, Color = Black
 2. For Hydrocarbon Service Applications: Nitrile = ASTM D2000 M1BF510, Color = Green
 3. For High Temperature of Fire Seal Applications: Silicone = ASTM D2000 M1GE505, Color = Gray
- B. The modular seal hardware for fastening the links shall be sized according to the manufacturer's recommendations for the service intended. Bolts, flange hex nuts shall be:
1. 316 Stainless Steel per ASTM F593, with a 585 MPa (85,000 psi) average tensile strength.

- C. Quality Assurance: Manufacturer's modular seal components and systems shall be domestically manufactured at a plant with a current ISO-9002 registration. Copy of the ISO-9002 registrations shall be provided with the submittal for these items.

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 3 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 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. 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.

3.6 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 RE. Allow the RE to inspect all below-grade splices of tracer wire prior to backfill.
- E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the RE.
- F. Bring two wires to the surface at each hydrant designated location within a valve box and cover and terminate with an accessible tracer wire termination.
- G. 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.

3.7 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

3.8 PIPE SUPPORTS

- A. All piping shall be properly and adequately supported. Hangers, supports, base elbows, tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the

superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on center and at each fitting.

- B. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
- C. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
- D. Where hangers cannot be used, provide pipe saddle supports with pipe column and floor flange.

3.9 RESTRAINED JOINTS

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1380 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be as specified herein in paragraph MECHANICAL JOINT RETAINER GLANDS or approved equal.
- D. Thrust blocks shall be required, unless otherwise noted.
- E. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- F. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with the specified Mechanical Joint Restrainer Gland, or approved equal.

3.10 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.

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).

3.11 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.

3.12 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.

3.13 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. Copper Tubing: No leaks.
 - 2. Ductile Iron Pipe: AWWA C600. Provide to RE office.
 - 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to RE office.

3.14 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 and the Department of Environmental Quality 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.

3.15 BACKFLOW PREVENTOR TESTING

- A. All backflow preventers shall be installed, tested, and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the RE.

3.16 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 RE will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the RE. Provide a minimum notice of 10 working days prior to startup and testing.

- - - E N D - - -

**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 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.
- G. Section 22 14 00, FACILITY STORM DRAINAGE.
- H. 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
- A1064/A1064M-2016.....Standard Specification for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete
- 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
- 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/ft ³ (600 kN-m/m ³)) |
| 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 |
| 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 |
| 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
- F894-2013.....Standard Specification for Polyethylene (PE)
Large Diameter Profile Wall Sewer and Drain
Pipe
- 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., 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.
- 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. Inline check valves
 - 1. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, headloss, flow data and pressure ratings.
 - 2. Upon request, provide shop drawings that clearly identify the valve materials of construction and dimensions.

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.
 - 3. Inline check valves
 - a. Supplier shall have at least twelve (12) years experience in the design and manufacture of "CheckMate™" style elastomeric check valves.
 - b. Manufacturer shall have designed, fabricated and have at least five (5) current installation of a "CheckMate" style elastomeric check valves in the 72" (1800mm) size. Manufacturer must provide documentation, including project name, location, and references.

- c. Manufacturer shall have conducted independent hydraulic testing to determine headloss, jet velocity and vertical opening height characteristics on a minimum of three (3) sizes of CheckMate Valves ranging from 6" (150mm) through 24" (600mm). The testing must have been conducted for free discharge (pressurized and open channel flow discharging to atmosphere) and submerged conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes catch basins 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 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 2017 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 RE 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 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron Class 35° pipe and fittings shall be as per AWWA/ANSI C115/A21.15, C150 /A21.50, C151/A21.51, C100/A21.10, C115/A21.15.
- B. Internal Coating: Internal coating shall be cement mortar per AWWA/ANSI C104/A21.4, but without the asphaltic seal coat.
- C. Exterior Coating: Bituminous Coated with polyethylene encasement per AWWA/ANSI C105/A21.5.
- D. Gaskets: Rubber, AWWA/ANSI C111/A21.11.
- E. Joints: Flanged or restrained push-on as shown on drawings.
- F. Flanged coupling adaptors:
 - 1. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets, supply flanges meeting standards of adjoining flanges, restrained type.
- G. Compression sleeve couplings:

1. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets, supply flanges meeting standards of adjoining flanges, restrained type.

2.3 PE PIPE AND FITTINGS

- A. Smoothwall PE drainage pipe and fittings; ASTM F714, DR 21 with smooth waterway for coupling joints.
- B. Corrugated PE pipe and fittings, DN 300 to DN 1500 (NPS 12 to NPS 60); AASHTO M294, Type S with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
 1. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
- C. High Density Polyethylene (HDPE) Pipe and Fittings:
 - a. Corrugated PE Pipe: Shall comply with ASTM F2648, Type S for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have following minimum properties:

| <u>Nominal Size</u> | <u>Minimum Wall Area</u> | <u>Min. Moment of Inertia mm⁴/mm (in⁴/in)</u> |
|---------------------|---|---|
| 300 mm (12 in) | 3200 mm ² /m (1.50 in ² /ft) | 390 (.024) |
| 375 mm (15 in) | 4000 mm ² /m (1.91 in ² /ft) | 870 (.053) |
| 450 mm (18 in) | 4900 mm ² /m (2.34 in ² /ft) | 1020 (.062) |
| 600 mm (24 in) | 6600 mm ² /m (3.14 in ² /ft) | 1900 (.116) |
| 750 mm (30 in) | 8300 mm ² /m (3.92 in ² /ft) | 2670 (.163) |
| 900 mm (36 in) | 9500 mm ² /m (4.50 in ² /ft) | 3640 (.222) |
| 1050 mm (42 in) | 9900 mm ² /m (4.69 in ² /ft) | 8900 (.543) |
| 1200 mm (48 in) | 10900 mm ² /m (5.15 in ² /ft) | 8900 (.543) |
| 1350 mm (54 in) | 12000 mm ² /m (5.67 in ² /ft) | 13110 (.800) |
| 1500 mm (60 in) | 13650 mm ² /m (6.45 in ² /ft) | 13110 (.800) |

2.4 PVC PIPE AND FITTINGS**A. PVC Pressure Piping:**

1. Pipe: AWWA C900 and AWWA C905, Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900 and AWWA C905, Class 150 PVC pipe with bell ends
3. Gaskets: ASTM F477, elastomeric seals.
4. All joints shall be restrained.

2.5 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 plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 2. 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 stainless steel shear ring and 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.
- 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.

2.6 PRESSURE PIPE COUPLINGS

- A. Couplings: AWWA C219, tubular sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.
- B. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150 psi minimum pressure rating and ends sized to match adjoining pipes.
- C. Center Sleeve Material: Ductile iron.
- D. Gasket Material: Natural or synthetic rubber.
- E. Metal Component Finish: Corrosion resistant coating or material.
- F. Field coating for buried couplings per AWWA C203.
- G. Flanged coupling adapters:

1. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets, supply flanges meeting standards of adjoining flanges, restrained type.

H. Compression sleeve couplings:

1. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets, supply flanges meeting standards of adjoining flanges, restrained type.

2.7 EXPANSION JOINTS AND DEFLECTION FITTINGS

- A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical joint ends complying with AWWA C110. Include two gasketed ball joint sections and one or more gasketed sleeve sections, rated for 250 psi minimum working pressure and for offset and expansion indicated.
- B. Ductile iron expansion joints: Three piece assemblies of telescoping sleeve with gaskets and restrained-type, ductile iron with protective coating, bell-and-spigot end sections complying with AWWA C110. Include rating for 250 psi minimum working pressure and for expansion indicated.
- C. Ductile iron deflection fittings: Compound coupling fitting, with ball joint, flexing section, gaskets, and restrained joint ends, complying with AWWA C110. Include rating for 250 psi minimum working pressure and for up to 15 degrees of deflection.
- D. All joints shall be restrained.

2.8 BACKWATER VALVES

- A. Cast Iron Backwater Valves: ASME A112.14.1, gray iron body and bolted cover, with bronze seat.
 1. Combination horizontal and manual gate valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
- B. Plastic backwater valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
- C. In line backflow preventer to be Tide Flex "Redline" or equal, as approved by the RE.

2.9 CLEANOUTS

- A. Cast Iron Cleanouts: ASME A112.36.2M, round, gray iron housing with clamping device and round, secured, scoriated, gray iron cover. Include gray iron ferrule with inside calk or spigot connection and countersunk, tapered thread, brass closure plug.

1. Top-Loading Classification(s): Heavy Duty.
 2. Pipe fitting and riser to cleanout shall be same material as main pipe line.
- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.10 DRAINS

- A. Cast Iron Area Drains: ASME A112.6.3, gray iron round body with anchor flange and round grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
1. Top-Loading Classification(s): Heavy Duty.
- B. Grate openings shall be 10 by 75 mm (3/8 by 3 inch) slots.

2.11 ENCASEMENT FOR PIPING

- A. Material: AWWA C105 linear low-density polyethylene film of 0.008 inch minimum thickness.
- B. Form: Tube.
- C. Color: Blue.

2.12 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: 48 inches minimum unless otherwise indicated on drawings.
 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
 4. Base Section: 6 inch minimum thickness for floor slab and 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 60 inches. Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2 inch steel reinforcing rods encased in ASTM D4101, PP, width of 16 inches minimum, spaced at 12 to 16 inch intervals.
 10. Adjusting Rings: Reinforced concrete rings, 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 (Stormwater pump stations and valve vaults):
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. 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 and Vault Frames and Covers:
1. Description: Ferrous; 24 or 27 inch ID by 7 to 9 inch riser with 4 inch minimum width flange and 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 or iron unless otherwise indicated.
- D. Heavy Duty Access Hatches:
1. Frame: 1/4 IN mill finish aluminum channel with anchor tabs.
 - a. 1-1/2 IN DIA drain coupling.
 2. Material:
 - a. Sheet and plate: ASTM B209.
 - b. Extruded shapes: ASTM B221.
 3. Cover:
 - a. 1/4 IN mill finish diamond plate aluminum.

- b. Reinforce cover with aluminum stiffeners.
 - 1) Live load: 300 PSF.
 - 2) Deflection: Maximum 1/150 of span.
- 4. Hardware:
 - a. All hardware to be stainless steel.
 - b. Positive hold open arm that engages automatically when door reaches full 90 degree open position.
 - c. Slam lock and removable key handle.

2.13 CONCRETE FOR MANHOLES, CATCH BASINS, AND VAULTS

- A. General: Cast-in-place concrete according to ACI 318, ACI 350, and the following:
 - 1. Cement: ASTM C150/C150M, Type II.
 - 2. Fine Aggregate: ASTM C33/C33M, sand.
 - 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 - 4. Water: Potable.
- B. Concrete Design Mix: 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 60,000 psi deformed steel.

2.14 PIPE OUTLETS

- A. Head walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."
 - 1. Average Size: NSSGA No. R-3, screen opening 2 inches.
 - 2. Average Size: NSSGA No. R-4, screen opening 3 inches.
 - 3. Average Size: NSSGA No. R-5, screen opening 5 inches.
 - 4. Average Size: 12" – 18" .
- C. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average size graded stone.
- D. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3 ton average weight armor stone, unless otherwise indicated.

2.15 HEADWALLS

- A. Headwalls: Cast-in-place concrete with a minimum compressive strength of 3000 psi at 28 days.

2.16 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.

2.17 WARNING TAPE

- A. Standard, 4-Mil polyethylene 3 inch wide tape non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

2.18 INLINE CHECK VALVES**A. CHECKMATE ULTRAFLEX ELASTOMERIC CHECK VALVES**

1. Check Valves are to be all rubber and the flow operated check type with slip-in cuff connection. The entire CheckMate Ultraflex Valve shall be ply reinforced throughout the body, saddle and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure any component of the valve to a valve housing. The port area of the saddle shall contour into a circumferential sealing area (the "bill") that is concentric with the pipe which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe inside diameter. The saddle area of the valve must be flat, not conical, and integral with the rubber body above centerline in order to not produce any areas or voids that can collect or trap debris. The valve must be easily installed in pipes with poor end condition without the need to modify or utilize the headwall or structure to seal and anchor the valve. Once installed, the CheckMate Ultraflex Valve shall not protrude beyond the face of the structure or end of the pipe.
2. The CheckMate Ultraflex Valve shall incorporate multiple concave grooves molded integrally into the flat saddle wall thickness extending longitudinally a minimum of 80% of the length of the saddle to reduce opening resistance and reduce headloss.

3. The CheckMate Ultraflex Valve shall incorporate a custom shaped notch in the end of the bill to reduce cracking pressure. The notch shall be at the invert/bottom of the bill and symmetrical about the valve centerline. The longitudinal length of the notch shall be no greater than half the length of the bill.
4. The outside diameter of the upstream and downstream sections of the valve must be circumferentially in contact with the inside diameter of the pipe.
5. Slip-in style CheckMate Ultraflex Valves will be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed in the upstream or downstream cuff of the valve, depending on installation orientation, and shall expand outwards by means of a turnbuckle. Each band shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.
6. Manufacturer must have flow test data from an accredited hydraulics laboratory to confirm pressure drop and hydraulic data.
7. Company name, plant location, valve size patent number, and serial number shall be bonded to the check valve.
8. Function
 - a. When line pressure exceeds the backpressure, the line pressure forces the bill and saddle of the valve open, allowing flow to pass. When the backpressure exceeds the line pressure, or in the absence of any upstream or downstream pressure, the bill and saddle of the valve is forced closed, preventing backflow.
9. Manufacturer
 - a. All valves shall be Series CMUF-SL slip-in CheckMate Ultraflex Valves as manufactured by Tideflex Technologies®, A Division of Red Valve Company, Carnegie, PA 15106. All valves shall be manufactured in the U.S.A.

PART 3 - EXECUTION

3.1 GENERAL

- 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 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 30 inch minimum cover and 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 12 inches over the crown of the pipe.
 7. Warning tape shall be continuously placed 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 PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
 3. Install PVC sewer piping according to ASTM D2321 and ASTM F1668.

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 stormwater 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 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Embed drains in 4 inch minimum concrete around bottom and sides.
- C. Set drain frames and covers with tops flush with pavement surface.
- D. Assemble trench sections with flanged joints and embed trench sections in 4 inch minimum concrete around bottom and sides.

3.7 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 2 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 1/2 inch or 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 an 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 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 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.
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. Install a 8 inch thick, by 12 inch concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.8 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.9 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.

3.10 INLINE CHECK VALVE INSTALLATION

A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

B. Manufacturer's Customer Service

1. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.
2. If specified, the manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

3.11 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 22 14 00, FACILITY STORM DRAINAGE.

B. Encase entire connection fitting, plus 6 inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 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 stormwater piping unless otherwise indicated.
 - a. Unshielded 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 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 200 mm (8 inch) thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least 900 mm (36 inches) below final grade. Fill to within 300 mm (12 inches) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 20 00, EARTH MOVING.

3.13 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.14 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.

3.15 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. Submit separate report for each test.
- C. 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.
 - 5. Air test gravity sewers. Concrete pipes conform to ASTM C924, plastic pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or ASTM C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

6. Test force main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 50 psi.
 - a. Ductile Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.16 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

3.17 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. RE

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**SECTION 33 41 13
FOUNDATION DRAINAGE**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foundation drainage system, including installation, backfill, and cleanout extensions.

1.2 RELATED REQUIREMENTS

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Existing utility protection, 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. Trenching and Excavation: Section 31 20 00, EARTH MOVING.

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. M006-13-UL - Fine Aggregate for Hydraulic Cement Concrete.
 2. M252-09-UL - Corrugated Polyethylene Drainage Pipe.
 3. M288-15-UL - Geotextile Specification for Highway Applications.
- C. ASTM International (ASTM):
 1. A74-16 - Cast Iron Soil Pipe and Fittings.
 2. A746-09 (2014) - Ductile Iron Gravity Sewer Pipe.
 3. D448-12 - Sizes of Aggregate for Road and Bridge Construction.
 4. D2321-14 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 5. D2729-03 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 6. D2737-12 - Polyethylene (PE) Plastic Tubing.
 7. D3034-14 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

8. D4216-13 - Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds.
9. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
10. F758-141 - Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

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. Filter fabric indicating manufacturer recommendation for each application.
 3. Installation instructions.
 4. Warranty.
- C. Samples:
 1. Product: 16 feet square, each type .
 - a. Submit quantity required to show full color and texture range.
- D. Certificates: Certify each product complies with specifications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. Regularly manufactures specified products.
 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.

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. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify field conditions affecting drainage installation. Show field measurements on Submittal Drawings.

1. Coordinate field measurement and fabrication schedule to avoid delay.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipes: Type and size indicated. Make transitions, adapters, or joint details for dissimilar materials.
- B. Underslab Header:
 1. DN 100 to DN 375 (NPS 4 to NPS 15):
 - a. Pipe and Fittings: Cast-iron, ASTM A74 or ASTM A746.
 - b. Joints: Hub-and-spigot, gasket type.
 2. DN 100 to DN 250 (NPS 4 to NPS 10):
 - a. Pipe and Fittings: PE, ASTM D2737.
 - b. Joints: Coupling type.
 3. DN 100 to DN 375 (NPS 4 to NPS 15):
 - a. Pipe and Fittings: PVC, ASTM D3034.
 - b. Joints: Bell-and-spigot.
 - c. Seal Gaskets: ASTM F477, elastomeric.
- C. Perforated Drainage Pipe:
 1. DN 100 to DN 150 (NPS 4 to NPS 6):
 - a. Pipe and Fittings: PE, ASTM D2737.
 - b. Joints: Coupling type.
 2. DN 100 (NPS 4):
 - a. Pipe and Fittings: PVC, ASTM D2729.
 - b. Joints: Bell-and-spigot, loose type.
- D. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron.
 1. Gravity Sewer Pipes: Provide neoprene gasket joints and long sweep elbow fittings.
- E. Drainage Conduit:
 1. Pipe: ASTM D4216 and ASTM D2729, PVC, perforated.
 - a. Size: 200 mm (8 inches), high minimum flow rate equal DN 100 (NPS 4) pipe.
 2. Fittings and Couplings: PVC.
- F. Filter Fabric: Woven pervious filament sheet polypropylene.

1. Equivalent Opening Size (AOS): Shall be US Standard Sieve No. 70.
2. Physical Characteristics:
 - a. Physical Strength: Minimum 120 pounds per inch when tested according to ASTM D 5034 using grab test method with 1 square inch jaws and 12 inches per minute constant travel rate.
 - b. Elongation at Failure: Shall be 50 percent.
- G. Drainage Material:
 1. Bedding: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4), ASTM D448.
 2. Pipe Fill 300 mm (1 Foot) Above: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.
- H. Concrete Sand: AASHTO M006.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation in the presence of Resident Engineer (RE).
- B. Correct substrate deficiencies.
 1. Fill.
 2. Level.
- C. Keep trenches dry during drainage system installation.
- D. Clean interior of pipe before installation.

3.2 INSTALLATION - FOUNDATION DRAINAGE

- A. Install products according to manufacturer's instructions and approved submittal drawings.
 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for RE consideration.
- B. Trenching, Excavation and Backfilling:
 1. Perform trenching, excavation and backfilling according to Section 31 20 00 EARTH MOVING. Make 1/8 bends changes in direction of drain lines. Use wye fittings at intersections.
- C. Bedding:
 1. Place and compact graded bedding at bottom trench, minimum 6 inches deep. Rest section firmly through entire length, with recesses formed for bell joints. Fully support pipe lower quadrant with bedding, except bell joint recesses.
- D. Filter Fabric: Place drainage pipe on filter fabric.

E. Pipe Laying:

1. Install PE and PVC Pipe according to ASTM D2321 and ASTM F758.
2. Lay drain lines to grades and alignment, with continuous fall in flow direction and as indicated on Drawings.
3. Place bells ends, face upgrade.
4. Lay drain lines and firmly bed in granular material minimum 75 mm (3 inches) below invert to top of pipe true to grades and alignment, and slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed, 300 mm (1 foot) above top of pipe, unless otherwise noted.
5. Lay perforated pipe, perforations down. Lay plain end pipe, closed joints, held in place with two No. 9 spring steel wire clips at joint or standard clay collars.
6. Foundation Subdrainage: Install pipe pitched down in flow direction, minimum slope 0.5 percent, minimum cover 900 mm (3 feet), unless otherwise indicated.
7. Underslab subdrainage: Install piping pitched down in flow direction, minimum slope of 0.5 percent.
8. Install gaskets, seals, sleeves, and couplings according to manufacturer's instructions and as follows:
 - a. PE Joint: ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, "Joint Properties".
 - b. PVC Joint: ASTM D3034 with elastomeric seals gaskets, ASTM D2321.
 - c. Perforated PVC Joint: ASTM D2729, with loose bell and spigot joints.
9. Install cleanout extensions as indicated on Drawings and as follows:
 - a. Pre-placed Crypt Field Underdrain Cleanouts: Install as indicated on Drawings and set not to interfere with mowing operations. Provide concrete anchorage for plastic tops. Check drain lines before backfilling. Remove obstructions and recheck lines.

3.3 FIELD QUALITY CONTROL

- A. Field Inspections:
- B. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

3.4 PROTECTION

- A. Protect pipe from and aggregate cover from damage and displacement until backfilling operation begins.

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