

DEPARTMENT OF VETERANS AFFAIRS



**NATIONAL CEMETERY ADMINISTRATION OFFICE
OF DESIGN AND CONSTRUCTION
WASHINGTON, D.C.**

**BID DOCUMENTS
VOLUME -1**

**NATIONAL CEMETERY DEVELOPMENT
CEDAR CITY RURAL INITIATIVE
CEDAR CITY, UT**

**IFB NUMBER VA-XXXXXXXX
PROJECT NO. 942CM3001**

BID DOCUMENT SUBMITTAL

22 July 22

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SIGNATURE PAGE



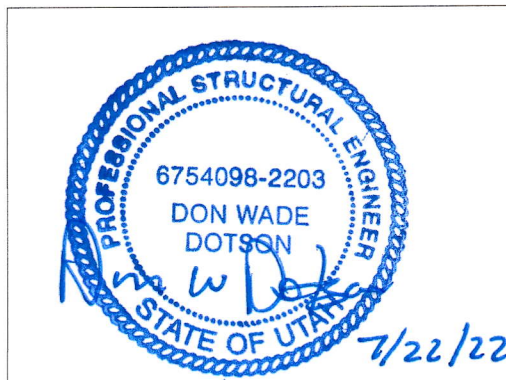
Architect & Security:
VALI COOPER INTERNATIONAL
Sections covered by these seals include:
Divisions: 00, 01, 03 (except 03 30 53 & 03 48 21), 04 (except 04 20 00), 05, 07, 09, 10, 28, 32 31 13 & 32 31 19.

ARCHITECT: Sean Fitzpatrick



Electrical Engineer:
VALI COOPER INTERNATIONAL
Sections covered by these seals include:
Divisions: 28

SECURITY: Sina Saboktakin



Civil & Structural Engineer:
WOOD
Sections covered by these seals include:
Divisions: 02, 03 30 53, 03 48 21, 04 20 00, 31, 32 05 23, 32 12 16 & 33.

CIVIL: Don Dotson



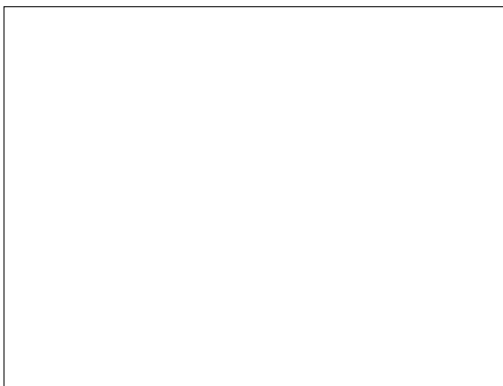
Electrical Engineer:

WOOD

Sections covered by these seals include:

Divisions: 26

ELECTRICAL:



STRUCTURAL:



Landscape Architect/Irrigation Planner:

MRWM

Sections covered by this seal include:

32 33 00, 32 84 00 & 32 90 00

LANDSCAPE: Brian Verardo

DEPARTMENT OF VETERANS AFFAIRS



**NATIONAL CEMETERY ADMINISTRATION OFFICE
OF DESIGN AND CONSTRUCTION
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**BID DOCUMENTS
VOLUME -2**

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**DEPARTMENT OF VETERANS AFFAIRS
NCA MASTER SPECIFICATIONS**

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SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for Cedar City National Cemetery Rural Initiative Cemetery Development as required by drawings and specifications. The Period of Performance for this contract shall be 18 months.
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. All Testing Laboratory services will be retained and paid for by the Contractor (see Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.
- D. All employees of general contractor and subcontractors shall comply with security requirements as established by the COR, be identified by name and employer. They shall be restricted from unauthorized access.
- E. Prior to commencing work, general contractor shall provide proof that a 30-hour OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- F. Training:
 - 1. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA CP.
 - 2. Submit OSHA training records of all employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. CLIN 0001, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications.

- B. CLIN 0002, Provide the cost for the removal and disposal of 700CY of bed rock. Rock removed over or under the 700CY will be added or removed by Contract Modification based on the unit price cost of the 700CY pricing provided.
- C. CLIN 0003, Manufacture and delivery of crypts. Installation of crypts to be included in CLIN 0001.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, one electronic set of specifications and drawings will be furnished to the contractor.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:
 - 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
 - 2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
- B. Security Procedures:
 - 1. General Contractor's employees shall not enter the site without following the procedures approved by the COR. They may also be subject to inspection of their personal effects when entering or leaving the project site.
 - 2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days' notice to the COR. 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 COR.
 - 4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the COR.
- C. Guards:
 - 1. No guards are required onsite unless requested by the COR.
- D. Key Control:
 - 1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of

every area of project including toolboxes and parked machines, and to take any necessary emergency action.

E. Document Control:

1. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
2. All electronic information shall be stored in a specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.

1.5 FIRE SAFETY

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

1. American Society for Testing and Materials (ASTM):
 - E84-2009aSurface Burning Characteristics of Building Materials
2. National Fire Protection Association (NFPA):
 - 10-2010Standard for Portable Fire Extinguishers
 - 30-2008Flammable and Combustible Liquids Code
 - 51B-2009Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 70-2008National Electrical Code
 - 241-2009Standard for Safeguarding Construction, Alteration, and Demolition Operations
3. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1926Safety and Health Regulations for Construction

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COR/Cemetery Director for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractor's beginning work, they shall undergo a

safety briefing provided by the General Contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc. Documentation shall be provided to the 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 Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- G. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR.
- H. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- I. 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.
- J. Dispose of waste and debris in accordance with NFPA 241. Remove from site weekly.
- K. 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 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 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 COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the 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. Working space and space available for storing materials shall be as shown on the drawings. Contractor parking will be only in areas and on roadways designated and agreed to by the COR in agreement of the Cemetery.
- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
- G. Phasing: To ensure such executions, the Contractor shall furnish the COR with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, the Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof.
- H. Construction Privacy 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 375 mm (15 inches). Bottom of fences shall extend to 25 mm (one inch) above grade. Install PVC privacy slats for entire length of fence. The temporary fencing shall encompass the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Remove the fence when directed by COR.

I. Utilities Services:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, electricity, site access, etc., payment of such fee shall be the responsibility of the Government, the Contractor will pay the fee and the government will reimburse (with no markups) the contractor for the cost of the connection fees.

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

1.7 ALTERATIONS (NOT USED)

1.8 ENVIRONMENTAL CONTROLS

- A. In general, following preventive measures shall be adopted during construction to keep down dust.
1. Dampen debris to keep down dust.
- B. Final Cleanup:
1. Upon completion of the project, or as work progresses, remove all construction debris.

1.9 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of the site, or parts thereof, shall be disposed of as follows:
1. Reserved items: There are no reserved items for the government.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.

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

- A. The Contractor shall preserve and protect all vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging

vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the COR.

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

(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 Article 1.11 "Restoration", and Article 1.6 "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate NCA Central/Cemetery) office. The contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
1. Designating areas for equipment maintenance and repair;

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

1.11 RESTORATION

- A. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged.
- C. At the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 PHYSICAL DATA

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.
 1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by GEM Engineering and survey by Platt & Platt, INC.
- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration conducted by GEM Engineering are in the geotechnical report.
- C. A copy of the geotechnical report is an Appendix to these specifications and shall be considered part of the contract documents.

D. The Government does not guarantee that other materials will not be encountered, nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, including approved scheduling bidders will be permitted to make subsurface explorations of their own at site.

1.13 PROFESSIONAL SURVEYING SERVICES

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

1.14 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and benchmarks indicated on the drawings and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the 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 COR may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

B. Establish and plainly mark center lines for each building, lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure, roads, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.

- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have lines, grades, locations and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, furnish to the 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.
 2. Elevations of bottoms of footings and tops of floors of each building.
 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 and streets.
 7. Lines and elevations and location of top of pre-placed crypts within their respective plots.
 8. Lines and elevations of grade over pre-placed crypts.
 9. Northing/Easting coordinate locations and elevation depth below finished grade of all water, storm and irrigation structures, directional fittings, control wire and lines.
 10. Northing/Easting coordinate locations and elevation for each gravesite grid monument.

- E. Upon completion of the work, the Contractor shall obtain the services of a registered professional land surveyor to conduct a final survey of all construction and furnish the 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. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, which will include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To ensure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. At substantial completion, the Contractor shall secure the services of a professional land surveyor, as defined in Section 1.10, to perform a site survey within the project limits in accordance with the NCA Site, Topographic, Utility, Landscape & Soil Survey scope of services, as listed in the appendix of this specification. Elements to be surveyed include, but are not limited to:
 - 1. Location, alignment, and dimension of roads, curbs, walks, parking, and paved areas. Indicate road centerlines with true bearings and lengths by 15 m (50') stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well as location of radius and vertex points. Designate roads with curbs by double lines. Show equalities for intersecting roads by station.
 - 2. Crown, grade, and climb of curb at road crossings contours.
 - 3. Elevations on 50' centers on centerline of roads, edges of roads, and top and bottom of curbs.
 - 4. Type of pavement of roads.
 - 5. Surface elevations on a 50' grid pattern, except where terrain features require greater detail. At abrupt changes in grade, show elevations at the tops and bottoms of slopes to the nearest 0.1'.

6. Site features of every character identified and located with exact measurements. Include fences, walls, areaways, steps, ramps, railings, gratings, flumes, pads, sprinkler heads, telephone poles, signage, and site furnishings.
7. All underground, overhead, and surface electrical utilities and structures. Show size, depth, and top elevation of all electrical structures, based on actual site investigation.
8. All underground and surface civil and mechanical utilities and structures. Show size depth, invert and top elevation of all utility structures, such as manholes, catch basins and headwalls, based on actual site investigation. Indicate direction of flow and size of pipe for all sewers drains and connecting lines between manholes.
9. Grid monuments.

D. The Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after acceptance of the project by the COR.

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

1.16 USE OF ROADWAYS

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

1.17 RE/COTR'S FIELD OFFICE (NOT USED)

1.18 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

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

1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, 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. All components of heat production, metering equipment, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.19 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by 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.

1.20 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for

chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery irrigation distribution system. Backflow preventer may not be required at connections to the irrigation system. Water is available at no cost to the Contractor.
 - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from the Cemetery's system.

3. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.

1.21 NEW TELEPHONE EQUIPMENT (NOT USED)

1.22 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the COR. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.23 INSTRUCTIONS

- A. The Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and

illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

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

1.24 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on drawings.
- B. Materials furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.
- C. Storage space for materials will be provided by the Contractor and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery.

- D. Notify COR in writing, 60 days in advance, of date on which Contractor will be prepared to receive materials furnished by Government. Arrangements will then be made by the Government for delivery of materials.
1. Immediately upon delivery of materials, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of materials described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 2. The Contractor thereafter is responsible for such material until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government, if any, will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.25 RELOCATED ITEMS (NOT USED)

1.26 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the 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. Sign face shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4-inch by 4-inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 mm x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.

- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is a part of the drawings.

1.27 SAFETY SIGN

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

1.28 CONSTRUCTION DIGITAL IMAGES

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

2. The digital photo files shall also be submitted on CD-ROM to the COR at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.29 FINAL ELEVATION PHOTOGRAPHS

- A. Final photographs shall be taken by a commercial/professional photographer. They shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day at as large a scale as possible to obtain sufficient detail to show depth and to provide clear, sharp pictures. All images shall become property of the Government.
- B. Photographs shall be artistically composed showing full front elevations of new columbarium court(s), memorial wall, site features and surrounding landscapes. A minimum of thirty six (36) images shall be taken as per these specifications.
- C. Minimum digital photo file size for final photos is 20 mb un-interpolated, preferably 52 mb. Submit proofs, via e-mail or web photo gallery, from which the COR will select the final images for printing.
- D. Pictures selected by the COR for printing shall be printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Photographs shall have full picture print with no margin.
- E. Submit two (2) 400 mm x 500 mm (16 x 20) framed prints and three (3) 8 x 10 prints of the final selected photos. Deliver to the COR/Project Manager, in boxes suitable for shipping,
- F. Submit a CD-ROM to the COR containing all (minimum 36) final digital photo files.
 1. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% of the original with no loss of information.

2. File names shall contain the date the image was taken, the Project number and a unique sequential identifier.
3. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- G. Each of the selected 16 x 20 prints shall be placed in a frame with a minimum 2 inches, maximum 3 inches, of appropriate matting as a border. Provide a selection of 3 different mats and 3 different frames from which the COR will select one mat and one frame style to frame both prints. Preferred frame style is wood molding, matte black finish, box frame, 1-1/8" wide x 7/8-inch deep.
- H. Place a typewritten self-adhesive identity label on the back of each final print without damage to photograph. PHOTO NUMBER shall be included in both the digital file name on the CD and on the photo print label.
- I. The following information shall be on the identity-label for photographs:
 1. PHOTO NUMBER;
 2. CEMETERY NAME
 3. LOCATION;
 4. PROJECT TITLE;
 5. PROJECT NUMBER;
 6. DATE TAKEN;
 7. CONSTRUCTION COMPANY;
 8. CONTRACT NUMBER.

1.30 HISTORIC PRESERVATION

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

1.31 PROJECT HEALTH AND SAFETY PLAN

- A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:
 1. Organizational structure (including Responsible Persons)
 2. Site Characterization and Job Hazard Identification
 3. Site Control and Security

4. Training
5. PPE
6. Heat Stress
7. Spill Containment
8. Decontamination
9. Emergency Response
10. Trench Safety

- - - E N D - - -

SPECIFICATIONS for SITE SURVEY

1.0 GENERAL

1.1 The purpose of the site survey is to develop base information of the site for design and construction of the proposed columbarium at the Cedar City Rural Initiative.

1.2 A licensed professional surveyor, registered in the State of California (hereinafter referred to as "Surveyor" or "A/E") will perform and furnish all surveying and professional services, labor, materials, equipment, and fees necessary to provide a Topographic, Utility and Landscape Survey as hereinafter specified. Incident to such services, the A/E shall do all fieldwork necessary to determine accurately the physical conditions existing on the site and shall obtain requisite information from the land records. Primarily work includes but is not limited to the location of existing grades (1' contours), all surface features including buildings, streets, etc.; utilities; and plant material.

1.3 Point of Contact for VA: Right of entry to accomplish the survey shall be obtained from the Cemetery Director, Cedar City Rural Initiative, Cedar City Rural Initiative, 32053 West McCabe Road, voice: (209) 854-1040 and e-mail: margaret.ayres@va.gov.

2.0 PROJECT LIMITS: The area to be surveyed shall include the proposed columbarium site, the proposed cremains site, the proposed roadways and limited adjacent areas,. Unless otherwise indicated or approved by VA, the survey limits shall extend to a minimum of 20 feet beyond the proposed construction area. The survey shall locate and identify all natural and man-made site features as described in the specifications below.

3.0 SUBMITTAL REQUIREMENTS

3.1 All survey drawings sheets shall use the standard VA/NCA title block. VA will provide an electronic version if the A/E requires it. All sheets will have the title block completed with correct information. Sheet size is 30" x 42".

3.2 All drawings shall be bound, along the left margin, into sets in accordance with NCS sequencing. The binding must not obscure any information on the drawings.

3.3 The A/E shall supply all drawings in AutoCAD format in accordance with the United States National CAD Standard, Version 6.0 © National Institute of Building Sciences 2014. The standard includes presentation graphics, level/layer assignments, electronic file naming and standard symbology. Numbering and sequencing of sheets shall adhere to the NCS conventions. These standards are available at the Internet website: <http://www.nationalcadstandard.org/>. Field notes, calculations, and supporting records shall be submitted to the VA Contracting Officer upon completion of the work.

3.3.1 The external label for the electronic submittal shall contain at a minimum:

- a. VA Project Number
- b. Format and version of the operating system software used

- c. Name and version of utility software used for preparation (e.g., compression/decompression, if applicable) and copying files to media
- d. Sequence number of the digital media
- e. A list of the filenames on the digital media, as space on the label permits.

4.0 BASE MATERIALS: The surveyor should incorporate boundary survey information previously obtained by the Department of Veterans Affairs and contained in data supplied to the A/E.

5.0 TOPOGRAPHIC, UTILITY, & LANDSCAPE SURVEY

5.1 GENERAL

5.1.1 Seals: The Surveyor shall affix his registration seal and signature to all final drawings.

5.1.2 Certification: All final site survey drawings shall bear the following certification adjacent to the Surveyor's seal and signature:

"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."

5.1.3 Legends: The final survey shall include a legend consisting of suitable weighted lines and symbols designating standard boundary and topographic features, facilities, and utilities, etc. A legend of symbols shall be provided on each survey sheet.

5.1.4 Drawing Scale: The scale of the final plans shall be 1"=30'-0". All plans shall show a scale of drawing, bar scale, and direction of true north. When more than one continuous plan is required, match lines shall identify adjoining plans. Each match line shall be referenced to the adjacent corresponding plan. Drawings using match lines must not overlap information. All information must stop at the match line and resume at the corresponding match line. A small key drawing shall be included on each plan illustrating the relationship of the sheet to the entire site.

5.1.5 Overall Site Plan: A site plan shall be submitted on a single sheet at the largest standard engineering scale that allows the entire project site to fit on the standard drawing sheet. The overall site plan shall show as much as practical the information contained on the multiple sheets, or shall show a reduced level of detail to clearly illustrate significant features.

5.1.6 Vertical Control: Vertical control shall be based on a USC&G, state, or local vertical datum, preferably NAD 27 or 83 datum, as approved by the Contracting Officer. The location and description of benchmarks shall be noted on the plans and tied together into a control plan. The control plan shall be illustrated on an overall plan of the survey.

5.1.7 Contour Interval: Contours shall be indicated by broken lines, drawn at one-foot (1') intervals or otherwise required and approved interval.

5.1.8 Site Restoration & Clean Up: The Surveyor shall leave the project area in a neat and clean condition at all times. Any damages (including ruts made by equipment) caused by the Surveyor shall be repaired in a timely and efficient manner to the satisfaction of the Contracting Officer.

5.1.9 Aerial Photographs: Provide VA with copies of all aerial photographs if used in the preparation of the survey.

5.2 DETAILED REQUIREMENTS

5.2.1 Bench Marks: Benchmarks shall be installed where none exist, and shall be of a usual and customary standard for the project locality, as approved by the Contracting Officer.

5.2.2 Boundary Lines: Boundary lines shall be illustrated by length, bearing, interior angles, radii, offsets, and points of tangency, as appropriate or available, on found boundary information.

5.2.3 Other Lines: Illustrate all known zoning setbacks, restriction lines, easements, and rights-of-way (ROW).

5.2.4 Roads & Walks: Illustrate the location, alignment and dimension of all roads, curbs, walks, parking and paved areas. Road centerlines shall be indicated with true bearings and by stationing on centerlines if found or available. Curves shall be described by designating the points of curvature and tangency by station. All curve data shall be included as well as the locations of radius and vertex points. Double lines shall be used to designate road curbs. Note the type of pavement for all highways, streets, roads, walks and other surfaces. Note the legal and common names of roads. Show the direction of travel on existing one-way or restricted roadways. Illustrate existing parking lot striping and handicapped designated parking spaces, aisles and ramps.

5.2.5 Contours Crossing Roadways: When crossing roads, contour lines shall clearly illustrate crown, grade, and height of curbs. Spot elevations shall be shown on approximate 50-foot centers along the centerline of roads, edges of roads and at the bottom and top of curbs.

5.2.6 Ownership and Jurisdiction: Identity the owner, or organization with jurisdictional responsibility, for all adjacent properties, roadways, easements, ROW, restrictions, covenants, etc.

5.2.7 Future Modifications & Improvements: Report all known proposed modifications to the property and adjacent properties to the Contracting Officer. Illustrate future modifications and improvements (i.e.: street widening, sewer or easement extensions, adjacent development, etc.) where appropriate, and as directed by the Contracting Officer.

5.2.8 Prominent Site Features & Structures: Provide the location, dimensions and elevations of all prominent site features including buildings, fences, gates, walls, pavement areas, signs, ramps, drainage facilities, and monuments. Illustrate all other prominent landscape features such as gravesite spoil and borrow areas, excavations, rock outcroppings, overhangs, faults, springs, and steep slope areas. (Where slopes exceed 25%, contour intervals of two feet will be considered.)

5.2.9 Surface Elevations: Spot elevations shall be provided on an approximate 50-foot minimum grid pattern, and at all other appropriate locations where site features, structures, or utilities require greater detail to illustrate existing conditions. Provide spot elevations (to the nearest tenth of a foot on pavements) at the top and bottom of abrupt changes in grade.

5.2.10 Underground and Overhead Utilities: Locate all overhead and visible underground services, utilities, utility poles, light standards, irrigation systems (including sprinkler heads), sewer manholes and inlets, fire and water hydrants, valve boxes, etc. Locate and indicate the type and size of all visible pipes and other utility system elements. Identify the visible system source or origin, the direction of flow, out-fall, noted or obvious pressure level, etc. Locate the invert and inlet elevations of all manholes, catch basins, inlets, culverts, and headwalls, where it is safe and practical to do so.

(Note: The Surveyor, or the A/E, shall alert the Contracting Officer of the need for underground utility survey, by a professional utility surveyor where design conditions appear to warrant additional detail.)

5.2.11 Trees & Shrubs: Locate and identify all freestanding trees of 3" caliper and larger by botanical and common names and by trunk caliper. Locate all trees of 15" caliper within wooded areas. Illustrate the perimeters of all shrubbed and wooded masses, ground cover, and plant beds. Describe the predominant vegetation located within these outlines, if known. Indicate the height and diameter of freestanding shrubs. Identify turf and lawn areas. Locate major hedge lines and delineate trunk sizes and locations.

5.2.12 Water Bodies and Flood Plains: Illustrate all watercourses and bodies, including any flagged wetlands defined by the A/E. The A/E shall provide the Surveyor with information and illustrate the limits of any 100-year flood plain areas, as delineated on FEMA maps, on the final survey drawings.

5.2.13 Location Of Borings and Grave Test Pits: The Surveyor shall locate and stake in the field, and illustrate the location of all borings and test pits on the final survey drawings.

- END -

SECTION 01 32 17
NETWORK ANALYSIS SCHEDULES
(MICROSOFT PROJECT GANTT CHART)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor shall develop a Microsoft Project 2003 (or later) Gantt Chart (bar chart) schedule demonstrating fulfillment of the contract requirements. The Contractor shall keep the network up-to-date in accordance with the requirements of this section. The Contractor shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The Gantt Chart will be utilized to satisfy time applications.

1.2 CONTRACTOR'S REPRESENTATIVE

- A. The Contractor shall designate an in-house representative who will be responsible to prepare the schedule, review the schedule and report progress of the project to the COR.
- B. The Contractor's in-house representative shall be given authority to act on behalf of the Contractor in fulfilling the requirements of this specification section. Such authority shall not be interrupted throughout the duration of the project.

1.3 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide to VA monthly computer processing of all computer produced schedules generated from monthly project updates. The Contractor shall provide to VA two (2) copies of the updated Microsoft Project Gantt Chart and an electronic copy of this data. This must be submitted with and substantively support the contractor's monthly payment request.
- B. 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 of the updated schedule.
- C. VA shall report errors in computer-produced reports to the Contractor's representative within ten (10) calendar days from receipt of reports. The Contractor shall reprocess the Gantt Chart

and associated CDs, when requested by the Contracting Officers Representative, to correct errors that affect the schedule for the project.

1.4 THE COMPLETE PROJECT GANTT CHART SUBMITTAL

- A. The Complete Project Microsoft Project Gantt Chart will contain work activities/events as necessary to fully detail the project schedule.
- B. Within ten (10) calendar days after receipt of the Notice to Proceed, the Contractor shall submit for the Contracting Officer's review, a Microsoft Project Gantt Chart and a CD. Each activity/event on the Gantt Chart schedule shall contain as a minimum, but not limited to, activity/event description, duration, start dates and finish dates. Activity constraints, not required by the contract, will not be accepted. Logic events (non-work) will be permitted where necessary to reflect proper sequence among work events, but must have zero duration.
- C. The complete working Gantt Chart shall reflect the Contractor's approach to scheduling the complete project. The final Gantt Chart in its original form shall contain no contract changes or delays that may have been incurred during the final Gantt Chart development period. It shall reflect the Contractors "AS BID" or "DAY 1" schedule. Changes and /or delays shall be entered at the first monthly update after the final Gantt Chart 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.
- D. Within ten (10) calendar days after receipt of the complete project Gantt Chart, 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. Schedule a meeting with the Contractor at, or near the job site, for joint review, correction or adjustment of the proposed plan.Within ten (10) calendar days after the joint review, the

Contractor shall revise and shall submit two (2) copies of the revised Gantt Chart and a revised CD as specified to the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

1.5 WORK ACTIVITY/EVENT AND COST DATA INFORMATION

- A. The Contractor shall not be required to "cost load" the computerized Microsoft Project Gantt Chart. As part of this submission, the Contractor shall provide a separate **Schedule of Costs** on AIA document G703. This Schedule of Costs shall reflect and contain all the same activities/events identified on the Gantt Chart.
- B. The Contractor and the Contracting Officer shall use this Schedule of Costs for monthly payment purposes as referenced in the General Requirements of this agreement.
- C. The Contractor and Contracting Officer shall agree on percentages for monthly work accomplished. The cumulative total amount of all cost loaded activities/events (including alternates) shall equal the total contract price.
- D. Prorate overhead, profit and general conditions on all work activities/events for the entire project. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

1.6 GANTT CHART REQUIREMENTS

- A. Show on the Gantt Chart the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the Gantt Chart, the Contractor shall:
 - 1. Show the following on each work activity/event:
 - a. Concise description of the work represented by the activity/event.
 - b. Duration (in work days.)
 - 2. Show activities/events as:

- a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Cemetery utilities, delivery of Government furnished equipment, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment.
3. Break up the work into activities/events of durations no longer than thirty (30) 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. [The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be less than ten (10) workdays.] The construction time as determined by the Gantt Chart schedule from start to finish for any sub-phase, phase or the entire project shall not exceed the total contract duration. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.

1.7 PAYMENT TO THE CONTRACTOR

- A. Monthly, the contractor shall submit the Gantt Chart updated for remaining activity durations and a Schedule of Costs updated for costs. AIA application and certification for payment documents G702 and G703 will be used. The payment request should reflect and be in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, PAYMENT UNDER FIXED-PRICE CONSTRUCTION

CONTRACTS of Section GENERAL REQUIREMENTS. The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Schedule of Costs unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: two (2) copies of the updated Microsoft Project Gantt Chart, a listing of all project schedule changes, and associated data, made at the update. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.

- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Gantt Chart data, which, in the sole judgment of the Contracting Officer, are necessary for validating the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be reasonably determined.

1.8 PAYMENT AND PROGRESS REPORTING

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's Representative) and the Contractor. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's Representative). 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. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Gantt Chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.

6. Activity/event duration and percent complete shall be updated independently.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contracting Officer. The narrative report shall include a description of 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 taken or proposed. 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 of the contract.
- C. As part of the monthly jobsite progress meeting, the General Contractor, specifically requested subcontractors and the Contracting Officers Representative shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period.

1.9 RESPONSIBILITY FOR COMPLETION

- A. Whenever it becomes apparent from the monthly progress review meeting or the monthly computer-produced Gantt Chart schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the CO for the proposed schedule changes. If such actions are approved, the revisions shall

be incorporated by the Contractor into the Gantt Chart before the next update, at no additional cost to the Government.

1.10 CHANGES TO GANTT CHART SCHEDULE

- A. Within ten (10) calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor shall submit a revised Gantt Chart, the associated CDs, and a list of any activity/event changes including predecessors and successors for any of the following reasons:
1. Delay in completion of any activity/event or group of activities/events, which indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Gantt Chart as the direct cause for delaying the project beyond the acceptable limits.
 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 3. The schedule does not represent the actual prosecution and progress of the project.
 4. When there is, or has been, a substantial revision to the activity/event costs of the network diagram regardless of the cause for these revisions.
- B. Revisions made under this paragraph, which affect the previously approved computer-produced schedules for Government furnished equipment, 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 Gantt Chart 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 Contracting Officer's Representative.

- D. The cost of revisions to the Gantt Chart resulting from contract changes will be included in the cost of the change.
- E. The cost of revisions to the Gantt Chart not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Gantt Chart data and supporting evidence as the Contracting Officer may deem *necessary for determination as to whether or not the Contractor is* entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.
- B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced Gantt Chart schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within thirty (30) calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.
- 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 in the, GENERAL CONDITIONS of the contract. The Contractor shall include, as a part of each change order proposal, a sketch showing all revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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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)

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

1-2. 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.

- A. Prior to construction starting, submit for VA approval, a submittal register listing all SUBMITTALS required as noted in the Drawings and Specifications. As a minimum, the listing will include the submittal requirement (a reference to the specification section or drawing No.), a brief description, submittal type (pre-construction, general (time period if recurring submittal), close-out), submission status and approval status. An example submittal register is provided at the end of this section and a file template can be provided after award.
 - a. The Contractor is not relieved from supplying submittals required by the contract documents, but which have been omitted from the submittal register.

- b. The Contractor shall track on a separate Submittal Log (example provided at the end of this section), the dates on which submittals are received and returned by the VA.
 - c. The Contractor shall update the submittal log and register as submittal actions occur until final acceptance of all work by the Contracting Officer.
 - d. The submittal register and log will be reviewed at progress meetings with the intent to ensure the project progresses as scheduled.
- 1-3. Submit for approval, all 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 the 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. The VA will review all submittals for compliance with the technical requirements of the contract documents. The Architect-Engineer for this project will assist the VA in reviewing all submittals and determining contractual compliance. Review will be only for conformance with the applicable codes, standards and contract requirements.
- A. Period of review for submittals begins when the VA COR receives submittal from the Contractor.
 - B. Period of review for each resubmittal is the same as for initial submittal.

- C. VA review period is 15 working days for submittals.
- D. VA review period is 10 working days for RFIs.
- E. The VA will return submittals to the Contractor with the following notations:
 - 1. "Approved": authorizes the Contractor to proceed with the work covered.
 - 2. "Approved as noted": authorizes the Contractor to proceed with the work covered provided the Contractor incorporates the noted comments and makes the noted corrections.
 - 3. "Disapproved, revise and resubmit": indicates noncompliance with the contract requirements or that submittal is incomplete. Resubmit with appropriate changes and corrections. No work shall proceed for this item until resubmittal is approved.
 - 4. "Not reviewed": indicates submittal does not have evidence of being reviewed and approved by Contractor or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals after taking appropriate action.
- 1-6. 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 Prime Contractor only and shipped prepaid if required or submitted electronically if no samples are required. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.

A. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in electronic format.

B. Samples

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

C. Submittals will receive consideration only when covered by a transmittal letter signed by the Contractor containing 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.
- D. 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 send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to VA COR 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.
- E. 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.

- F. Approved samples will be kept on file by the COR 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.
- G. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be reviewed and certified that all submittals are in compliance with contract requirements before submitting for VA review. Proposed deviations from the contract requirements are to be clearly identified. All deviations submitted must include a side by side comparison of item being proposed against item specified. Failure to point out deviations will result in the VA requiring 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 the Contractor certifying to such check.**
1. Reproducible shall be full size.
 2. 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.
 - a. Stamp used by the Contractor on the submittal transmittal form to certify that the submittal meets contract requirements is to be similar to the following:

| | | |
|--|-------------|--|
| | CONTRACTOR | |
| | | |
| | (Firm Name) | |
| | | |

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

3. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate VA approval or disapproval stamp.
 4. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 5. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 6. 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

(Architect-Engineer)

(A/E P.O. Address)

(City, State and Zip Code)

- 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 COR.
- 1-12. Samples (except laboratory samples) for approval shall be sent to Architect-Engineer, in care of COR, VA Medical Center,

(P.O. Address)

(City, State and Zip Code)

1-13. Operation and Maintenance Data and Manuals

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

1-14. Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

[illegible]

| Submittal Number | Submitted to VA | Date VA answered | Status |
|--|-----------------|------------------|---------------------|
| 01 00 02-01_Constr Security Plan_18C0123_832CM3032 | 9/19/2019 | 9/19/2019 | approved as noted |
| 01 00 02-02_Site Safety and HealthPlan_18C0123_832CM3032 | 10/6/2019 | 10/6/2019 | approved |
| 01 00 02-03_Quality Control Management_18C0123_832CM3032 | 9/20/2019 | 10/7/2019 | approve as noted |
| 01 32 17-01_Baseline Project Schedule_18C0123_832CM3032 | 9/19/2019 | 10/6/2019 | approved |
| 33 40 00-01_Storm Drainage Utilities_18C0123_832CM3032 | 10/2/2019 | 10/22/2019 | revise and resubmit |
| 33 40 00-01R1_Storm Drainage Utilities_18C0123_832CM3032 | 10/29/2019 | 11/4/2019 | revise and resubmit |
| 33 40 00-01R2_Storm Drainage Utilities_18C0123_832CM3032 | 11/12/2019 | 11/13/2019 | approved as noted |
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Submittal Number: includes reference number, sequence number, title, contract number and project number

Format: XX XX XX-YY_(Title)_(Last 7 digits of contract number)_(VA Project No.)

XX XX XX is the specification section, **YY** is the sequence number

For revisions use YYRR where RR is the revision # (R1, R2, etc.)

Example Submittal Log

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

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| 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 |
| ACI | American Concrete Institute http://www.aci-int.net |
| ACPA | American Concrete Pipe Association http://www.concrete-pipe.org |
| ADA | Americans with Disabilities Act http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag |
| AGC | Associated General Contractors of America http://www.agc.org |
| AISC | American Institute of Steel Construction http://www.aisc.org |
| AISI | American Iron and Steel Institute http://www.steel.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/ |
| ASCE | American Society of Civil Engineers http://www.asce.org |
| ASME | American Society of Mechanical Engineers http://www.asme.org |
| ASTM | American Society for Testing and Materials http://www.astm.org |
| AWI | Architectural Woodwork Institute http://www.awinet.org |
| AWS | American Welding Society http://www.aws.org |
| AWWA | American Water Works Association http://www.awwa.org |

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| CFR | Code of Federal Regulations http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR |
| CID | Commercial Item Description http://www.gsa.gov/portal/content/100847 |
| CISCA | Ceilings and Interior Systems Construction Association http://www.cisca.org |
| CLFMI | Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org |
| CRSI | Concrete Reinforcing Steel Institute http://www.crsi.org |
| DASMA | Door and Access Systems Manufacturers Association http://www.dasma.com/ |
| DHI | Door and Hardware Institute http://www.dhi.org |
| DOE | U.S. Department of Energy http://www.energy.gov/ |
| EPA | Environmental Protection Agency http://www.epa.gov |
| ETL | ETL Testing Laboratories, Inc. http://www.envirotestinglabs.com/ |
| 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 |
| GSA | General Services Administration http://www.gsa.gov |
| ICC | The International Code Council http://www.iccsafe.org/Pages/default.aspx |
| IEEE | Institute of Electrical and Electronics Engineers http://www.ieee.org/ |

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| MHI | Material Handling Industry of America http://www.mhi.org/ |
| 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 |
| NHLA | National Hardwood Lumber Association http://www.natlhardwood.org |
| NIH | National Institute of Health http://www.nih.gov |
| NIOSH | The National Institute for Occupational Safety and Health http://www.cdc.gov/niosh/ |
| NIST | National Institute of Standards and Technology http://www.nist.gov |
| NLMA | Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org |
| NPCA | National Precast Concrete Association http://www.precast.org |
| NRCA | National Roofing Contractors Association http://www.nrca.net |
| NWWDA | Window and Door Manufacturers Association http://www.nwwda.org |

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| OSHA | Occupational Safety and Health Administration Department of Labor http://www.osha.gov |
| PCA | Portland Cement Association http://www.cement.org/ |
| PPI | The Plastic Pipe Institute http://www.plasticpipe.org |
| RCSC | Research Council of Structural Connections http://www.boltcouncil.org/ |
| RFCI | The Resilient Floor Covering Institute http://www.rfci.com |
| 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/ |
| SMACNA | Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org |
| SSPC | The Society for Protective Coatings http://www.sspc.org |
| SWRI | Sealant Waterproofing and Restoration Institute http://www.swrionline.org/ |
| UL | Underwriters' Laboratories Incorporated http://www.ul.com |
| USDA | U.S. Department of Agriculture http://www.usda.gov |
| USGBC | U.S. Green Building Council http://www.usgbc.org |
| WDMA | Window and Door Manufacturers Association https://www.wdma.com/ |

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SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

- A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. ASTM International (ASTM)
 - 1. D3740 - (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 2. E329 - (2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.3 SUBMITTALS

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

- 1. Preconstruction Submittals
 - a. Interim CQC Plan
 - b. CQC Plan
- 2. Test Reports
 - a. Verification Statement

PART 2 PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

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

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

3.2 CQC PLAN:

- A. Submit the CQC Plan to the CO/COR for review and acceptance no later than 30 days after receipt of Notice to Proceed (NTP). The CQC Plan must effectively implement the requirements of the FAR Clause 52.246.12 titled "Inspection of Construction". The Government will consider an Interim CQC Plan for the first 30 days. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an Interim plan applicable to the particular feature of work to be started. Work outside of the accepted Interim CQC Plan will not be permitted to begin until acceptance of a CQC Plan or another Interim CQC Plan containing the additional work scope is accepted.
- B. Content of the CQC Plan: Include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, designers of record consultants, architects/engineers (A/E), fabricators, suppliers, and purchasing agents:
 1. A description of the QC organization, including a chart showing lines of authority and acknowledgement that the CQC staff will implement the three-phase control system for all aspects of the work specified. The Superintendent shall be responsible for the CQC plan.
 2. The name, qualifications (in resume format) duties, responsibilities, and authorities of each person assigned a CQC function.
 3. A copy of the letter to the CQC System Manager/Superintendent signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately

- perform the functions of the CQC System Manager/Superintendent, including authority/responsibility to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities issued by the CQC System Manager/Superintendent. Furnish copies of these letters to COR.
4. Procedures for scheduling, reviewing, certifying, and managing submittals including those of subcontractors, designers of record, consultants, A/E's offsite fabricators, suppliers and purchasing agents. These procedures must be in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
 5. Control, verification, and acceptance of testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer or Authorized designee are required to be used, per spec section 01 45 29)
 6. Procedures for tracking Preparatory, Initial, and Follow-Up control phases and control, verification, and acceptance tests including documentation.
 7. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.
 8. Reporting procedures, including proposed reporting formats.
 9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of specifications can generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the Coordination meeting.
 10. Coordinate schedule work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections and Schedule of Special Inspections. Where the applicable Code issue by the International Code Council (ICC) calls

for inspections by the Building Official, the Contractor must include the inspections in the CQC Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors.

Include the Special Inspection Plan requirements in the CQC Plan.

- C. Acceptance of Plan: Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during construction. The Government reserves the right to require the Contractor to make changes in the CQC Plan and operations including removal of personnel as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC Plan, notify the Contracting Officer or Authorized designee in writing of any proposed change. Proposed changes are subject to acceptance by the Government prior to implementation by the Contractor.

3.3 COORDINATION MEETING:

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

3.4 QUALITY CONTROL ORGANIZATION:

- A. Personnel Requirements: The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager/Superintendent, The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and

responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer or Authorized designee. Provide adequate office space, filing systems, and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawings submittals, schedules, inspection documentation and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Government.

- B. CQC System Manager/Superintendent: Identify as CQC System Manager/Superintendent an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager/Superintendent is required to be a degreed engineer, degreed architect, or a degreed construction manager, with a minimum of 5 years of relevant construction experience on projects similar in size, scope and complexity of this Contract. This CQC System manager/Superintendent is on the site at all times during construction and is employed by the General Contractor. The CQC System Manger is assigned as CQC System Manager but has duties as project superintendent in addition to quality control. Identify in the plan an alternate to serve in the event of the CDQC System Manager's or Superintendent's absence. The requirements for the alternate are the same as the CQC System Manager/Superintendent.
- C. Additional Requirements: The CQC System Manager/Superintendent and Alternate CQC System Manager are required to have completed the Construction Quality Management (CQM) for Construction course. If the CQC System Manager does not have a current certification, 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 Contracting Officer or Authorized designee for information on the next scheduled class.
- D. Organizational Changes: Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise

the CQC Plan to reflect the changes and submit the changes to the Contracting Officer or Authorized designee for acceptance.

3.5 SUBMITTALS AND DELIVERABLES: Submittals have to comply with the requirements in Section 01 33 23 Shop Drawings, Product Data, and Samples. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL:

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

1. Preparatory Phase: This phase is performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes a preparatory meeting addressing the following:
 - a. A review of each paragraph of applicable specifications, references codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.
 - b. Review of the Contract drawings.
 - c. Check to assure that all materials and equipment have been tested, submitted, and approved.
 - d. Review of provisions that have been made to provide required control inspection and testing.
 - e. Review Special Inspections required by Section 01 45 35 Special Inspections, that Statement of Special Inspections and the Schedule of Specials Inspections.
 - f. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

- g. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
 - h. Review of the appropriate Activity Hazard Analysis (AHA) to assure safety requirements are met.
 - i. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards - contract defined or industry standard if not contract defined - for that feature of work.
 - j. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
 - k. Discussion of the initial control phase.
 - l. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the Preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the Preparatory phase actions by separate minutes prepared by the CQC System Manager/Superintendent and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.
- B. Initial Phase: This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:
- 1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the Preparatory meeting.
 - 2. Verify adequacy of controls to ensure full contract compliance. Verify the required control inspection and testing is in compliance with the contract.
 - 3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
 - 4. Resolve all differences.
 - 5. Check safety to include compliance with an upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

6. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the initial phase for definable features of work. Prepare separate minutes of this phase by the CQC System Manager/Superintendent and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with Follow-Up phases.
 7. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
 8. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections.
- C. Follow-Up Phase: Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements until the completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final Follow-Up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections
- D. Additional Preparatory and Initial Phases on the same definable features of work if: the quality ongoing work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

- A. Testing Procedure: Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government (48 hours minimum notice to be provided by government). Testing includes operation and acceptance test when specified. Procure the services of a Department of Veteran Affairs approved testing laboratory or establish an approved testing laboratory at the project

site. Perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.
 2. Verify that facilities and testing equipment are available and comply with testing standards.
 3. Check test instrument calibration data against certified standards.
 4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 5. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the unique sequential control number identifying the test. If approved by the Contracting Officer or Authorized designee, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer or Authorized designee. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.
- B. Testing Laboratories: All testing laboratories must be validated through the procedures contained in Specification section 01 45 29 Testing Laboratory Services.
1. Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt and steel is required to meet criteria detailed in ASTM D3740 and ASTM E329.
- C. Onsite Laboratory: The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

- A. Punch-Out Inspection: Conduct an inspection of the work by the CQC system Manager/Superintendent near the end of the work, or any increment of the work established by the specifications. Prepare and

include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final Inspection.

- B. Pre-Final Inspection: The Government will perform the Pre-Final Inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final Acceptance Inspection with the customer can be scheduled. Correct any items noted on the Pre-Final Inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph need to be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate construction completion dates.
- C. Final Acceptance Inspection: The Contractor's QC Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Authorized designee is required to be in attendance at the Final Acceptance Inspection. Additional Government personnel can also be in attendance. The Final Acceptance Inspection will be formally scheduled by the Contracting Officer's or Authorized designee based upon results of the Pre-Final Inspection. Notify the Contracting Officer through the Resident Engineer office at least 14 days prior to the Final Acceptance Inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date schedule for the Final Acceptance Inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with FAR Clause 52.246-12 titled "Inspection of Construction".

3.9 DOCUMENTATION

- A. Quality Control Activities: Maintain current records providing factual evidence that required QC activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:
1. The name and area of responsibility of the Contractor/Subcontractor
 2. Operating plant/equipment with hours worked, idle, or down for repair.
 3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
 4. Test and control activities performed with results and references to specification/drawing requirements. Identify the Control Phase (Preparatory, Initial, and/or Follow-Up). List deficiencies noted, along with corrective action.
 5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specification/drawing requirements.
 6. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.
 7. Offsite surveillance activities, including actions taken.
 8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
 9. Instructions given/received and conflicts in plans and specifications.
- B. Verification Statement: Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily within 1 week after the date covered by the report, except those reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit on report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only.

Reports need to be signed and dated by the CQC System Manager/Superintendent. Include copies of test reports and copies of reports prepared by all subordinate QC personnel within the CQC System Manager Report.

3.10 SAMPLE FORMS

Templates of various quality control reports can be found on the Whole Building Design Guide website at [https://www.wbdg.org/FFC/NAVGRAPH/01%2045%2000.00%2020 quality control reports.pdf](https://www.wbdg.org/FFC/NAVGRAPH/01%2045%2000.00%2020%20quality%20control%20reports.pdf)

- 3.11 NOTIFICATION OF NONCOMPLIANCE:** The Contracting Officer or Authorized designee will notify the Contractor in writing or via email, of any detected noncompliance with the foregoing requirements. The Contractor should take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site will be deemed sufficient for the purpose of notification. The contractor shall maintain a log of all noncompliance work. If the Contractor fails or refuses to comply promptly, the Contracting Officer can issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

END OF SECTION 01 45 00

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 02, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 02, 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):
- T27-11Sieve 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
- T99-10The 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
- T180-10Moisture-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):
- A325-10Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A370-12aDefinitions for Mechanical Testing of Steel Products
- A490-12Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
- C31/C31M-12Making and Curing Concrete Test Specimens in the Field

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| 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 |

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| 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 |
| D6938-17a | In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| 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):

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| D1.1-07 | Structural Welding Code-Steel |
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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 COR 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 COR 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 COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to COR and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory 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 COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 2. Provide part time observation of fill placement and compaction and field density testing in building areas and provide part 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 D1557 Method A.
2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 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 COR 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 feet) 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 COR. 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 COR.

3.2 LANDSCAPING

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

3.3 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
 - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
 - 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 ensure 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 stockpile 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.

3.4 SITE WORK CONCRETE

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

3.5 CONCRETE

- A. Batch Plant Inspection and Materials Testing:
 - 1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COR with concurrence of Contracting

Officer and perform periodic inspections thereafter as determined by COR.

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 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. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 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 COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.

19. Other inspections:

- a. Grouting under base plates.
- b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows: Compressive strength test 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 COR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.

- i. Ambient temperature when concrete sample in test cylinder was taken.
- j. Date delivered to laboratory and date tested.

3.6 REINFORCEMENT

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

3.7 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.

3.8 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.
 - i. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - c. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COR.

3.9 TYPE OF TEST

- A. Earthwork:
- 1. Laboratory Compaction Test, Soils: ASTM D1557, Method A
 - 2. Field Density, Soils ASTM D1556
- B. Landscaping:
- 1. Topsoil Test
- C. Aggregate Base:
- 1. Laboratory Compaction, ASTM D1557, Method D
 - 2. Field Density, ASTM D1556
 - 3. Aggregate, Base Course
 - 4. Gradation, AASHTO T27
 - 5. Wear, AASHTO T96
 - 6. Soundness, AASHTO T104
- D. Asphalt Concrete:
- 1. Field Density, ASTM D1188Aggregate, Asphalt Concrete Gradation: AASHTO T27.
 - 2. Wear, AASHTO T96
 - 3. Soundness, AASHTO T104

E. Concrete:

1. Making and Curing Concrete Test Cylinders, ASTM C31
2. Compressive Strength, Test Cylinders ASTM C39
3. Concrete Slump Test, ASTM C143
4. Concrete Air Content Test, ASTM C173
5. Aggregate, Normal Weight: Gradation, ASTM C33
6. Aggregate Deleterious Substances, ASTM C33
7. Soundness, ASTM C33
8. Abrasion, ASTM C33

F. Reinforcing Steel:

1. Tensile Test, ASTM A370
2. Bend Test, ASTM A370
3. Mechanical Splice, ASTM A370
4. Welded Splice Test, ASTM A370

G. Masonry:

1. Making and Curing, Test Cubes ASTM C109
2. Compressive Strength, Test Cubes ASTM C109
3. Sampling and Testing Mortar, Comp. Strength ASTM C780
4. Sampling and Testing Grout, Comp. Strength ASTM C1019
5. Masonry Unit, Compressive Strength ASTM C140
6. Prism Tests, ASTM C1314

H. Structural Steel:

1. Ultrasonic Testing of Welds, ASTM E164
2. Magnetic Particle Testing of Welds, ASTM E709

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BID DOCUMENT Submittal
National Cemetery Development
Cedar City Rural Initiative

Project No. 942CM3001
22 July 2022

SECTION 01 45 35
SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This guide specification will be applicable to both new buildings and existing building rehabilitations/renovations. In addition to the Special Inspection and testing specified requirements, a registered design professional must perform structural observations during construction. All observed deficiencies will be immediately reported to the Contracting Officer. The registered design professional performing these observations will be a representative of the Designer of Record (DOR) for the building being constructed.
- B. Structural observations are required for the following project conditions per IBC Chapter 17:
 - 1. Seismic Design Category D, E or F; and assigned to Risk Cat III, IV or V.
 - 2. Seismic Design Category D, E or F; and with a height greater than 22860 mm 75 ft.
 - 3. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two stories above grade plane.
 - 4. Nominal design wind speed in excess of 49 m/sec 110 mph; and assigned to Risk Cat III, IV or V.
 - 5. Nominal design wind speed in excess of 49 m/sec 110 mph; and with a height greater than 23 m 75 ft.
 - 6. Concrete constructions which utilize a compressive strength greater than 2500 psi.

1.2 APPLICABLE PUBLICATIONS

- A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7 - (2010; Errata 2011; Supp 2 2013) Minimum Design Loads for Buildings and Other Structures
- C. International Code Council (ICC)
 - 2. ICC IBC - (2015) International Building Code

1.3 GENERAL REQUIREMENTS

- A. Perform Special Inspections in accordance with Chapter 17 of ICC IBC. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the prime contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.
- B. Structural observations will be performed by the contractor.

1.4 DEFINITIONS

- A. Continuous Special Inspections - The constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.
- B. Periodic Special Inspections - Special Inspections by the special inspector who is intermittently present where the work to be inspected has been or is being performed.
- C. Observe - Observe these Special Inspections items on a random daily basis. Operations need not be delayed pending these inspections.
- D. Special Inspector (SI) - A qualified person retained by the contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.
- E. Associate Special Inspector (ASI) - A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.
- F. Third Party - A third party inspector must not be company employee of the Contractor or any Sub-Contractor performing the work to be inspected.
- G. Contracting Officer - The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).
- H. Contractor's Quality Control (QC) Manager - An individual retained by the prime contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the contractor's QC organization.

- I. Designer of Record (DOR) - A registered design professional is contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The DOR is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in state in which the design professional works. The DOR is also referred to as the Engineer of Record (EOR) in design code documents.

QUALIFICATIONS

| Area | Special Inspector | Associated Special Inspector | SIOR |
|-----------------------|---|--|------|
| Concrete Construction | ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or ACI Concrete Construction Special Inspector, or NICET Concrete Technician Level III Certificate in Construction Materials Testing, or, Registered Professional Engineer with related experience | ACI Concrete Construction Special Inspector in Training, or Engineer-In-Training with one year of related experience | |

PART 2 - EXECUTION

3.1 RESPONSIBILITIES MATRIX

| Inspector | Responsibility | Condition |
|------------|---|--------------------------------------|
| QC Manager | a. If there is no SIOR, QC Manager must Supervise all Special Inspectors required by the contract documents and the IBC; Verify the qualifications of all of the Special Inspectors; Verify the qualifications of fabricators; Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project | Applicable when SIOR is not required |

| Inspector | Responsibility | Condition |
|--------------------|--|--------------------------------------|
| | trailer/office to allow review by the Contracting Officer and the DOR. | |
| | b. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report. | n/a |
| Special Inspectors | a. Inspect all elements of the project for which the special inspector is qualified to inspect. b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect. | |
| | c. Submit a copy of the daily reports to the QC Manager. d. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report. e. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following: 1. A brief summary of the work performed during the reporting time frame 2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems that were observed during the reporting period. 3. Discrepancies which were resolved or corrected. 4. A list of nonconforming items requiring resolution. 5. All applicable test result including nondestructive testing reports. j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection. | Applicable when SIOR is not required |

| Inspector | Responsibility | Condition |
|-----------|-------------------------------------|----------------------------------|
| | k. Submit daily reports to the SIOR | Applicable when SIOR is required |

3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Government to accept such work.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely affect 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, APDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. 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>
 - 3. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 4. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
<http://www.epa.gov/ebtpages/airmobilesources.html>
 - 5. National Environmental Policy Act (NEPA) requirements for construction activities
 - 6. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: <http://endangered.fws.gov/>
 - 7. National Historic Preservation Act
- D. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. State Office/Department of Environmental Quality.
 - 2. Local Office/Department of Environmental Quality.
 - 3. The Construction Industry Compliance Assistance Center:
<http://www.cicacenter.org/index.cfm>

4. The national environmental compliance assistance clearinghouse:

<http://cfpub.epa.gov/clearinghouse/>

1.5 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 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 COR, 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, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the 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.

1.6 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 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.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
 - a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local 25-year storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, that drain from the surface of the basin.
 - b. Reuse or conserve the collected topsoil sediment as directed by the COR. Topsoil use and requirements are specified in Section 31 20 00, 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 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 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.
- 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.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 0800 a.m. and 0400 p.m. unless otherwise permitted by local ordinance or the 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 | BLASTING | //--// |
| 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 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 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. 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 (e.g., 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 (e.g., steel, wire, beverage containers, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (e.g., ABS, PVC).
 - 10. Carpet and/or pad.
 - 11. Gypsum board.
 - 12. Insulation.
 - 13. Paint.

1.2 RELATED WORK

- A. Section 02 41 10, DEMOLITION AND SITE CLEARING.
- B. Section 01 00 02, 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 COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
1. Procedures to be used for debris management.
 2. Techniques to be used to minimize waste generation.
 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
 4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - 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.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

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 02 41 10
DEMOLITION AND SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Safety Requirements: GENERAL REQUIREMENTS Article, PROJECT HEALTH AND SAFETY PLAN.
- B. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. 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 REQUIREMENTS Article, PROJECT HEALTH AND SAFETY PLAN.
- 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 02, GENERAL REQUIREMENTS, Article 1.10 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.
- E. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
1. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.
- F. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in

place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the COR. Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required.

- G. 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.
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.
- 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 SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.
- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 150 mm (6 inches). Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 25 mm (1 inch) in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

- a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Division 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. Removal of certain underground pipe or conduits may be indicated on drawings and is included under work of related division sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section.
- 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.
- B. 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.
- C. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.3 CLEAN-UP

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

END OF SECTION

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 curbing and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 inch and -3/4 inch.
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 inch and -1/2 inch where gross bar length is less than 12 feet, or +0 inch and -3/4 inch where gross bar length is 12 feet or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +3/4 inch and -1/4 inch. Tolerance of thickness of beams more than 12 inches but less than 3 feet is +3/4 inch and -3/8 inch.

1.4 REGULATORY REQUIREMENTS

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 - Standard Specifications for Structural Concrete.

(SHORT FORM) CAST-IN-PLACE CONCRETE

1.5 SUBMITTALS

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

B. Concrete Mix Design.

1. The proposed materials and mix design shall be fully documented and reviewed by an independent testing laboratory and submitted to the engineer of record for review a minimum of 15 days prior to use. Responsibility for obtaining the required design strength is the contractor's.

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.

1.6 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

(SHORT FORM) CAST-IN-PLACE CONCRETE

recommendations of the following, except as otherwise shown or specified.

B. American Concrete Institute (ACI):

117Specification for Tolerances for Concrete
Construction and Materials and Commentary

211.1Standard Practice for Selecting Proportions
for Normal, Heavyweight, and Mass Concrete

214RGuide to Evaluation of Strength Test
Results of Concrete

301Standard Specifications for Structural
Concrete

304RGuide for Measuring, Mixing, Transporting,
and Placing Concrete

305.1Specification for Hot Weather Concreting

306.1Standard Specification for Cold Weather
Concreting

308.1Specification for Curing Concrete

309RGuide for Consolidation of Concrete

SP-66ACI Detailing Manual

318Building Code Requirements for Structural
Concrete and Commentary

347RGuide to Formwork for Concrete

C. American National Standards Institute and American Hardboard
Association (ANSI/AHA):

A135.4Basic Hardboard

D. ASTM International (ASTM):

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| | |
|--------------------|---|
| A615/A615M | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| A1064/A1064M | Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. |
| C31/C31M | Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| C33/C33M | Standard Specification for Concrete Aggregates |
| C39/C39M | Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| C94/C94M | Standard Specification for Ready Mixed Concrete |
| C143/C143M | Standard Test Method for Slump of Hydraulic Cement Concrete |
| C150/C150M | Standard Specification for Portland Cement |
| C171 | Standard Specification for Sheet Materials for Curing Concrete |
| C172 | Standard Practice for Sampling Freshly Mixed Concrete |
| C173/C173M | Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method |
| C192/C192M | Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory |

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C231/C231MStandard Test Method for Air Content of
Freshly Mixed Concrete by the Pressure
Method

C260/C260MStandard Specification for Air-Entraining
Admixtures for Concrete

C494/C494MStandard Specification for Chemical
Admixtures for Concrete

C618Standard Specification for Coal Fly Ash and
Raw or Calcined Natural Pozzolan for Use in
Concrete

C666Standard Test Method for Resistance of
Concrete to Rapid Freezing and Thawing

C1107/C1107MStandard Specification for Packaged Dry,
Hydraulic-Cement Grout (Non-shrink)

C1315Standard Specification for Liquid Membrane-
Forming Compounds Having Special Properties
for Curing and Sealing Concrete

D1751Standard Specification for Preformed
Expansion Joint Filler for Concrete Paving
and Structural Construction (Nonextruding
and Resilient Bituminous Types)

E. Utah State Highway and Transportation Department:

1. Standard Specifications for Highway Construction, latest
Edition.

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood: free from loose knots and suitable to facilitate finishing
concrete surface specified; tongue and grooved.

(SHORT FORM) CAST-IN-PLACE CONCRETE

B. Plywood: (concrete form) 5/8-inch, or 3/4-inch thick for unlined contact form. B-B High Density Concrete Form Overlay optional.

C. Form Lining:

1. Hardboard: ANSI/AHA A135.4, Type 2, Grade 2-M-2, exterior bond not less than 3/16 inch thick.

2. Plywood: Grade B-B Exterior (concrete-form) not less than 1/4 inch thick.

3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.

D. 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 V or equivalent sulfate-resistant cement.

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 57. Size 467 may be used for footings and walls over 12 inches thick. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

D. Mixing Water: Fresh, clean, and potable.

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E. Air-Entraining Admixture: ASTM C260.

F. Chemical Admixtures: ASTM C494.

1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one-year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
7. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.

H. Welded Wire Fabric: ASTM A1064.

L. Expansion Joint Filler: ASTM D1751.

M. Sheet Materials for Curing Concrete: ASTM C171.

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- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. Liquid Curing & Sealing Compound: ASTM C1315, Type 1 (VOC compliant, 350 g/L) Styrene Acrylate or Methacrylate type 25% minimum solids content, clear, non-yellowing. Styrene Butadiene not allowed as part of the blend. Prior to turnover of project to owner, clean the slab-on-ground and concrete pavement and apply a second coat of the same curing compound to act as a sealer.
- Q. Grout, Non-Shrinking: ASTM C1107, 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 2500 psi at 3 days and minimum 5000 psi at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4-foot by 4-foot base plate. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 18-inch by 36-inch base plate.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified as set forth in Section 501 (as applicable) of the Utah Standard Specifications.
- B. Compressive strength at 28 days:
1. Foundations: Minimum 4500 psi.
 2. Slabs: Minimum 4500 psi.

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3. All Other Structural Concrete: Minimum 4500 psi. This applies to structural concrete only. For all site concrete (pedestrian/vehicular pavement, columbarium slab, monuments, flower watering station slab etc.) refer to Specification Section 32 05 23 - Cement and Concrete for Exterior Improvement.

- 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. One cylinder is tested at 7 days, 2 cylinders at 28 days and one specimen is held in reserve.
- D. Cement and water factors (See Table I): Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Fly ash may be substituted for up to 20 percent of the minimum cement factor at option of Contractor, except fly ash may not be used in concrete designated as architectural concrete. Water-cement ratios indicated in Section 501 (as applicable) of the Utah Standard Specifications for the class of concrete specified may be used instead of the values in Table I in accordance with local standards as determined by the COR.

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 |
| 35 (5000) ¹ | 375 (630) | 0.45 | 385 (650) | 0.40 |
| 32 (4500) ¹ | - | - | 365 (610) | 0.45 |
| 30 (4000) ¹ | 325 (550) | 0.55 | 340 (570) | 0.50 |
| 25 (3000) ¹ | 280 (470) | 0.65 | 290 (490) | 0.55 |
| 25 (3000) ¹ | 300 (500) | * | 310 (520) | * |

+Reference Construction Drawings for project specific compressive strength

1. If trial mixes are used, the proposed mix design must achieve a compressive strength 1200 psi in excess of f'c.

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

E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II, or in accordance with the provisions set forth in Section 501 of the Utah Standard Specifications.

TABLE II - MAXIMUM SLUMP, INCHES*

| Type of Construction | Normal Weight Concrete |
|--|------------------------|
| Reinforced Footings and Substructure Walls | 3 inches |
| Slabs, Beams, Reinforced Walls, and Building Columns | 4 inches |

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- * Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 9 inches. The concrete shall arrive at the job site at a slump of 2 inches to 3 inches, and 3 inches to 4 inches for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.
- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23. Air content shall conform to plans (see sheet S-001).
- G. Concrete slabs placed at air temperatures below 50 degrees Fahrenheit shall use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).
- H. Enforcing Strength Requirements: Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 500 psi below specified strength. Interpret field test results in accordance with ACI 214R. Should strengths shown by test specimens fall below required values, COR may require any one or any combination of the following corrective actions, at no additional cost to the Government:
 - 1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.

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2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values presented in paragraph 2.3 B, or if test results are so low as to raise a question as to the safety of the structure, COR may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in paragraph 2.3 B, COR may order load tests, made by Contractor-retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the COR.

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. Maximum delivery temperature of concrete is 100 degrees Fahrenheit. Minimum delivery temperature as follows:

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| Atmospheric Temperature | Minimum Concrete Temperature |
|------------------------------|------------------------------|
| 30.1 degrees to 40 degrees F | 60 degrees F. |
| 0 degrees to 30 degrees F. | 70 degrees F. |

3. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the COR for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise COR.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation shall conform to ACI 347R. Formwork shall be 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. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.
1. Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and COR approves their reuse.
 2. Provide forms for concrete footings unless COR determines forms are not necessary.

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3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.

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. Use sealer on reused plywood forms as specified for new material.

C. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 6 inches apart.

D. Lined Forms: May be used in lieu of unlined plywood forms. Back up form lining solidly with square-edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing may coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 8 inches on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.

E. 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. Properly brace the forms so the set concrete is correct within the allowable construction tolerances when the forms are removed.

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3. Upon removal of the forms, the professional surveyor must survey the placed concrete and provide information to the COR where the work is not in conformance with the Drawings, within the allowable construction tolerances. The work cannot progress until the exposed concrete for the foundations are brought into compliance.
4. Remedial work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the Contractor.
5. 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, shall be in accordance with ACI 318 and ACI SP-66, unless otherwise shown.

3.3 PLACING CONCRETE

- A. 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 5 feet in unexposed work nor more than 3 feet in exposed work. Place and consolidate concrete in horizontal layers not exceeding 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.

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- B. Hot weather placing of concrete: Follow recommendations of ACI 305.1 to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- C. Cold weather placing of concrete: Follow recommendations of ACI 306.1, to prevent freezing of thin sections less than 12 inches and to permit concrete to gain strength properly, except that use of calcium chloride is not permitted.

3.4 PROTECTION AND CURING

- A. Conform to ACI 308.1. Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by COR.
 - 1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 400 square feet per gallon on steel troweled surfaces and 300 square feet per gallon on floated or broomed surfaces for the curing/sealing compound.
 - 2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 2 inches. Tightly seal joints with tape.

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3. Paper: Utilize widest practical width paper and overlap adjacent sheets 2 inches. Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

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. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 1 inch. Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 6 inches surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force

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mortar through wall. Wipe excess mortar off exposed face with a cloth.

3.8 FINISHES

- A. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Provide information to COR and floor consultant for evaluation and recommendations for subsequent placements.
- B. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs-on-grade, wet screeds may be used to establish initial grade during strike-off, unless COR determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
- C. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
- D. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding

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- before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
- E. Immediately following screeding, and before any bleed water appears, use a 10 foot wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or a darby, except that darbying may be allowed for narrow slabs and restricted spaces.
- F. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 1/4-inch indentation.
- G. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 10-foot highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
- H. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by COR from sample panel (if applicable).

3.9 SURFACE TREATMENTS

- A. Mix and apply surface treatments in accordance with manufacturer's printed instructions.

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- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.

3.13 PRECAST CONCRETE ITEMS

- A. Cast precast concrete items, not specified elsewhere, using 4000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

END OF SECTION

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SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the performance criteria, materials, production, and erection of architectural precast concrete flower water station spigot post units. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the construction documents.

1.2 RELATED WORK:

- A. Concrete: Section 32 05 23, CEMENT CONCRETE FOR EXTERIOR IMPROVEMENTS.
B. Color and finish: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 QUALITY ASSURANCE:

- A. Fabricator Qualifications: A firm that complies with PCI MNL 117 and the following requirements and is experienced in producing units similar to those indicated for this Project and with a record of successful in-service performance:
1. Participates in PCI's Plant Certification program at the time of bidding and is designated a PCI-certified plant for Group A, Category AT- Miscellaneous Architectural Trim Units. Submit PCI certification.
 2. Fabricator must have a minimum of three (3) years' experience in Precast Architectural Concrete work comparable to that shown and specified in not less than three (3) projects of similar scope.
- B. Testing Laboratory Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority. Submit a copy of the Certificate of Accreditation and Scope of Accreditation.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01, GENERAL REQUIREMENTS.

1.4 SOURCE QUALITY CONTROL:

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements respectively.

- B. Testing: When determined by the COR that there is evidence that the concrete strength of precast concrete units may be deficient, the units must be replaced with new units.
- D. Defective or Damaged Work: Units that do not comply with acceptability requirements, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped or spalled units may be repaired if repaired units match the visual mock-up. The COR will reject units that do not match the accepted samples and visual mock-up. Remove unacceptable units from the site and replace with precast concrete units that comply with requirements.

1.5 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Design Mixes: For each concrete mix along with compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of units.
 - 1. Provide plans, elevations, dimensions, corner details, shapes and cross sections.
 - 2. Indicate aesthetic characteristics including joints, reveals, and extent and location of each surface finish.
 - 3. Indicate locations, tolerances and details of devices to be embedded in or attached to structure or other construction.
- D. Samples: Design reference samples for initial verification of design intent, approximately 4 inches x 4 inches representative of finishes, color, and textures of exposed surfaces of units.
- E. Qualification Data for fabricator: PCI Certification documentation.
- F. Testing laboratory accreditations.
- G. Material Test Reports: From an accredited testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Concrete strengths and mix designs.
- H. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
 - 1. Cementitious materials.
 - 2. Reinforcing materials.
 - 3. Admixtures.
- I. Certificate of Compliance.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Comply with product handling requirements of PCI MNL 117 at the plant and project site.
- B. Deliver all units to the project site in such quantities and at such times to assure compliance with the agreed project schedule and proper setting sequence to limit unloading units temporarily on the ground.
- E. Store units with adequate dunnage and protect units to prevent contact with soil to prevent staining, and to prevent cracking, distortion, warping, and other physical damage. Place stored units so identification marks are clearly visible for inspection.

1.7 WARRANTY:

- A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".

1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. ASTM International (ASTM):
 - A27/A27M-13Steel Castings, Carbon, for General Application
 - A108-13Steel Bar, Carbon and Alloy, Cold-Finished
 - A615/A615M-14Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - A706/A706M-14Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 - A775/A775M-07b(R2014) ..Epoxy-Coated Steel Reinforcing Bars
 - A884/A884M-14Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
 - A1064/A1064M-14Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - C33/C33M-13Concrete Aggregates
 - C40/C40M-11Organic Impurities in Fine Aggregate for Concrete
 - C150/C150M-12Portland Cement
 - C260/C260M-10aAir-Entraining Admixtures for Concrete
 - C373-14aTest Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
 - C494/C494M-13Chemical Admixtures for Concrete

- C618-12aCoal Fly Ash and Raw or Calcined Natural Pozzolan
for Use as a Mineral Admixture in Concrete
- C979/C979M-10Pigments for Integrally Colored Concrete
- C989/C989M-14Ground Granulated Blast-Furnace Slag for Use in
Concrete and Mortars
- E488/E488M-10Strength of Anchors in Concrete Elements
- F593-13aStainless Steel Bolts, Hex Cap Screws, and Studs
- C. American Concrete Institute (ACI):
- ACI 211.1-91(R2009)Selecting Proportions for Normal, Heavyweight and
Mass Concrete (Reapproved 2002)
- ACI 211.2-98(R2004)Selecting Proportions for Structural Lightweight
Concrete
- D. Precast/Prestressed Concrete Institute (PCI):
- Architectural Precast Concrete - Color and Texture Selection Guide
- MNL-117-96Quality Control for Plants and Production of
Architectural Precast Concrete Products
- MNL-120-10Design Handbook - Precast and Prestressed Concrete
- MNL-122-07Architectural Precast Concrete
- MNL-135-00Tolerance Manual for Precast and Prestressed
Concrete Construction

1.9 MANUFACTURING TOLERANCES

- A. Cross section dimensions shall not deviate by more than +/- 1/8 in. from approved dimension.
- B. Length of units shall not deviate by more than +/- 1/4 in.
- C. Warp bow or twist of units shall not exceed 1/8 in.
- D. Location of dowel holes, reveals, false joints and similar features - On all sides of unit, 1/16 in maximum deviation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS:

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes:
1. Mold-Release Agent: Commercially produced form-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.2 REINFORCING MATERIALS:

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 30 percent.
- C. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.
 - 1. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M.
- D. Epoxy-Coated-Steel Welded Wire Reinforcement: ASTM A884/A884M Class A coated, plain on flat sheet, Type 1 bendable coating.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 CONCRETE MATERIALS:

- A. Portland Cement: ASTM C150/C150M, Type I or III.
 - 1. For surfaces exposed to view in finished structure, use gray, same type, brand, and mill source throughout the precast concrete production.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Provide and stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for entire project.
 - 1. Core-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: Uniformly graded.
 - b. Hard durable quartz, granite or limestone aggregate carefully graded from coarse to fine.
 - c. Eliminate off color material from exposed aggregate.
 - 2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by COR.
- C. Admixtures: Admixtures containing calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture are not permitted.
 - 1. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading.

2. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
 3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 4. Retarding Admixture: ASTM C494/C494M, Type B.
 5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 6. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

2.4 COLOR AND FINISH

- A. Color and Finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. (0.8 mm) and the density of such voids shall be less than 3 occurrences per any 1 in² (25mm²) and not obvious under direct daylight illumination at a 5 ft. (1.5m) distance.
- C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3m) distance.
- D. ASTM D 2244 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.

2.5 STAINLESS-STEEL CONNECTION MATERIALS:

- A. Stainless-Steel Plate: ASTM A666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Screw: ASTM F593, alloy 304 or 316, torx head screws; and flat, stainless steel washers.

2.6 GROUT MATERIALS:

- A. Sand-Cement Grout: Portland Cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144, or ASTM C404. Mix at ratio of 1-part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Epoxy-resin grout: Two-component mineral-filled epoxy-resin: ASTM C881 of type, grade, and class to suit requirements.

2.7 STONE LIKE MATERIALS AND ACCESSORIES:

- A. Fabricate units in sizes, types and shapes to comply with requirements as indicated on contract documents.

1. Tolerance of length and width of +0, -3 mm (+0, -1/8 inch).
- B. Anchors: Stainless steel, ASTM A666, Type 304, of temper and diameter required to support loads without exceeding allowable design stresses.
- C. Sealant Filler: ASTM C920, low-modulus, multicomponent, non-sag polyurethane or silicone sealant that is non-staining to unit substrate.
- D. Epoxy Filler: ASTM C881/C881M, 100% solids, sand-filled non-shrinking, non-staining of type, class, and grade to suit application.
- E. Bond Breaker: Preformed, compressible, resilient, non-staining, non-waxing, closed-cell polyethylene foam pad, nonabsorbent to liquid and gas, 3 mm (1/8 inch) thick.

2.8 CONCRETE MIXES:

- A. Prepare design mixes to match COR's sample for each type of concrete required.
 1. Limit use of fly ash and granulated blast-furnace slag to 20 percent replacement of Portland cement by weight; metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Provide design mixes prepared by a qualified independent testing agency or by qualified precast plant personnel at fabricator's option.
- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318/318M or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- D. Normal Weight Concrete Face and Core Mixtures: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Release strength as required by design.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows.
- H. Total air content for various sizes of coarse aggregate for normal weight concrete.

| Nominal Maximum Size of Aggregate mm (inch) | Total Air Content, Percent, by Volume | |
|---|---------------------------------------|-------------------|
| | Severe Exposure | Moderate Exposure |

| | | |
|-------------------|-------|-------|
| Less than 9 (3/8) | 9 | 7 |
| 9 (3/8) | 7-1/2 | 6 |
| 13 (1/2) | 7 | 5-1/2 |
| 19 (3/4) | 6 | 5 |

H. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MOLD FABRICATION:

- A. Molds: Construct and maintain molds, mortar tight, within fabrication tolerances and sufficient strength to withstand pressures due to concrete-placement, vibration operations, and temperature changes.
1. Form joints are not acceptable on faces exposed to view in the finished work.
 2. Edge and Corner Treatment: Uniformly chamfered as detailed on drawings.

3.2 FABRICATION:

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Position anchors for attachment of loose hardware and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Provide cast-in reveals, slots, holes, and other accessories in units as indicated on contract documents.
- C. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
1. Place reinforcing steel to maintain at least 19 mm (3/4 inch) minimum concrete cover. Increase cover requirements for reinforcing steel to 38 mm (1-1/2 inches) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 2. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

4. Accurately position, support, and secure reinforcement against displacement during concrete- placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
- D. Mix concrete according to PCI MNL 117 and requirements in PART 2. After concrete batching, no additional water may be added.
 1. At the fabricator's option either of the following mix design/casting techniques may be used:
 - a. A single design mix throughout the entire thickness of unit.
- E. Place concrete in a continuous operation. Comply with requirements in PCI MNL 117.
- F. Cure concrete, according to requirements in PCI MNL 117.
- G. Repair damaged units to meet acceptability requirements of PCI MNL 117 and the COR.
- H. Reinforce architectural precast concrete units to resist handling, transportation and erection stresses, and specified in-place loads, whichever governs.
- I. Comply with requirements in PCI MNL 117 and requirements in this section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- J. Place face mixture to a minimum thickness after consolidation of the greater of 25 mm (1 inch) or 1.5 times the nominal maximum aggregate size, but not less than the minimum reinforcing cover of 3/4 inch.
 1. Use a single design mixture for those units in which more than one major face (edge) is exposed.
- K. Thoroughly consolidate placed concrete by internal or external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
 1. Place self-consolidating concrete without vibration in accordance with PCI TR-6.

3.3 FABRICATION TOLERANCES:

- A. Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
 1. Additional Position Tolerances: For cast-in items measured from datum line location, as indicated on shop drawings.

- a. Location of architectural reveals: Plus or Minus 1/16 inch.
- b. Position of Sleeves: Plus or Minus 1/16 inch.
- B. Fabricate architectural details with tolerances meeting PCI MNL 135.

3.4 FINISHES:

- A. Provide exposed unit faces free of joint marks, grain, and other obvious defects. Corners, including false joints to be uniform, straight and sharp. Finish exposed-face surfaces of units to match approved design drawings and as follows:
 - 1. PCI's "Architectural Precast Concrete -Color and Texture Selection Guide,".
 - 2. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections and insulation from acid attack.
- B. Finish exposed top and all side surfaces of units to match face-surface finish.

3.5 INSTALLATION PREPARATION:

- A. Deliver anchorage devices that are embedded in or attached to the foundation before start of such work.
- B. Examine supporting foundation/soils and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install units until supporting structure/soils are structurally ready to receive loads from precast.

3.6 ERECTION:

- A. Erect units level, plumb and square within the specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
- B. Sealing of Joints: Where shown and where required to make work watertight: clean, dry and seal joints between precast concrete elements and between precast elements and adjoining materials.

3.7 ERECTION TOLERANCES:

- A. Erect units level, plumb, square, true, and in alignment without exceeding the erection tolerances of 1/8".

3.8 FIELD QUALITY CONTROL:

- A. As directed by COR, repair, or remove and replace work that does not comply with specified requirements.

3.9 REPAIRS:

- A. When permitted by COR, repair damaged units.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 2 feet.
- C. Remove and replace damaged units when repairs do not meet requirements.
- D. Repair damaged units to meet acceptability of PCI MNL 117.
- E. Wire brush, clean, and paint damaged prime painted components with the same type of shop primer.

3.13 CLEANING:

- A. Clean surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean any other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

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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. Install sand and/or backfill on top of crypts
9. Compact fill materials
10. Topsoil
11. Provide additional Materials:
 - a. Three (3) OSHA-approved crypt lid-lifting apparatuses
 - 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.
12. 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: Section 31 20 00, EARTH MOVING.
- B. Materials Testing and Inspection during Fabrication and Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.4 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 ensure 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.

1.5 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 COR.
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 Contracting Officer's Representative COR 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) with removable anchor covers to prevent dirt from entering the anchor bowl and installed in such a manner as to stay in-place when excavating equipment is scraping backfill off the top of the.
 - 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.

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 COR 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, caps, 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 COR 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 COR 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 COR 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 COR 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 318-05Building Code Requirements for Structural Concrete
- D. American Society for Testing and Materials (ASTM):
A36/A36M-12Standard Specification for Carbon Structural Steel.
A153/A153M-09Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
A615/A615M-13Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A1064/A1064M-13Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
C31/C31M-12Standard Practice for Making and Curing Concrete Test Specimens in the Field.
C33/C33M-13Standard Specification for Concrete Aggregates

C39/C39M-14Standard Test Method for Compressive Strength
of Cylindrical Concrete Specimen

C78/C78M-10e1Standard Test Method for Flexural Strength for
Concrete (Using Simple Beam with Third-Point
Loading)

C150/C150M-12Standard Specification for Portland Cement.

C172/C172M-14Standard Practice for Sampling Freshly Mixed
Concrete.

C260/C260M-10aStandard Specification for Air-Training
Admixtures for Concrete.

C494/C494M-13Standard Specification for Chemical Admixtures
for Concrete

C595/C595-13Standard Specification for Blended Hydraulic
Cement.

C1017/C1017M-13Standard Specification for Chemical Admixtures
for Use in Producing Flowing Concrete.

C1116/C1116M-10aStandard Specification for Fiber-Reinforced
Concrete.

C1157/C1157M-11Standard Performance Specification for
Hydraulic Cement

C1399/C1399M-10Standard Test Methods for Obtaining Residual-
Strength of Fiber-Reinforced Concrete.

C1602/C1602M-12Standard 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 C494

- 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 thiocyanates 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, color black, 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 6 mm (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.
 - c. A removable plastic cap secured to the anchor which prevents fill material from entering the anchor bowl. Cap to be flush mounted to ensure the entire assembly is not an obstruction for crypt excavating equipment.
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 COR.

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 COR 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 COR.
 - a. The COR 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 COR.

3.2 GENERAL LAYOUT CONTROL

- A. A professional registered Land Surveyor 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 COR 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 COR 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 COR inspector and numbering. Numbers furnished by NCA shall be painted on the outside of the crypt lids and 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 COR 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 the NCA Inspector.
- C. Proposed repair work shall be sound, permanent, and flush with adjacent surfaces and submitted for approval by the 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 as installed. Provide a sufficient number of survey points for the government to verify. Additional survey points maybe requested by the government at no additional cost.
 - a. At the design locations
 - b. Properly aligned
 - c. At correct elevations and slopes
- B. The following documents shall be provided to the COR:
 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 COR will approve the Contractor proceeding with the backfill between the crypts. The Contractor is responsible for ensuring 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, ensuring 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.
 - a. At COR's discretion, a non-rounded stone may be considered as a substitute for the rounded stone. The COR may accept the (non-rounded) stone only following demonstration, through an approved submittal process, that rounded stone is not available for less than 4 times the cost of a cut/crushed angular (non-rounded) aggregate substitute. Largest size for the non-rounded stones shall not exceed the gradation size for the rounded stones. (A smaller gradation size will be required for the non-rounded stones to ensure that the stones are not larger than their rounded counterparts.) The non-rounded stone shall only be considered when with the largest size of the stone passing a sieve size does not exceed the allowable stone size for the rounded stone gradations. The non-rounded stone may be approved when the size is as described above, and with a successful demonstration that filling gaps between crypts leaves no voids, because the stones fall into place without bridging as should occur when using rounded stones.
 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 50 mm (2 inches) of identification sand, soil to specified level, and 100 mm (4 inches) minimum of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% density (Standard Proctor (AASHTO T-99)).
- H. Install drainage board for pea gravel flow containment located in perimeter crypt gaps in areas shown on Drawings.
1. Drainage board shall be installed at the perimeter of crypt field in locations where standard or oversize traditional gravesite burial spaces are identified on the drawings and other areas so designated.
 2. Drainage board shall be as appropriate to fill gap and stop pea gravel flow, and provide for drainage rates of 1000 L/hr/m (100 gal/hr/lf) in any direction.
 3. The drainage board shall be made of "non-deteriorating" recycled materials and be able to be compressed and return to its original thickness.
 4. Drainage board shall contain pea gravel between Crypts. Attach board to Crypt wall exterior with fastening method approved during functional load testing. Ensure board material re-expands to original thickness if compressed. Drainage board shall be installed from bottom of Crypt to bottom of lid. Exterior edge of board shall be inset at least 50 mm (2 inches) from edge of crypt and extend 600 mm (2 feet) in between Crypts.
- 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 feet) 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 COR 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 COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance will be by COR 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.

END OF SECTION

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, (SHORT-FORM) CAST-IN-PLACE CONCRETE
- C. Section 04 72 10, STONE MASONRY
- D. Section 07 92 00, JOINT SEALANTS
- 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 precast concrete supplier and 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 COR.
- 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 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 COR 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 COR, 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 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 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: 1/8"
 - 2. Variation in overall dimensions of precast element (height and width): 1/8"
 - 3. Maximum differential between adjacent units in erected position: 1/8"
 - 4. Variation in thickness of precast panels and elements: 1/8"
 - 5. Maximum vertical differential between adjacent columbarium units in installed position: 1/8"

1.6 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. Planimetric 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 COR, or adjustments made to the foundations that are acceptable to the 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.

1.7 DELIVERY, STORAGE

- A. Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked with 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.

1.8 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.

1.9 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 the guarantee period is one year.

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. Federal Specifications (Fed. Spec.):
 - QQ-S-766C (5)Steel Plates, Sheets, and Strip-Corrosion Resisting
 - QQ-W-423BWire, Steel, Corrosive-Resisting
 - TT-S-00227E (3)Sealing Compound Elastomeric Type, Multi-Component (For Caulking, Sealing)

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-70Fabrication, Handling and Erection of Precast
Concrete.

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

A36/A36M-08Structural Steel

ASTM A276-13Stainless Steel Bars and Shapes

A615/A615M-12Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement.

A1064/A1064M-13Standard Specifications for Carbon-Steel Wire
and Welded Wire Reinforcement.

C33/C33M-12Concrete Aggregates

C150/C150M-12Portland Cement

E. American Welding Society (AWS) Publications:

AWS D1.1/D1.1M-12(e11) .Structural Welding Code

AWS D1.4/D1.4M-11Welding 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, 0.100 inch thick.
- b. Die stamp, producing an eight-petal flower pattern as shown on drawings, one-inch diameter with slight convex; center hole of 0.218", concentric to outer edge, with shoulder recess of 0.400" in diameter and 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

- A. Type and material recommended by sealant manufacturer.

2.14 SEALING COMPOUND

- 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 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, 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.

- a. Back side of single columbarium units, with back exposed to view shall have surface finish as indicated on the drawings.
 - b. Specified surface finish for the exposed back of the columbarium units shall be applied during the appropriate time of fabrication and curing. Seal coating of exposed back of units shall be applied as per manufacturer's recommendations.
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.

2.16 STAIN AND FINISH OF EXPOSED EDGES

- A. Finish for all exposed faces and edges of columbarium units shall be coated with a color coat suitable for cured concrete, which has been used successfully on at least one columbarium project for a National Veteran Cemetery. Color and texture to be approved by designer prior to application of coating. Manufacturer's literature and color charts shall be submitted as part of the submittal process as well as the listing of previous project.

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.
- C. Refer to the drawings, if any, regarding the critical element relationships to be used during the creation of the foundations and setting of the precast units.
- D. 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 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 COR. 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.

3.6 FINISHING OF EXPOSED FACES

- A. Apply coating to complete, cleaned exposed concrete back and sides as per manufacturer's standard specifications and recommendations.

3.7 INSTALLATION OF NICHE COVERS

- A. Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers. Due to the manufacturing tolerances in the niche covers and the allowable deviations from the nominal dimensions, it will be impossible to install the niche covers perfectly. Coordinate the installation procedures with the COR and establish the critical visual line for which the best alignment is to be established.

END OF SECTION

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SECTION 03 48 26
CONCRETE MEMORIAL WALL UNITS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. 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.

1.1 DESCRIPTION

- A. This section covers the manufacture and installation of precast concrete memorial wall units, as shown on the plans and specified herein, including, but not limited to, the applicable steel reinforcement, steel embedment plates, pins, required sleeves, and fasteners.

1.2 RELATED WORK

- A. Cast-in-place concrete work: Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- B. Workmanship for sealant application: Section 07 92 00, JOINT SEALANTS.
- C. Memorial Wall Cap: Section 04 72 10, STONE MASONRY.
- D. Installation of memorial wall markers: Section 04 73 10, MEMORIAL WALL MARKERS.

1.3 MANUFACTURER / INSTALLER QUALIFICATIONS

- A. Precast concrete memorial wall units shall be product of manufacturer/installer who has a minimum of 3 years' experience in fabrication and installation of precast concrete units similar in material, design features, manufacturing tolerances and product quality, to the extent indicated on the drawings and specified herein.

1.4 ALLOWABLE TOLERANCES

- A. Manufacturing and installation tolerances shall be as follows:
1. Variation of location for the anchors and fasteners for memorial marker attachment brackets from the dimensions specified - within 1200 microns (3/16")
 2. Variation in overall dimensions of precast element (height and width and depth inside and outside) - 3 mm (1/8 inch)
 3. Variation in thickness of walls of precast units - 3 mm (1/8 inch)
 4. Maximum vertical and horizontal differential between adjacent units in installed position - 3 mm (1/8 inch)

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.

1.6 SUBMITTALS

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

1. Samples: Submit sample of all fastening systems and mounting hardware including, but not limited to, the following:
 - a. Stainless Steel Angle (rosette plates of varying sizes depending on position of Government provided marble wall markers on memorial wall- see drawings).
 - b. Stainless Steel Bolt and Washers
 - c. Stainless Steel Spring Plate
 - d. Tamperproof Stainless Steel Bolt
 - e. Stainless Steel Rosette
 - f. Stainless Steel Expansion Anchors and Bolts
2. Shop Drawings: Complete fabrication and installation drawings of all precast concrete memorial wall units, showing all dimensions, sizes of units, and details of construction, installation and relation to adjoining work, joint locations and details, reinforcements, anchorage, attachments, inserts, location of all predrilled sleeves (see paragraph "Fabrication" in Part 2) and other trades, joint treatment, finishes, and other work required for a complete installation.
3. Manufacturer's Literature and Data:
 - a. Each type of fastener or anchorage

- b. Instructions for final cleaning
- c. Coating and/or sealers
- 4. Certificates:
 - a. Manufacturers qualifications specifying precast concrete memorial wall units meet the requirements of ACI 533.3R as specified.
 - B. Installers qualification.

1.7 DELIVERY, STORAGE

- A. Ship precast concrete memorial wall units to site with adequate protection to prevent chipping, breaking and other damage. Provide lifting devices that will allow the units to be set without the use of lifting straps that wrap around the unit. Materials shall be marked giving proper identification and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

- A. Coordinate the manufacture and installation of precast concrete memorial wall units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete memorial wall 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 memorial wall unit work.

1.10 GUARANTEE

- A. Guarantee precast concrete memorial wall 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, for a period of not less than one year.

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. Federal Specifications (Fed.Spec.):
 - QQ-S-766C (5)Steel Plates, Sheets, and Strip-Corrosion Resisting
 - QQ-W-423BWire, Steel, Corrosive-Resisting
- C. American Concrete Institute (ACI) Publications:

ACI 533.3R-70Fabrication, Handling And Erection of Precast
Concrete.

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

A36/A36M-12Structural steel.

A82/A82M-07Steel Wire, Plain, for Concrete Reinforcement

A185/A185M-07Welded Steel Wire Fabric for Concrete
Reinforcement.

A615/A615M-12Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement.

C33/C33M-13Concrete aggregates.

C 150/C150M-12Portland Cement.

E. American Welding Society (AWS) Publications:

AWS D1.1/D1.1M-10Structural Welding Code

AWS D1.4/D1.4M-11Welding Reinforcing Steel

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE

A. Hard durable aggregate carefully graded from coarse to fine in
proportions required to match approved samples.

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

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

2.3 PORTLAND CEMENT

A. ASTM C150, Type I and Type III; Color as required to match existing.

2.4 WATER

A. Water shall be clean, fresh and potable.

2.5 STRUCTURAL STEEL

A. ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

A. ASTM A185, galvanized.

2.7 STEEL WIRE REINFORCEMENT

A. ASTM A82, cold drawn.

2.8 REINFORCING STEEL

A. ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS STAINLESS STEEL ITEMS

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

2.10 BACK-UP MATERIAL

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

2.11 BOND BREAKERS

- A. Type and material recommended by sealant manufacturer.

2.12 SEALING COMPOUND

- A. Fed. Spec. TT-S-00230 C, Type 11, Class A, or ASTM C 920-87, Type S, Grade NS, Class 25.

2.13 ROSETTES

- A. To be produced from sheet goods like or similar to #316 stainless steel as manufactured by Aeon Manufacturing Co. Inc., Harbor City, CA. Thickness to be 2.5 mm (0.100 inch). Die stamp, producing an eight-petal flower pattern. Luster finish. 25 mm (1") in 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 1 mm (0.035") in depth. Rosettes shall match existing in place at the site in color, finish and design.

2.14 NATURAL STONE CAPS

- A. Natural Stone Caps shall meet the requirements of Section 04 43 00 NATURAL STONE VENEER for the type of stone identified in the drawings.

2.15 DECORATIVE GRAVEL

- A. See Section 32 90 00, PLANTING.

2.16 CONCRETE FOOTINGS

- A. See Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE-CONCRETE

2.17 PRECAST FABRICATION

- A. Memorial wall units shall be of size and form as indicated on the plans.
- B. Concrete for precast memorial wall units shall have minimum compressive strength of 35 MPa (5,000 psi) at 28 days.
- C. Provide additional steel reinforcing as required for casting, handling and erection loads.
- D. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
- E. Precast memorial wall 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, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.

b. All fastener location holes, including those for anchoring of units and attachment of memorial wall markers, shall be field drilled for anchor bolts.

F. 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.

G. Architectural Finish: Exposed faces shall have smooth finish, rubbed with a fine abrasive or stone hone to create a cast stone like finish, uniformly smooth. Use ample water during rubbing to prevent working up a lather of mortar or changing texture of concrete. There shall be no air bubble marks or other such imperfections visible on the surface.

H. 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 CONCRETE FOOTINGS

A. Place concrete footings per lines and grades indicated on the drawings and in accordance with Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.

3.2 HANDLING AND INSTALLATION

A. Before beginning installation, inspect work of other trades insofar as it affects the work of this Section. Commencing installation of precast concrete memorial wall units will be construed as acceptance, as suitable, of such work of other trades. Precast Memorial wall 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 memorial wall units against staining and

other damage. Reinstall, realign and otherwise correct improperly installed units.

1. Accurately place and securely anchor precast concrete memorial wall units to adjoining construction in accordance with approved shop and installation drawings.

3.3 SETTING

- A. Concrete footings (pads) for memorial wall(s) shall be constructed to meet all structural requirements to meet local soil and climate conditions and the weight and dimensions of the memorial wall(s) being supported by the respective footing.
- B. Joints shall be filled with sealant. Surfaces and other joints for precast concrete memorial wall units shall be cleaned of all dust, dirt and other foreign matter. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealant shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances that are likely to cause staining shall be removed from joints. Where two units are butted together, alignment shall be precise so that a smooth continuous line is produced.
- C. Natural Stone caps shall be installed on top of the memorial wall(s). A urethane caulking adhesive shall be in place prior to setting the capping. Two (2) anchor pins shall be placed between the concrete core for the wall and the caps to secure the caps on top of the wall. The cap lengths shall be such that the joints between the caps align with the memorial wall markers as indicated on the drawings. The cap installation shall follow the details on the drawings.
- D. Place decorative gravel to the line and grade as indicated on the drawings. See Section 32 90 00, PLANTING.

3.4 SEALING OF JOINTS

- A. Where shown and where required for either the precast or cast-in-place installation, to make the work watertight furnish and install backer rod and sealant in the joints where indicated on the drawings. Joints shall be cleaned and primed with manufacturer recommended primer, and the joints shall have backer rod installed as recommended by the manufacturer, with the recommended width to depth ratio according to the 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.

- B. Workmanship shall be in accordance with Section 07 92 00, JOINT SEALANTS.

3.5 CLEANING

- A. After installation is complete, clean precast memorial wall units using materials, equipment and methods recommended by manufacturer.

3.6 REPLACEMENT AND REPAIR

- A. Precast concrete memorial wall units that 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 COR. Repaired work shall be sound, permanent, and 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 OF SECTION

SECTION 04 05 13
MASONRY MORTARING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies mortar materials and mixes.

1.2 RELATED WORK

- A. Mortar used in Section:
1. Section 04 43 00, NATURAL STONE VENEER.
 2. Section 04 72 10, STONE MASONRY.
 3. Section 04 20 00, UNIT MASONRY.
 4. Section 04 05 16, MASONRY GROUTING

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

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

1.4 TESTS

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

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Certificates:
1. Indicating that the following items meet specifications:

- a. Portland cement.
 - b. Masonry cement.
 - c. Mortar cement.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - f. Color admixture (if required to match existing finish).
- 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) latest version:
 - C40.....Organic Impurities in Fine Aggregates for
Concrete
 - C91.....Masonry Cement
 - C109.....Compressive Strength of Hydraulic Cement Mortars
(Using 2-in. or 50-MM Cube Specimens)
 - C144.....Aggregate for Masonry Mortar
 - C150.....Portland Cement
 - C207.....Hydrated Lime for Masonry Purposes
 - C270.....Mortar for Unit Masonry
 - C595.....Blended Hydraulic Cement
 - C780.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
 - C979.....Pigments for Integrally Colored Concrete

C1329.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

- A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

- A. ASTM C144 and as follows:
 - 1. Light colored sand for mortar for laying stone veneer.
- 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

- A. ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

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

2.5 MORTAR CEMENT

- A. ASTM C1329, Type S or M.

2.6 PORTLAND CEMENT

- A. ASTM C150, Type I.

2.7 LIQUID ACRYLIC RESIN

- A. 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

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

2.9 MASONRY MORTAR

- A. Conform to ASTM C270.
- B. Admixtures:
 - 1. Do not use mortar admixtures, except color admixtures if approved by COR.
 - 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 mortar on the existing columbarium wall.

D. Color Admixtures:

1. Proportion as specified by manufacturer.

2.10 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.
- D. Mortar that has stiffened because of loss of water through evaporations:
 1. Re-temper by adding water to restore to proper consistency and workability.
 2. Discard mortar that has reached its initial set or has not been used within two hours.

3.2 MORTAR USE LOCATION

- A. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered)
- B. For stone veneer use Type M portland cement-lime mortar or Type S masonry cement or mortar cement mortar.

END OF SECTION

SECTION 04 05 16
MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies grout materials and mixes.

1.2 RELATED WORK

- A. Grout used in Section:
1. Section 04 20 00, UNIT MASONRY.

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 COR.
D. Testing:
1. Grout:
a. Test for compressive strength; ASTM C1019.
b. Grout compressive strength of 2000 psi at 28 days.
2. Cement:
a. Test for water soluble alkali (non-staining) when non-staining cement is specified.
b. Non-staining cement shall contain no 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).
f. Coarse aggregate for grout.
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. Comply with the latest edition of all referenced publications unless otherwise specified.

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

C40Organic Impurities in Fine Aggregates for
Concrete

C91Masonry Cement

C150Portland Cement

C207Hydrated Lime for Masonry Purposes

C404Aggregate for Masonry Grout

C476Grout for Masonry

C595Blended Hydraulic Cement

C979Pigments for Integrally Colored Concrete

C1019Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME

A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT

A. 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.

B. Use white masonry cement whenever white mortar is specified.

2.5 PORTLAND CEMENT

A. ASTM C150, Type I.

B. Use white Portland cement wherever white mortar is specified.

2.6 LIQUID ACRYLIC RESIN

A. 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

A. 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.
- d. Coarse aggregate: one to two 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 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 2 inches.
- C. Do not use grout for filling bond beam or lintel units.

END OF SECTION

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. Sealants and Sealant Installation: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Concrete masonry units.
 - 2. Joint reinforcing 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. Reinforcement.
 - 2. Shear keys.
 - 3. Reinforcing bars.

1.4 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.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
- A615/A615MDeformed and Plain Carbon-Steel Bars for
Concrete Reinforcement
 - A675/A675MSteel Bars, Carbon, Hot-Wrought, Special
Quality, Mechanical Properties
 - A951/A951MSteel Wire for Masonry Joint Reinforcement
 - C67Sampling and Testing Brick and Structural Clay
Tile
 - C90Load bearing Concrete Masonry Units
 - C216Facing Brick (Solid Masonry Units Made From
Clay or Shale)
 - C476Grout for Masonry
 - C612Mineral Fiber Block and Board Thermal
Insulation
 - D1056Flexible Cellular Materials - Sponge or
Expanded Rubber
- C. American Welding Society (AWS):
- D1.4/D1.4MStructural Welding Code - Reinforcing Steel
- D. Brick Industry Association - Technical Notes on Brick Construction (BIA):
- 11-2001Brick Masonry, Part I
 - 11A-1988Brick Masonry, Part II
 - 11B-1988Brick Masonry, Part III Execution
 - 11C-1998for Brick Masonry Engineered Brick Masonry,
Part IV

11D-1988Brick Masonry Engineered Brick Masonry, Part IV
continued

11E-1991Brick Masonry, Part V

E. Masonry Industry Council:

Hot and Cold Weather Masonry Construction Manual

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

G. American Concrete Institute (ACI):

SP-66ACI Detailing Manual

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

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.

1. Unit Weight: lightweight.

2. Sizes: Modular. To match existing Committal Shelter

2.2 REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615, deformed bars, Grade 60 for bars No. 3 to No. 18, except as otherwise indicated.

B. Where 1/4 inch diameter (No. 2) bars are shown, provide plain, round, carbon steel bars, ASTM A675, 550 MPa (Grade 80).

C. Joint Reinforcement:

1. Form from wire complying with ASTM A951.

2. Galvanized after fabrication.

3. Width of joint reinforcement 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 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 16 inches to longitudinal wires.
9. Truss Design:
 - a. Longitudinal wires deformed 0.16-inch diameter wire.
 - b. Cross wires 0.16-inch diameter.

2.4 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.

2.5 ACCESSORIES

- A. 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.
- B. Masonry Cleaner:
 1. Detergent type cleaner selected for each type of masonry used.
 2. Acid cleaners are not acceptable.
 3. Use soapless 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 10 feet - 1/4 inch.
 - 2. In 20 feet - 3/8 inch.
- C. Maximum variation from level:
 - 1. In any bay or up to 20 feet - 6 mm 1/4 inch.
 - 2. In 40 feet or more - 1/2 inch.
- D. Maximum variation from linear building lines:
 - 1. In any bay or up to 20 feet - 1/2 inch.
 - 2. In 40 feet or more - 3/4 inch.
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
 - 1. Minus 1/4 inch.
 - 2. Plus 1/2 inch.
- F. Maximum variation in prepared opening dimensions:
 - 1. Accurate to minus 0 inch.
 - 2. Plus 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. Tooling Joints:
 - 1. Do not tool until mortar has stiffened enough to retain thumbprint 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.
- D. Lintels:
 - 1. Lintels are not required for openings less than 3 feet 4 inches wide that have hollow metal frames.

2. Openings 2 feet 0 inches wide to 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-#5 rod top and bottom for each 4 inches of nominal thickness unless shown otherwise.
3. Use steel lintels, for openings over 5 feet 4 inches wide, and brick masonry unless shown otherwise.
4. Provide length for minimum bearing of 4 inches at ends.
- E. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- F. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- G. Wetting and Wetting Test:
 1. Test and wet brick in accordance with BIA 11B.
 2. Do not wet concrete masonry units before laying.

3.4 REINFORCEMENT

- A. Joint Reinforcement:
 1. Use as joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
- 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.

3.5 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.

3.6 CONCRETE MASONRY UNITS

A. Kind and Uses:

1. Provide special concrete masonry shapes as required, including lintel and bond beam 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 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 a 1/4 inch open joint an open joint as indicated in the drawings for caulking between exterior walls, 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 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.

3.7 GROUTING

A. Preparation:

Unit Masonry

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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 1-1/2 inch below top of last masonry course.

3.8 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 1 inch, whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the 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 5/8 inch on exterior face of walls and 1/2 inch at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8 inches on exterior face of walls and 1/2 inch at other locations. Lap joint reinforcement not less than 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.

3.9 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 3/4 inches 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.

END OF SECTION

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SECTION 04 43 00
NATURAL STONE VENEER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies requirements for construction of natural stone masonry veneer for the following work:

1. Stone masonry veneer for exterior stone walls and columns.

1.2 RELATED WORK

- A. Cast-in-place concrete columbarium and memorial wall complexes:
Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Precast Memorial Wall Units: Section 03 48 26, CONCRETE MEMORIAL WALL UNITS.
- D. Mortars: Section 04 05 13, MASONRY MORTARING.
- E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

1.3 QUALITY ASSURANCE

- A. Installer shall have demonstrated successful experience in construction of concrete walls with stone masonry veneer of similar size and type.
- B. Mortar type and color, and stone type, size and color range shall match the stone installed on the existing stone walls and columns at the cemetery as determined by the COR.
- C. Workmanship, including masonry mortar work, shall match existing stone walls and columns as determined by the COR.
- D. Field Construction Mock-Up:
1. Before starting stone masonry work, lay up a sample panel in accordance with recommendations of the referenced Masonry Standards Joint Committee (MSJC) publication. Use stones from random loads of units delivered to the site. Include anchors. Show color range, bond, mortar joints, exposed surface condition, and workmanship.
 2. Do not begin stone masonry construction until the COR accepts the mock-up. The standard for stone masonry work is established by the accepted mock-up

1.4 SUBMITTALS

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

1. Submit four stone samples, minimum 3 inches by 4 inches in size, illustrating general color range and texture.
2. Submit mortar color samples.
3. Anchors and ties, one each, and joint reinforcing 1200 mm (48 inches) long.

C. Certificates

1. Certificates signed by suppliers of specified products, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
2. Certificates shall indicate that the stone supplied for the project meet specified rock type.

D. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.

1.5 MOCKUPS

- A. Provide a full-scale mockup for each natural stone veneer type. Mockups shall represent the full range of colors, textures, cuts, finishes, grout color & texture, and setting methods for all stonework.
- B. Mockups shall be erected in location and orientation approved by the COR and shall be erected by the same team that will install stonework for the project.
- C. Sizes of mockups shall be approved in advance by the COR through the shop drawing process.
- D. In situ mockups of natural stone veneer are expressly prohibited.
- E. Completed mockups shall be inspected and approved by the COR before installation of any stonework.
- F. Approved mockups shall become the standard of workmanship and appearance for the project. All stone installed for this project shall especially match the appearance of approved mockups for stone quality, texture, color, grout, and the frequency and appearance of any blemishes, including but not limited to: color streaks, texture streaks, spots, fossil formations, pit holes, reedy formations, honeycomb, travertine-like formations, and grain formation variations.
- G. Any piece of stone that does not (as determined by the COR) match in appearance the stone used in an approved mockup shall be considered automatically rejected by VA and shall be immediately removed from the

project site and replaced by the Contractor at no cost to the Government.

- H. Mockups shall be complete in all respects and shall represent the final complete assembly for all conditions of stone placement abutting other surfaces. Mockups shall demonstrate reinforcing, ties, anchors, grout, jointing, termination of stone against caps in horizontal surfaces, termination of veneer on corners of piers and columns, termination of veneer against vertical concrete (whether precast or cast-in-place), and termination against filler strips.
- I. Use mockups to test cleaning methods.
- J. Where review of mockups may require revisions of designs or construction techniques, the COR will provide such revisions in writing. Such revisions will be completed and final approval of all aspects of the mockup shall be achieved prior to stone work beginning for the finished project.
- K. Do not install mockup components or materials in the completed project.
- L. Mockups shall remain in place until the project is complete and accepted by VA after final inspection. Afterward, remove and dispose of mockups.

1.6 WARRANTY

- A. Warrant exterior stone veneer against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that the warranty period is to be five years.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. ASTM International:
 - C91Standard Specification for Masonry Cement
 - C270Standard Specification for Mortar for Unit Masonry
- C. Masonry Standards Joint Committee: Specification for Masonry Structures (ACI 530.1-08/ASCE 6-08/TMS 602-08) (MSJC)

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 COR and all parties whose work is affected or related to the work of this section.

PART 2 - PRODUCTS

2.1 STONE

- A. Quality rock type, sizes and colors of stone furnished for this project shall match stone installed in existing walls and columns and as specified in the following paragraphs.
- B. Stones shall be Southwest Stone, Diamondback Jumpers & Ledge, or approved equal.
- C. Stone size:
 - 1. Standard thickness of stones (in-place dimension perpendicular to wall face) shall be 4 inches.
 - 2. Minimum dimension of stones shall be 3 inches by 4 inches.
 - 3. Maximum dimension of stones shall be 12 inches by 16 inches.
 - 4. Number of stones in each size range shall match materials used in existing construction as much as practicable

2.2 REINFORCEMENT AND ANCHORAGES

- A. Anchors and ties shall conform to the following specifications. Use only one type throughout the project.
- B. Adjustable Veneer Anchors and Ties (for attachment to concrete masonry units or concrete after installed):
 - 1. Provide anchor straps and ties as specified in following paragraphs.
 - a. Anchor Strap: Screw-on stainless steel anchor strap 3/4 inches wide by 5 inches long by 12 gage (2.7 mm) thick, with 1/4 inch offset (clearance) and hole at each end for fasteners. Dur-O-Wal DA207 MSSA Veneer Anchor Screw-on Straps, or approved equal.
 - b. Tie: Triangular wire tie 4 by 4 inches formed of stainless steel wire. Tie to extend at least 3 inches into masonry. Dur-O-Wal DA700 Series Triangular Ties, or approved equal.
 - c. Fasteners: Tapcon® concrete screws, stainless steel.

2.3 MASONRY MORTAR

- A. Masonry mortar shall be masonry cement mortar consisting of cementitious material, aggregates and water conforming to the requirements of ASTM C270, Type S or M.
- B. Masonry cement shall conform to ASTM C 91, Type S or M.

C. Admixtures:

1. Do not use mortar admixtures, except for high bond mortar and color admixtures, unless approved by the COR.
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.

D. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.
2. Match mortar color in approved mock-up.

E. Color Admixtures:

1. Proportion as specified by manufacturer

2.4 ACCESSORIES

A. Joint Sealant: Refer to Section 07 92 00, JOINT SEALANTS.

B. Weep Holes: Leave-out of full head mortar joints.

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 and 250 mm (10 inches) wide, with dovetail shaped notches 175 mm (7 inches) deep that prevent mesh from being clogged with mortar droppings.

D. Expansion Joint Fillers: ASTM D1056 Class RE-11.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Protection:

1. Cover tops of walls with nonstaining 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 when air temperature is below 40 degrees F provided that methods of protection are utilized in compliance with the referenced MSJC publication and as approved by the COR.

3.2 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 has erected a fully approved on-site mockup and accepts existing conditions.

3.3 PREPARATION

- A. Reinforced concrete construction for stone walls and columns shall be completed and accepted by the COR as specified in Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Lay out stones in roughly the configuration and pattern to be provided on the wall as specified in subsection 3.6, STONE MASONRY CONSTRUCTION, paragraph D, "Laying." Pattern shall match existing stone wall and approved mock-up.
- C. Clean stones before setting. Do not use tools which will mark or damage exposed surfaces.

3.4 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in subsection 3.5, ANCHORAGE.
- C. 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. Provide joints sizes and shape to match existing stone wall.
- D. Temporary Formwork: Provide formwork and shores as required for temporary support of stone masonry.

3.5 ANCHORAGE

- A. Conform to the following specifications for anchorage of stone masonry to concrete:
 - 1. Attach anchor screw-on straps to CMU or concrete after grout is poured and cured using specified concrete screws. Attach triangular ties to anchor straps.
- B. Spacing of anchor and ties shall be installed to provide spacing of 16 inches on center vertically and 16 inches on center horizontally.

3.6 STONE MASONRY CONSTRUCTION

- A. Construct stone masonry as indicated on the Drawings and as specified in the following paragraphs.
- B. Coordinate stone placement work with installation of anchors.
- C. Begin placement of stones on foundation at base of wall.
- D. Laying:
 - 1. Lay stones in random-coursed, random bond, with full mortar coverage on horizontal and vertical faces.
 - 2. Do not use stone smaller than minimum specified size at any angle, corner or break.
 - 3. Each stone shall be adjusted to its final position while mortar is still soft and plastic.
Stones that have been disturbed after the mortar has stiffened shall be removed, cleaned, and re-laid with fresh mortar.
 - 4. Lay stone masonry plumb, level and true to line within the tolerances as per applicable MSJC requirements and as specified in subsection 3.6.
- E. Joints:
 - 1. After mortar has properly stiffened, rake and tool joints as required to provide the same depth and surface finish as the joints in the existing stone walls.
- F. Keep cavity behind stone masonry clean of mortar accumulations and debris using following procedures:
 - 1. Clean cavity by use of hard rubber, wood or metal channel strips having soft material on side contacting stone.
 - 2. Lift strips with wires before placing next courses of individual ties.
- G. Top, ends and corners of stone masonry shall be laid to an even surface, unless otherwise approved by the COR.

3.7 CONSTRUCTION TOLERANCES

- A. Maximum variation from plumb: 1/4 inch in 10 feet.
- B. Maximum variation from plane of wall or column face: 1/4 inch in 10 feet.
- C. Maximum variation between face plane of adjacent stones: 1/8 inch.

3.8 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 required depth and repoint.
4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Stone:

1. First wet surfaces with clean water, then wash down with a solution of soapless detergent. Do not use muriatic acid.
2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
3. Wash surfaces with water to remove traces of detergent, foreign streaks, and stains.

3.9 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.

END OF SECTION

SECTION 04 72 10
STONE MASONRY (ALL CAPS AND NUMBER PLAQUES)

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes the performance criteria, materials, production, and erection of columbaria, memorial wall cap units and wall number plaques. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural stonework shown on the contract drawings.

1.2 RELATED WORK

- A. Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- B. Section 03 48 26, PRECAST MEMORIAL WALL UNITS.
- C. Setting and pointing mortar: Section 04 05 13, MASONRY MORTARING
- D. Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, Shop Drawings, Product Data, and samples.
- B. Samples: (Verify sizes prior to submittal)
 - 1. Stone cap and trim, 12" x 12" x 3/4".
 - 2. Full size sample of number plaque w/ engraved lettering. Sample maybe used in project if accepted.
- C. Shop Drawings:
 - 1. Stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
 - 2. Setting drawing with setting mark.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store stone under waterproof covers on planking clear of ground.
- B. Protect from handling, dirt, strain, and water damage.
- C. Package units and protect them from staining or damage during shipping and storage.

1.5 PROJECT CONDITION

- A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover

securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.

C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.6 COORDINATION

A. Advise installers of other work about specific requirements for placement of stone caps.

1.7 WARRANTY

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

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):

A167-99 (2004) Stainless and Heat Resisting Chromium-Nickel Steel
Place, Sheet, and Strip

C150-07 Portland Cement

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters. Stone setter must have five (5) years experience setting natural building stone.

B. Source Limitations for Stone: Obtain stone from one quarry with resources to provide materials of consistent quality in appearance and physical properties.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or

producer for each aggregate.

PART 2 PRODUCTS

2.1 STONE

- A. Stone Caps and Number Plaques: Provide sound cut limestone cap, and number plaques as shown on Drawings.
Color: Indiana Limestone, Full Color Blend.
Grade: Select.

2.2 STAINLESS-STEEL ANCHORS AND TIES

- A. Stainless-Steel expansion anchors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine substrate to verify that veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.

3.2 PREPARATION

- A. 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.
- B. Deliver anchorage devices that are embedded in or attached to the structure or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.
- C. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Do not install units until supporting structure is structurally ready to receive loads from stone.

3.3 SETTING OF STONE CAPS AND NUMBER PLAQUES, GENERAL

- A. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

3.4 CONSTRUCTION TOLERANCES STONE CAPS

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 10 feet. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet.
- B. Maintain uniform joint widths. Lay units with joints as indicated on drawings. Maximum joint width at caps is 1/2 inch. Centerline and width of cap joints must align with centerline and width of joints between precast columbarium units, except at wall spacer locations, where terminal or corner cap unit will extend over terminal or corner wall spacer to meet the end or corner pilaster, per the drawings. Field verify the required lengths for caps at end or corner wall spacer locations.
- C. Use shim spacers sized for joint thickness in bed joints; not less than two shims per unit.
- D. Variation in Plane between Adjacent Stones: Do not exceed 1/16".

3.5 POINTING

- A. Rake out joints 3/4-inch; clean, wet and pack solid with pointing mortar.
- B. Tool smooth to concave profile.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry broken, chipped, stained, or otherwise damaged or stone masonry not matching approved samples and mockups.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone masonry as work progresses.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry. Remove large mortar particles. Clean stone masonry by bucket and brush hand cleaning method described in BIA Technical Note No. 20 using job-mixed detergent solution.

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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 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 32.

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 REFERENCE STANDARDS

A. The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise herein.

1. Munsell Neutral Value Scale, Matte (31 - step scale) 617 Little Britain Road, New Windsor, NY 12553 - 6148
2. American Society for Testing Materials (ASTM) standards:
 - a. C97/C97M-09 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
 - b. C99/C99M-09 Standard Test Method for Modulus of Rupture of Dimension Stone
 - c. C119-08 Standard Terminology Relating to Dimension Stone
 - d. C170/C170M-09 Standard Test Method for Compressive Strength of Dimension Stone
 - e. C241/C241M-09 Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
 - f. C880/C880M-09 Standard Test Method for Flexural Strength of Dimension Stone
3. Drawings, Department of Veterans Affairs, National Cemetery Administration A-BNC-1 - Blank Niche Cover Layout (Marble/Granite)

PART2 - PRODUCTS

2.1 NICHE COVER ATTACHMENT HARDWARE

A. United States Department of Military and Veterans Affairs, National Cemetery System, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units

PART 3 - EXECUTION

3.1 NICHE COVERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

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 COR.

3.3 INSTALLATION

A. See section 03 45 50: Precast Concrete Columbarium Units

3.4 INSTALLATION OF NICHE COVERS

A. Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers. Due to the manufacturing tolerances in the niche covers and the allowable deviations from the nominal dimensions, it will be impossible to install the niche covers perfectly. Coordinate the installation procedures with the COR and establish the critical visual line for which the best alignment is to be established

3.5 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 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.

3.6 INSTALLATION OF NICHE COVER ATTACHMENT HARDWARE

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 COR 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.

3.7 CLEANING AND PROTECTION

- A. 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 04 73 10
MEMORIAL WALL MARKERS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. 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 memorial wall markers for installation in the memorial wall(s) to be constructed by the Contractor. This specification section provides all work necessary for the Contractor to accept, handle, store, move and install one approved blank memorial wall marker for each of the memorial wall marker sites in the new memorial wall(s).
 2. The number of approved, government provided spare memorial wall markers for this project to be accepted, offloaded and stored at the designated location is 19.

1.3 INSTALLER QUALIFICATIONS

- A. Installation of memorial wall markers 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 26, CONCRETE MEMORIAL WALL UNITS, the precast concrete memorial wall units with: memorial wall marker mounting hardware assemblies (installed); and memorial wall marker attachment hardware assemblies (provided for use to attach the Government provided memorial markers). The memorial marker mounting hardware assemblies shall be furnished and installed at the corners of the memorial markers, whether they adjoin other markers, filler strips, or are a shadow box concrete installation. Refer to the drawings for specific details. A memorial wall marker attachment hardware assembly will secure the corner of each approved government provided memorial wall marker, as shown on the drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MEMORIAL WALL MARKERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

- A. Memorial wall markers that have been inspected and accepted as being in compliance with manufacturing tolerances for size, 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 markers 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 intended memorial wall marker locations, plus required spares, shall be verified by the Contractor prior to accepting the units and performing the offloading operations. The Contractor shall note any shipping damage and reject any damaged markers before the delivery truck leaves the site. Once satisfied, the Contractor shall take ownership of the acceptable markers, as all being approved as meeting the government specifications and being suitable for installation at this project. Once the memorial markers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the COR.

3.2 INSPECTION

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

3.3 MEMORIAL WALL MARKER ATTACHMENT HARDWARE

- A. Hardware for attachment shall be specifically designed for attaching markers that will have plaques installed. The hardware is designed to be recessed or totally hidden, except for the rosettes at the corners of the markers and the hardware visible through the cracks between the individual markers, or concrete shadow box edge. The hardware allows for the removal of an individual marker for installation of the plaque if pins are used, without having to remove multiple markers. The material for the attachment hardware shall be verified to be compatible with stainless steel rosettes and rosette attachment screws, without adverse reactions during the submittal process. The hardware provided

shall not cause staining on the markers. The marker attachment hardware shall only be visible when looking in the cracks between or adjoining the markers, and shall be installed being recessed from the face of the markers. The marker attachment hardware shall be suitable for the project installation using precast memorial wall installation(s). The shop drawing and submittal process shall be used to indicate that the installation of the memorial wall markers is in compliance with design and installation as indicated in the drawings. The submittal, shop drawings and narrative of the work to be performed and coordinated shall clearly indicate how the work is to be coordinated, from the installation of the memorial wall concrete core to the completed installation of the memorial wall markers in the finished memorial wall(s). The attachment hardware shall be suitable for a permanent installation, out of doors, be suitable for the indicated loads, and shall produce the finish installation as indicated on the contract drawings.

- B. The Contractor performing the installation of the memorial wall markers shall maintain control of the memorial wall marker attachment hardware assemblies from delivery to the site through acceptance of the installation of the government provided memorial wall markers.

3.4 INSTALLATION

- A. Installation of the government-provided memorial wall markers shall include all materials, manpower, tools and equipment required to receive the approved government-provided memorial wall markers from the manufacturer and handle them as necessary and perform whatever work is needed to result in the successful installation of one memorial marker for every marker location in the memorial wall(s), as indicated on the drawings.
- B. The installation shall be such that the joints are straight, even width or height, and the face of the markers shall all be in the same plane as the shadow box concrete edge with a maximum allowable deviation from the plane of 1 mm (1/32").
- C. The installation of the memorial wall markers shall be coordinated with the work of constructing and finishing the memorial wall as designed so the end result is a complete and accepted memorial wall installation with the government-provided memorial wall markers installed as indicated in the drawings, details, notes and specifications.

3.5 CLEANING AND PROTECTION

- A. 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 markers 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.

END OF SECTION

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.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS 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.

1.3 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.

1.4 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 the latest applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society of Mechanical Engineers (ASME):
- B18.6.1Wood Screws
 - B18.2.2Nuts for General Applications
- C. American Society for Testing and Materials (ASTM):
- A36/A36MCarbon Structural Steel
 - A123/A123MZinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A30Carbon Steel Bolts, Studs, and Threaded Rod
60,000 PSI Tensile Strength
 - A500/A500MCold-Formed Welded and Seamless Carbon Steel
Structural Tubing in Rounds and Shapes
 - A653/A653MSteel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
 - C1107/C1107MPackaged Dry, Hydraulic-Cement Grout
(Nonshrink)
 - E488Strength of Anchors in Concrete Elements
 - F436Hardened Steel Washers
- D. American Welding Society (AWS):
- D1.1/D1.1MStructural Welding Code Steel
 - D1.2/D1.2MStructural Welding Code Aluminum
 - D1.3/D1.3MStructural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM):
- AMP 500-06Metal Finishes Manual
- F. Structural Steel Painting Council (SSPC):
- SSPC-SP 1Solvent Cleaning
 - SSPC-SP 2Hand Tool Cleaning
 - SSPC-SP 3Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A36.

- B. Structural Tubing: ASTM A500.
- C. Primer Paint: As specified in Section 09 91 00, PAINTING.
- D. 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. Expansion and Sleeve Anchors: Design values listed must be as tested according to ASTM E488.
- 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, and 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
 - 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. 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 frame 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 A36 structural steel shapes as shown.
 - 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
 - 3. Field connections may be welded or bolted.

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.

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.

3.3 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.

3.5 CLEAN AND ADJUSTING

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

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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. Stone control and other joints: Section 04 43 00, NATURAL STONE VENEER.
- C. Masonry control and expansion joint: Section 04 72 10, STONE MASONRY.

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 other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 - 4. Determine sealants will not stain joint substrates according to ASTM C1248.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field-test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:

JOINT SEALANTS

1. Locate test joints where indicated or, if not indicated, as directed by COR.
 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 COR seven days in advance of dates and times when test joints will be erected.
- E. Meet VOC requirements of pertinent CARB and/or SCAQMD Rule for sealants VOC (4 percent by weight VOC or less in less than 16 ounce package or less than 250 g/L in larger package). All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.

1.4 SUBMITTALS

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

1.5 PRE-INSTALLATION CONFERENCE

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

1.6 PROJECT CONDITIONS

- A. Environmental Limitations:
 1. Do not proceed with installation of joint sealants under following conditions:

JOINT SEALANTS

- 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.

1.7 DELIVERY, HANDLING, AND STORAGE

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures less than 5° C (40° F) or exceeding 32° C (90° F).

1.8 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.

1.9 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 5-year warranty for urethanes and horizontal silicones; 20 years for vertical silicones.
- 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.

1.10 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):
- C717-12bStandard Terminology of Building Seals and Sealants
 - C734-06(2012)Low Temperature Flexibility of Latex Sealants after Artificial Weathering
 - C834-10Latex Sealants
 - C920-11Elastomeric Joint Sealants
 - C1021-08Laboratories Engaged in Testing of Building Sealants
 - C1193-13Use 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
 - D1056-07Flexible Cellular Materials—Sponge or Expanded Rubber
 - E84-12cSurface Burning Characteristics of Building Materials
- C. South Coast Air Quality Management District (SCAQMD)
- D. 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-6:
- 1. ASTM C920, silicone, neutral cure.

JOINT SEALANTS

2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.

C. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

D. 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.

2.2 CAULKING COMPOUND

- A. C-1: ASTM C834, acrylic latex.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.
- C. Match color of all adjacent materials in other locations.

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

JOINT SEALANTS

(minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER

- A. Mineral fiber board: ASTM C612, Type IVA.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.7 CLEANERS - NON-POUROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS

- A. Prepare joints in accordance with manufacturer's instructions and as specified only when installers are ready to initiate sealant application as soon as practicable after preparation and before subsequent surface deterioration.

- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
- 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.

JOINT SEALANTS

- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three-sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written installation instructions for products and applications indicated.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.

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: Type S-1.
3. Masonry to Masonry: Type S-1.
5. Threshold Setting Bed: Type S-1, S-3, S-4.
6. Masonry Expansion and Control Joints: Type S-6.

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6.
2. Metal to Metal: Type S-6.

C. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-11 or S-12.

D. Interior Caulking:

1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, C-2 and C-3.
2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2 and C-3.
3. Joints at Masonry Walls or Exterior Walls: Types C-1, C-2 and C-3.

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SECTION 08 35 13
FOLDING GLASS DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installing a top hung or floor track supported, sliding-folding, thermally broken, aluminum-framed glass panel system that includes:
 - 1. Aluminum frame
 - 2. Threshold
 - 3. Panels
 - 4. Sliding-folding and locking hardware
 - 5. Weather stripping
 - 6. Glass and glazing
 - 7. Accessories as required for a complete working installation
- B. Related Documents and Sections: Contractor to examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, Specification Sections, apply to this Section
 - 2. Section 06 10 00, Rough Carpentry
 - 3. Section 06 20 00, Finish Carpentry
 - 4. Section 07 62 00, Sheet Metal Flashing and Trim
 - 5. Section 07 90 00, Joint Sealants
 - 6. Section 08 42 23, Glass Entrance Swing Doors

1.02 REFERENCES

- A. Reference Standards in accordance with Division 01 and current editions from the following:
 - 1. AAMA. American Architectural Manufacturers Association; www.aamanet.org
 - 2. ANSI. American National Standards Institute; www.ansi.org
 - a. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings
 - 3. ASTM. ASTM International; www.astm.org
 - a. ASTM C1036, Standard Specification for Flat Glass
 - b. ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 - c. ASTM E283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

- d. ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- e. ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- f. ASTM E413, Classification for Rating Sound Insulation
- g. ASTM E547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential
- h. ASTM E1332, Standard Classification for Rating Outdoor-Indoor Sound Attenuation
- 4. BSI Group. The British Standards Institution;
<http://www.bsigroup.com/en-GB/>
 - a. PAS 24 (Publicly Available Specification), Enhanced security performance requirements for door assemblies
- 5. CPSC. Consumer Product Safety Commission; www.cpsc.gov
 - a. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials
- 6. Energy Star, U.S. Environmental Protection Agency (EPA) Program;
www.energystar.gov
- 7. NFRC. National Fenestration Rating Council; www.nfrc.org
 - a. NFRC 100, Procedure for Determining Fenestration Product U-factors
 - b. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - c. NFRC 400, Procedure for Determining Fenestration Product Air Leakage
 - d. NFRC 500, Procedure for Determining Fenestration Product Condensation Resistance Rating Values

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product literature for each Folding Glass Storefront system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles, and colors.
- B. Product Drawings: Indicate Folding Glass Storefront system component sizes, dimensions and framing R.O., configuration, swing panels, direction of swing, stacking layout, typical head jamb, side jambs and sill details, type of glazing material, handle height and field measurements.
- C. Installation, Operation and Maintenance Data: Submit Owner's Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer capable of providing complete, precision built, engineered, pre-fitted units with a minimum thirty (30) years' experience in the sale of folding-sliding door

systems for large openings in the North American market.

- B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three (3) projects of similar scale and complexity successfully completed in the last three (3) years.

1. Installer to be trained and certified by manufacturer.

- C. Single Source Responsibility: Furnish Folding Glass Storefront system materials from one manufacturer for entire Project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions and recommendations as follows:

1. Deliver materials to job site in sealed, unopened cartons or crates.

- a. Upon receipt, contractor to inspect the shipment to ensure it is complete, in good condition and meets project requirements.

2. Contractor to store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

1.06 FIELD CONDITIONS BY CONTRACTOR

- A. Field Measurements: Contractor to field verify dimensions of rough openings (R.O.) and threshold depressions to receive sill. Mark field measurements on product drawing submittal.

1.07 WARRANTY

- A. Manufacturer Warranty: Provide Folding Glass Storefront system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.

1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:

a. Rollers and Insulated Glass Seal Failure: Ten (10) years

b. All Other Components Except Screens: Ten (10) years

- 1). Exception: Five (5) years if NOT installed by manufacturer's specific system approved or certified trained installer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product by Manufacturer: NanaWall SL60 or approved equal.

2.02 PERFORMANCE / DESIGN CRITERIA

- A. Performance Criteria (Lab Tested): Low Profile Saddle Sill - Inward/Outward Opening

1. Air Infiltration| Exfiltration (ASTM E283):

a. 0.10 | 0.08 cfm/ft² (0.5 | 0.4 L/s/m²) at a static air pressure difference: of 1.57 psf (75 Pa)

b. 0.37 | 0.17 cfm/ft² (1.9 | 0.9 L/s/m²) at 6.24 psf (300 Pa)

2. Water Penetration (ASTM E331, ASTM E547): No uncontrolled water leakage at a static test pressure of 5.43 psf (260 Pa) with weeps by

others.

3. Structural Loading (ASTM E330): [DP-40] [DP-45]
 - a. Design Pressure - Positive Inswing or Negative Outswing: 40 psf (1920 Pa)
 - b. Design Pressure - Negative Inswing or Positive Outswing: 45 psf (2160 Pa)
 4. Swing Panel with Surface Mounted Hinges - Operation / Cycling Performance (AAMA 920):
500,000 cycles
 5. Folding Glass Storefront Units tested to AAMA/WDMA/CSA 101/I.S.2/A440.
 6. System - Life Cycle Performance (DIN EN 1191/12400):
Pass; 20,000 cycles
 7. Forced Entry (AAMA 1304): Meets requirements
 8. Thermal Performance (U-factor): NFRC 100 rated, certified, and labeled
 9. Solar Heat Gain Coefficient (SHGC) + Visible Light Transmission (VT): NFRC 200 rated, certified, and labeled
 10. Air Leakage: NFRC 400 rated, certified, and labeled
 11. Condensation Resistance Factor (CRF): NFRC 500 rated, certified, and labeled
- B. Design Criteria:
1. Sizes and Configurations: As indicated by the Drawings for selected number and size of panels, location of swing panels, and stacking.
 2. Unit Operation: Sliding and folding hardware with top and bottom tracks.
 3. Mounting Type:
 - a. Top-hung
 - b. Floor track supported
 4. Panel Configuration:
 - a. Straight
 5. Panel Type: Hinged
 - a. Primary swing panel of paired swing panels, looking from inside, to be on the left & right.
 6. Panel Pairing Configuration: See Drawings.
 7. Stack Storage Configuration:
 - a. Inswing

2.03 MATERIALS

- A. Thermally Broken Aluminum Framed Folding Glass Storefront Description: Top-hung or floor track supported system. Manufacturer's standard frame and panel profiles, with head track, side jambs and panels with dimensions as shown on Drawings.
1. Panels and Frames

- a. Panels
 - 1). Single lite.
 - 2). Panel Size (W x H): See drawings.
 - 3). Rail Depth: 2-5/16 inch (59 mm)
 - 4). Top Rail and Stile Width: 2-3/8 inch (60 mm)
 - 5). Bottom Rail Width: 2-3/8 inch (60 mm)
- b. Frame:
 - 1). Matching top track and side jambs
 - a). Top Track Width (Top-Hung): 3-15/16 inch (100 mm)
 - b). Top Track Width (Floor Supported): 2-9/16 inch (65 mm)
 - c). Side Jambs Width: 2-9/16 inch (65 mm)
 - d). Top Track and Side Jambs Depth: 3-1/8 inch (66 mm)
 - 2). Sill Type:
 - a). [Low profile saddle sill (thermally broken)]
 - 3). Sill Aluminum Finish:
 - a). a dark bronze anodized finish.
 - 4). For ADA Compliance at Swing Panel: Provide gasket to cover the channel in the sill at swing panels.
- 2. Aluminum Extrusion: AIMgSi0.5 alloy, 6063-T5 (F-22 - European standard)
 - a. Thickness: 0.078 inch (2.0 mm) nominal
 - b. Thermal Break: 7/8 inch (22 mm) wide polyamide plastic reinforced with glass fibers. Narrower or poured and de-bridged type thermal breaks not acceptable.
- 3. Panel and Frame Aluminum Finish: Inside and Outside;
 - a. Same (one-color)
 - b. Anodized (AAMA 611):
 - 1). Dark Bronze
- B. Glass and Glazing:
 - 1. Safety Glazing: In compliance with ASTM C1036, ASTM C1048, ANSI Z97.1 and CPSC 16CFR 1201.
 - 2. Manufacturer's tempered and laminated glass lites in double insulated glazing units, dry glazed with glass stops on the inside.
 - a. Insulated Glass Unit (IGU) Lites:
 - 1). Double IGU:
 - a). 15/16 inch (24 mm) thick.
 - b. IGU Fill:
 - 1). Air filled
 - c. Glass Lite Type:
 - 1). Standard
 - d. Glass Spacers: Manufacturer's standard

- 1). black finish with capillary tubes
- e. IGU Surface:
 - 1). Clear
- C. Locking Hardware and Handles:
 - 1. Main Entry Panel(s) for Models WITH a Swing Panels: Provide manufacturer's or Lever handles with return on the inside and outside, and a lockset with a lockable latch, and multi-point locking with a dead bolt and rods at the top and bottom on primary panel only.
 - a. Rods to be concealed and not edge mounted.
 - b. After turn of key or thumb-turn, depression of handles withdraws latch.
 - c. Lifting of handles engages rods and turn of key or thumb turn engages deadbolt and operates lock.
 - d. [Secondary Swing Panel: Provide matching dummy lever handles on both sides and concealed flush bolts that operate the rods at the top and the bottom for the secondary swing panel.]
 - e. Locking:
 - 1). Standard profile cylinder
 - 2. Main Entry [Pair of] Panel(s) for Models WITH a Swing Panel attached to the Side Jamb and with Surface Mounted Hinges: Provide manufacturer's push-pull handles with separate lockset and dead bolt.
- D. Sliding- Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks and threshold. All running carriages to be with sealed, self-lubrication, ball bearing multi- rollers. Surface mounted hinges and running carriages not acceptable.
 - 1. For Each Pair of Folding Panels:
 - a. Top-Hung System (SL60/o): Provide independent cardanic suspension for four (4) wheeled rollers coated with fiberglass reinforced polyamide upper running carriage and lower guide carriage. Running carriage to be adjustable in height, 1/4 inch (6 mm) up and down.
 - b. Floor Supported System (SL60/u): Provide upper guide carriage and lower running carriage with two vertical stainless-steel wheels and two horizontal wheels. Vertical wheels to ride on stainless steel guide track covers over the full length of sill track and lie above the water run-off level.
 - 1). Lower Running Carriage Carrying Capacity: 220 lbs. (100 kg)
 - 2. On All Four Corners of Panels: Provide thermally broken die cast zinc multi-functional corner fittings with carriage connectors, hinges and standard hinge pins.
 - a. Finish: Powder coated, closest match to finish of frame and panel.
 - 3. Adjustment: Provide 1/16 inch (1.5 mm) in width per hinge adjustments without removing panels from tracks and without needing to remove panels from tracks.

- E. Weather stripping: Manufacturer's double layer EPDM between panels, EPDM gasket and Q-lon gasket, or brush seal between panel and frame, or brush seals with a two-layer fiberglass reinforced polyamide fin attached at both inner and outer edge of bottom of door panels with a recessed sill or on frame for sealing between panels and between panel and frame.

- 1. UniverSILL: For outswing low profile saddle sill, UniverSILL sill adaptor is available for additional air and water performance when needed.

- F. Fasteners: Tapered pins and stainless-steel screws for connecting frame components.

2.04 **FABRICATION**

- A. Folding Glass Wall: Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather-stripping components needed to construct a folding glass wall.

- 1. Each unit factory pre-assembled and shipped with complete system components and installation instructions.
 - 2. Exposed work to be carefully matched to produce continuity of line and design with all joints.
 - 3. No raw edges visible at joints.

PART 3 EXECUTION

3.01 **EXAMINATION**

- A. Examination and Acceptance of Conditions as follows:
 - 1. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
 - a. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square with no unevenness, bowing, or bumps on the floor; and other conditions as required by the manufacturer for readiness to receive Work.
 - b. Verify structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

- A. General: Install Folding Glass Storefront system in accordance with the Drawings, approved submittals, manufacturer's recommendations, and installation instructions, and as follows:
 - 1. Properly flash, waterproof and seal around opening perimeter.
 - 2. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb, and square. Install frame in proper elevation, plane, and location, and in proper alignment with other work
 - 3. When lower track is designed to drain, provide connections to allow for drainage.

4. Install panels, handles, lockset, screens, and other accessories in accordance with manufacturer's recommendations and instructions.

3.03 **FIELD QUALITY CONTROL**

- A. Field Tests and Inspections of the following:
 1. Verify the Folding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.
- B. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.04 **CLEANING AND PROTECTION**

- A. Keep units closed and protect Folding Glass Storefront installation against damage from construction activities.
- B. Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

BID DOCUMENT Submittal
National Cemetery Development
Cedar City Rural Initiative

Project No. 942CM3001
22 July 2022

SECTION 09 06 00
SCHEDULE FOR FINISHES

NCA Facility: CEDAR CITY NATIONAL CEMETERY

Location: CEDAR CITY, UT

Project No. and Name: 942CM3001, CEDAR CITY NATIONAL CEMETERY RURAL INITIATIVE CEMETERY DEVELOPMENT

Submission Date: March 20, 2020

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 |
|---------------------------|--------------------------|
| Flower Water Station Slab | Plain Gray, Medium Broom |

B. SECTION 03 45 00, PRECAST ARCHITECTURAL CONCRETE

| Piece | Finish | Manufacturer | Mfg. Color & Texture No. |
|----------------------------------|------------------------|--------------|--------------------------|
| Pylon Section Markers | light acid etch finish | Davis Colors | Pewter 860 |
| Flower Water Station Faucet Post | light acid etch finish | Davis Colors | Pewter 860 |

2.3 DIVISION 04 - MASONRY

A. SECTION 04 05 13, MASONRY MORTARING

| Finish Code | Manufacturer | Mfg. Color Name |
|---------------------|----------------------|-----------------|
| Stone Veneer Mortar | Solomon Colors, Inc. | 45X |

B. SECTION 04 43 00, NATURAL STONE VENEER

| Name of Stone | Color, Texture, Finish | Stone Source |
|---------------|--|-----------------|
| Stone Veneer | Diamondback Jumpers & Ledge, Natural finish | Southwest Stone |

SCHEDULE FOR FINISHES

C. SECTION 04 72 10, STONE MASONRY

| Name of Stone | Color, Texture, Finish | Stone Source |
|--------------------|------------------------------------|-------------------|
| Cut Limestone Caps | Full Color Blend, Smooth, Polished | Indiana Limestone |

D. SECTION 04 73 00, COLUMBARIUM NICHE COVERS

| Name of Stone | Color, Texture, Finish | Stone Source |
|---------------|------------------------|------------------------|
| Niche Covers | White Marble | Provided by Government |

E. SECTION 04 73 10, MEMORIAL WALL MARKERS

| Name of Stone | Color, Texture, Finish | Stone Source |
|---------------|------------------------|------------------------|
| Wall Markers | White Marble | Provided by Government |

2.6 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 92 00, JOINT SEALANTS

| Location | Color | Manufacturer | Manufacturer Color |
|------------------------|------------------------|--------------|--------------------|
| Stone Sealed Joints | To match mortar joints | N/A | N/A |
| Concrete Sealed Joints | To match concrete | N/A | N/A |
| Masonry Sealed Joints | To match mortar joints | N/A | N/A |

2.9 DIVISION 10 - SPECIALTIES

A. SECTION 10 14 00, EXTERIOR SIGNS

| Component | Background Finish | Type Color | Manufacturer | Mfg. Color Name/No. |
|------------|-------------------|------------|--------------|---------------------|
| Sign Posts | Cast Bronze | White | Matthews | MP7458 |

SCHEDULE FOR FINISHES

| Component | Background Finish | Type Color | Manufacturer | Mfg. Color Name/No. |
|---|-------------------|-------------|--------------|---------------------|
| and Panels | | | | |
| Bronze Plaques, Service Emblems and Seals | Cast Bronze | Cast Bronze | Matthews | MP7458 |
| Pylon Section Marker Metal Plaques | Cast Bronze | White | Matthews | MP7458 |
| Dimensional Letters | Cast Bronze | Cast Bronze | Matthews | MP7458 |
| Flower Water Station ('Do Not Drink' Sign Panels) | Cast Bronze | White | Matthews | MP7458 |
| | | | | |

B. SECTION 10 73 46, PREFABRICATED SITE SHELTERS

| Component | Manufacturer | Mfg. Color Name/No. |
|--------------------------|--------------|------------------------|
| Exterior Roof Panels | RCP Canopies | Delta Rib, Matte Black |
| Wood T&G Soffit | RCP Canopies | Mission Wall |
| Steel Columns and Purlin | RCP Canopies | Jet Black |
| | | |

C. SECTION 10 73 47, PREFABRICATED SITE BUILDING

| Component | Manufacturer | Mfg. Color Name/No. |
|-----------|--------------|---------------------|
| | | |

SCHEDULE FOR FINISHES

| Component | Manufacturer | Mfg. Color Name/No. |
|----------------------|--------------|---------------------------|
| Exterior Wall Panels | CXT | Split Face Block |
| Exterior Roof Panels | CXT | Delta Rib, Raven Black |
| Interior Wall Panels | CXT | Plywood, White, Semigloss |
| Door and Frame | CXT | Dark Bronze, Semigloss |
| Door Hardware | CXT | Stainless Steel, Brushed |
| Louvers | CXT | Dark Bronze, Semigloss |
| Lighting | CXT | White, Semigloss |
| Vinyl Base | CXT | Grey |

D. SECTION 10 75 00, Flagpoles

| Component | Manufacturer | Mfg. Color Name/No. |
|-----------------|--------------|------------------------|
| Flagpole Shaft | N/A | Satin Brushed Aluminum |
| Finial Ball | N/A | Gold Anodized Aluminum |
| Base and Cleats | N/A | Match Flagpole |
| | | |

2.14 DIVISION 32 - EXTERIOR IMPROVEMENTS

A. SECTION 32 30 00, SITE FURNISHINGS

| Item | Style Name/No. | Finish | Manufacturer | Mfg. Color Name/No. |
|------------------------|----------------|------------------|----------------|---------------------|
| Benches | RB28 | Gloss Powdercoat | Victor Stanley | Dark Bronze |
| Trash Receptacles | S42 | Gloss Powdercoat | Victor Stanley | Dark Bronze |
| Flower Vase Receptacle | S35 | Gloss Powdercoat | Victor Stanley | Dark Bronze |

SCHEDULE FOR FINISHES

B. SECTION 32 31 13, CHAIN LINK FENCES AND GATES

| Finish Chain Link Fabric | Finish Posts and Rails | Manufacturer | Mfg. Color Name/No. |
|--------------------------|------------------------|--------------|---------------------|
| PVC Vinyl Coated | Powder Coat | N/A | Black |
| PVC Privacy Slats | N/A | N/A | Black |

C. SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES

| Finish Posts, Pickets & Rails | | Manufacturer | Mfg. Color Name/No. |
|-------------------------------|--|--------------|---------------------|
| Powder Coated | | N/A | Black |
| | | | |

--- E N D---

BID DOCUMENT Submittal
National Cemetery Development
Cedar City Rural Initiative

Project No. 942CM3001
22 July 2022

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SCHEDULE FOR FINISHES

09 06 00 - 8

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 from manufacturers regularly engaged in manufacturing signs of the types specified.
- C. Signs included are as follows:
 - 1. Information/Regulation
 - 2. You Are Here Map
 - a. Vertical
 - 3. Traffic Regulatory
 - a. Low Profile
 - 4. Post and Panel
 - a. One Line of Text
 - b. Two Lines of Text
 - c. Three Lines of Text
 - 5. Bronze Plaques, Service Emblems and Seals
 - 6. Faucet Post with Sign Panel
 - 7. Pylon Section Marker
 - 8. Dimensional Letters.

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. Flower Watering Station piping, appurtenances and mounting: Section 32 33 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 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 200 mm by 250 mm (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. Square tube post, 150 mm (6") minimum length, showing typical color and finish. Attachments for the sign panels shall be provided to demonstrate the complete signage system materials and functionality.
 - 3. Aluminum samples showing full range of finish colors available.
 - 4. Cast Metal Letter, of the style, size and finish indicated
 - 5. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.
 - 6. Sample of typeface, arrow and symbols in a typical full size layout.
 - 7. Directory panels and frames, with letters and symbols, each type.
- 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 of the cast lettering shown on the entry wall, showing pin locations and letter spacing of all words. Approved template shall be used during the actual installation of the lettering.
- 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 prepare 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.
- H. Sample(s) shall be submitted of sign(s) of sufficient size to show the full scaled features of each of the sign types, including frame, mounting, panels, panel mounting, sign mounting facilities, lettering, color and texture. All aluminum signs shall have full exterior Powder Coated finish, with color and quality as specified herein.

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.

1.7 WARRANTY

- A. Sign Manufacturer shall guarantee the text and symbols applied to the powder-coated aluminum for a period of one year following final acceptance of the project and acceptance of the exterior signage system work. 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.

1.8 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. 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):
 - B209-10Aluminum and Aluminum-Alloy Sheet and Plate
 - B221-12Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - B449-93(2010)e1Standard Specification for Chromates on Aluminum
- E. American Architectural Manufacturer's Association (AAMA):
 - AAMA 2605-05Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels.
- F. Federal Specifications (Fed. Spec.):
 - MIL-P-8184FPlastic Sheet, Acrylic, Modified.
 - A-A-59502Plastic Sheet, Polycarbonate

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. Contracting Officer's Representative (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: Helvetica 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 have the background color of sign panels and the aluminum posts as powder coated matching Cast Bronze.

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, two size designations.
2. NC-02 - You Are Here Maps Signs, one size designations.
3. NC-03 - Traffic Regulatory Signs, one size designations.
4. NC-04 - Post and Panel Signs, two size designations.
5. NC-07 - Pylon Section Marker, one size designations.
6. NC-10 - Dimensional Letters.
7. NC-11 - Dimensional Seal.

B. Location, layout and construction details for 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. 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, font, letter spacing, graphics being shown. Only signs and/or sign faces approved in the submittal process shall be manufactured.

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 0.4 mm (1/64 inch). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Members shall have square turns and corners sharp, and curves shall be true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.

- I. 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.
- J. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. All contact surfaces fit tight and even without forcing or warping components.
- K. 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.
- L. Completed sign installations shall not have any exposed openings so insect nesting inside of signs will be prevented.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the COR & forwarded to contractor.
- N. 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 DOUBLE-POST-PANEL SIGNS

- A. Post and Panel Signs: Furnish the standard post style for each of the Post and Panel Signs, as designated in the drawings. The two standard types of posts are metal as follows:
 - 1. Metal post signs:

- a. The posts, frame and panel(s) that make up the metal post sign system shall be constructed of an aluminum tubing system with approved post caps. Posts and frame elements for supporting the panels at individual sign locations shall be sized using the minimum sizes, as indicated herein, or as indicated on the drawings, with the drawing sizes taking precedence. The minimum size for the metal posts, if not indicated in the drawings, shall be 50 mm x 100 mm x 3 mm (2 inches by 4 inches by 1/8 inch).
- b. 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 1/8 inch x 1 1/4 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.
- c. Sign panel assembly shall be constructed with extruded aluminum support channels and fasteners that secure a removable powder-coated aluminum sign panel assembly. Aluminum sign panel faces shall be 3 mm (1/8 inches) minimum thickness. The design for the sign panel system shall be such that the sign panels can be removed and replaced, if damaged, without having to move the posts that secure the sign panel assembly. The sign panel assembly shall be constructed so there are no gaps or holes in the assembly that could let insects enter and construct nests or otherwise become a nuisance. The top of the sign panel assembly shall be constructed such that it is water tight from above and shall not have unsealed joints where water can collect or enter the assembly. The sign configuration and mounting shall be as depicted in the drawings.
- d. Lettering shall be as indicated on the applicable "Site Details" type of Drawing(s).

- e. Exposed fasteners shall be aluminum, tamper-proof type, and shall be colored to match the color for the sign panels.
- f. 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 meets 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. Color as indicated in the schedule of finishes and approved submittal.
 - 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 Utah 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.

2.9 FLAG TYPE STREET SIGNS

- A. Sign posts shall be constructed with extruded tubular aluminum, 3 mm (1/8") minimum thick with corners that are crisp and true to line. Aluminum cap with concealed, tamper-proof attachments shall be provided.
- B. Lettering shall be as indicated on the applicable "Site Details" type of Drawing(s).
- C. Finish shall match Double-Post-Panel signs.

2.10 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 previously approved and used casting mold 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. Casting 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 six bronze service emblem plaques shall be of the sculpted BAS relief style. The six emblems include one of each military branch: Army, Navy, Air Force, Marines, Coast Guard and Space Force. 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.
- a. Plaques shall be provided with four threaded bosses, 13 mm x 50 mm (1/2" x 2") nominal size. Space as shown on Contract Drawings. Contractor shall provide threaded bronze bolts, 13 mm x 50 mm (1/2" x 2") nominal size to fit threaded bosses.
 2. Department of Veteran Affairs Bronze Seal - Shall be of the sculpted BAS relief style with the size and graphics matching that of previously approved seals and as approved during the submittal review and approval process. The size, location and attachment for the seal shall be as indicated on the construction drawings, with the seal between 600 mm and 1200 mm (2 and 4 feet) in diameter.
 3. Gettysburg Address Plaque (Contractor Provided) - Shall be mounted as indicated on the contract drawings. Shall be of the sculpted BAS relief style. The size and configuration of the plaque shall be generally as indicated on the contract drawings, with the final configuration, and mounting to be as submitted and approve during the submittal review process.
 4. Bivouac of the Dead Plaque (Contractor Provided) - Shall be mounted as indicated on the contract drawings. Shall be of the sculpted BAS relief style. The size and configuration of the plaque shall be generally as indicated on the contract drawings, with the final configuration, and mounting to be as submitted and approve during the submittal review process.
 5. Dedication Plaque (Contractor Provided) - Shall be mounted as indicated on the contract drawings. Shall be of the sculpted BAS relief style. The size and configuration of the plaque shall be generally as indicated on the contract drawings, with the final configuration, and mounting to be as submitted and approve during the submittal review process.

2.11 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. Concrete Markers

- a. 7.5" x 7.5" x 1'-4" above finished grade, and minimum depth of concrete below grade holding the sign shall be 30".
- 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. The approximate height for the aluminum text panels is 178mm (7"). 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.
- f. Pylon Section Markers shall be manufactured in accordance with Section 03 45 00, Precast Architectural Concrete using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and

texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, 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.

- B. The approved shop drawings and sample(s) of the complete Pylon Section Marker shall be the basis for manufacturing and assembly.

2.12 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 the concrete post on a separate metal panel attached to the concrete post.
- B. The posts contain and/or are used to mount 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.
- C. The posts shall be concrete, with location, materials, color, 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. Details for the Faucet Posts with Signs are as indicated on the drawings and associated notes.
 2. Unless indicated differently on the drawing details, the faucet posts with signs shall be as follows:
 - a. Concrete Faucet Posts
 - 1) 190 mm x 190 mm x 710 mm (7-1/2" x 7-1/2" x 3'-6") above finished grade, and depth as indicated on the drawings (minimum depth of concrete holding the sign shall be 1'-10"). Drawing details shall take precedence.
 - 2) The style for the markers shall have rounded 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 +3 mm, -0 mm (+ 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 3 mm (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 as follows:
 - a) "DO NOT DRINK" SIGN PANEL: 95 mm (3-3/4") wide with the symbol being 75 mm (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 19 mm (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 3 mm (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. The approximate height for the aluminum text panels is 175 mm (6-3/4"). Dimensions shown on detailed construction drawings shall take precedence over the specifications.
 - b) "NON-POTABLE WATER" SIGN PANEL: 95 mm (3-3/4") wide. The text height shall be 62 mm (2-1/4"). The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3 mm (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. The approximate height for the aluminum text panels is 175mm (2'-8 3/4"). 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.

6) Concrete Faucet Posts shall be manufactured in accordance with Section 03 45 00, Precast Architectural Concrete using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, minimum of 300 mm (12") in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. The shop drawings and sample shall include the details space for the pipes, appurtenances, and spigot as well as room for assembly and attachment to produce the fully functional FWS spigot assembly as specified. An acceptable sample must be obtained prior to manufacturing the units.

D. "Do Not Drink" decal - The "Do Not Drink" decal shall be the universal symbol with a faucet above a glass with water, and a red circle and diagonal line through the symbol. Decal has black background with white text and black and red symbol (Spanish translation recommendation). The text "Do Not Drink" shall be stacked vertically below the international symbol. Decal shall be aligned vertically to fit the metal or concrete post location, as submitted and approved.

2.13 DIMENSIONAL LETTERS

A. Dimensional Letters shall be individually mounted on the provided substrate material. The location, alignment, letter configuration, size, font, material and finish shall be as indicated on the Drawings.

A. Cast dimensional metal letters shall be surface mounted tight to the wall unless otherwise noted. Letters to be mounted to other than flat surfaces, like stone masonry veneer walls with irregular shaped and faced stones, and with random joints 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. Lettering shall be Times New Roman Regular with layout, font, style, size and spacing as indicated on the Drawings.

- B. Dimensional lettering shall be sized and depth as indicated on the drawings.
- C. Materials, color, and finish for the individual letters shall be as indicated in the schedule of finishes.

2.14 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. For all elements that are connected to another adjoining element, like double post signs, provide a continuous reinforced concrete mow strip. The requirements for the collars and strips 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 fill depth of the concrete.
 - d. Closed steel rebar, with overlap at joint, 50 mm (2") minimum distance from surrounding earth.
 - e. Minimum 10 mm (#3) diameter rebar as enclosing the element or elements approximately 50 mm (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 50 mm (2") from the closest parts of the adjoining elements.
 - f. Cast-in-place concrete shall be same as for other flatwork elements.
 - g. Construct the collars and/or strips to be 25 mm (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 13 mm (1/2") to 19 mm (3/4").

2.15 VERTICAL/HORIZONTAL YOU ARE HERE MAP

- A. Each graphic panel shall be sized to fit onto the designated double faced post and panel sign with the sign panel and posts as indicated on the drawings. Aluminum cap with concealed, tamper-proof attachments shall be provided. The maximum size for the sign panel shall be 900mm x 1200mm (3' x 4') or as indicated on the drawings, either horizontal or vertical as shown on the drawings, based upon the image to be displayed. The overall sign height shall be 1800mm (6').
- B. Graphics for these panels shall be as indicated on the drawing details and final graphics will be provided by the designer prior to the submittal process.
- C. Graphic process shall be performed by a manufacturer that regularly produces similar products using materials, colors and sizes as indicated, and has performed this work for a minimum of three years. The graphics process shall produce sign panels that are curable, UV resistant, have crisp colors, shall not delaminate, be designed so surfaces scratches do not remove or damage the graphics, have been used for similar signs that have been exposed to the elements while mounted tipped up from horizontal to facilitate viewing, and have performed without failure for long periods of time. The longer the performance life of comparable products used elsewhere, the better. Minimum acceptable performance of similar signs shall be 20 years or more. Samples of the graphic sign panel, with the colors and detail that will be provided for the final sign shall be submitted, reviewed, modifications made as required, and eventually approved if fully compliant, prior to the signs being manufactured. The graphics process shall be surface applied reflective vinyl for text, map is surface silkscreened on the powder coated aluminum panel.
- D. Colors for the graphic image shall be white and necessary colors to create the map as indicated in the graphic file provided by the design A/E.

2.21 TRAFFIC REGULATORY - LOW PROFILE

- A. Each sign shall be sized to fit onto the designated post and panel sign with the sign panel and posts as indicated on the drawings. Aluminum cap with concealed, tamper-proof attachments shall be provided.
- Sign faces shall be 1'-6" x 12" and shall be mounted so the bottom of message panel is 2'-0" above finished grade.

- B. The background color for the signs shall be as selected from the Signage Design Guide (SDG) color chart during the submittal process.
- C. Text and graphics shall be white surface applied vinyl of same material used for the text on the other signs.
- D. The post for mounting the message panels shall be as indicated on the drawings.

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 as shown on Contract Drawings. Depth of posts shall be such that the bottom of the concrete 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 2.7, "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 entry wall. Pins shall be securely anchored as detailed. Face of all lettering shall be in a constant plane, while at the same time minimizing the distance between the back of the letters and the stone wall. Maintain a minimum gap as detailed between the back of the letter and the face of the stone wall.
- 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. Furnish and install concrete collars and/or mow strips, 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.
- J. Sign message panels shall be mounted using tamper-proof mechanical fasteners that are coated and colored to match the message panels.
- K. Install permanent caps on top of all aluminum posts.
- L. 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.

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SECTION 10 73 46
PRE-FABRICATED SITE SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Design, fabrication, finishing, and delivery of pre-engineered, factory-fabricated site shelters.
- B. Site work related to installation, by Contractor, including:
 - 1. Unloading and temporary storage, if any.
 - 2. Site preparation.
 - 3. Column footings, column anchor bolts, and embedment of column anchors.
 - 4. Concrete slab.
 - 5. Erection.
 - 6. Field touch up painting of factory finishes, if necessary.
- C. Related Sections: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE, Section 04 20 00, UNIT MASONRY, Section 04 43 00 - NATURAL STONE VENEER.

1.2 System Description

- A. Design shall meet or exceed applicable building code.
- B. Pre-fabricated package shall include structural steel framing members, pre-cut roof panels, structural wood decking, trim, and fasteners.
- C. All bolts shall be hidden, concealed inside the steel tubes.
- D. Field labor required to install the pre-fabricated parts. Onsite welding shall not be required or permitted.

1.3 References

- A. American Society of Testing Material (ASTM)
 - 1. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated
 - 2. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - 3. ASTM A563 - Standard Specification for Carbons and Alloy Steel Nuts
 - 4. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - 5. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- B. American Institute of Steel Construction (AISC)

- C. American Welding Society (AWS)
- D. Steel Structures Painting Council (SSPC); SSPC-SP10 - Near-White Blast Cleaning
- E. Leadership in Energy and Environmental Design (LEED)
- F. OSHA Standards 29 CFR, Part 1926, Subpart R (Steel Erection), Standard Number 1926.755: Compliance requires a minimum of four anchor bolts per column.

1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State where the Project is located.
- B. Manufacturer Qualifications: Company experienced in design and manufacture of shelters of the type specified, and having the following:
 - 1. Minimum five years of experience in design and fabrication of pre-fabricated steel shelters.
 - 2. Three references of similar shelters completed within the past year.
 - 3. Fabricator membership in American Institute of Steel Construction (AISC), requiring quality control documentation and procedures. Provide current AISC shop certification upon request.
 - 4. All welding to be performed to AWS standards by AWS certified welders. Provide welding certification upon request.
- C. Perform the work in accordance with applicable federal, State, and local building and safety codes and regulations.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 - 1. Provide the licensed professional engineer's state stamp or seal on the shop drawings.
 - 2. Provide the licensed professional engineer's state stamp or seal on the structural calculations.
- B. Selection Samples: For each finish product specified, color charts representing manufacturer's full range of available colors.
- C. Warranty
 - 1. Provide minimum five year frame warranty against manufacturer defects.
 - 2. Provide roofing manufacturer's limited warranty.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Package factory-finished steel components in foam, cardboard, and stretch wrap to protect the finish during transit.
- B. Shipped knocked down for minimal shipping charges.
- C. Deliver products to project site in manufacturer's protective packaging.
- D. Follow shelter manufacturer's recommendations and instructions, including those printed on the shop drawings. To minimize damage during unloading, use only padded forks or non-marring slings.
- E. Store products in manufacturer's unopened packaging well off the ground and covered out of weather until ready for installation.

PART 2 PRODUCTS - STEEL FRAME (SLF)

2.1 GENERAL

- A. Model: Approved similar or equal to -TS-SQ25-04-TG-SSM as manufactured by RCP Shelters, Inc.
- B. Size and dimensions
 - 1. Shape: square
 - 2. Dimensions: 25' x 25' roof, 21' x 21' columns center to center
 - 3. Roof Style: hip
 - 4. Roof Pitch: 4:12
 - 5. Eave Height: minimum clearance at eave shall be 9'-0"

2.2 STRUCTURAL COMPONENTS

- A. Structural Framing: fabricated for field assembly using bolted connections with no welding required or permitted; cold-formed shapes prohibited.
 - 1. Columns & Beams: ASTM A500 Grade B structural steel tube. The following shapes are prohibited: I-beams, wide-flange beams, C-channels, Z-shapes.
 - 2. Plates: ASTM A572 Grade 50.
 - 3. Compression Ring: steel plate, ASTM A572 Grade 50.
 - 4. Fasteners
 - a. Bolts: ASTM A325 high strength bolts.
 - b. Nuts: ASTM A563 high strength nuts.
 - 5. Column Anchors: ASTM A307, provided by Contractor, attached to top of foundation, recessed below slab on grade.

6. Cap plates: shop welded on purlins not normal to roof, so that metal roof deck does not bear structurally on beam corner only; bolted or screwed cap plates are not acceptable.

7. Finish: Powder Coat

- a. Pre-blast inspection to catch and remove oil, grease, and other coatings impeding contaminants
- b. Steel grit blasted to near white condition in accordance with SSPC-SP10, removing all oil residue, mil scale, weld spatter, and slag
- c. Five stage phosphate wash (includes detergent, phosphate, rust protectant sealant)
- d. Epoxy powder coat primer
- e. Double topcoat TGIC polyester powder coat; color to be selected from manufacturer's standard color chart by Owner.
- f. Primer plus finish coats shall be 7-12 mils thick
- g. All materials inspected to meet 100% coating, proper cure, film thickness, and impact resistance
- h. Wet-coat alternatives shall not be acceptable.

B. Structural Wood Deck

1. Species: #1 grade Southern Yellow Pine, kiln dried
2. Treatment: none
3. Size: nominal 2" x 8"
4. Pattern: center matched, tongue and groove, with veed edges 1 side (EV1S)

C. Fascia

1. Species: #1 grade Southern Yellow Pine, kiln dried
2. Treatment: Penta Type C, 0.3pcf
3. Size: nominal 2" x 6"

D. Factory Stained Wood

1. Deck and fascia shall receive factory applied semi-transparent wood stain, recommended to preserve the beauty of the wood. The color shall be chosen from manufacturer's standard color chart.

E. Metal Roof System

1. Galvalume® metal roof panels with hidden fasteners.
2. Profile: Medallion-Lok
3. Panel Gauge: minimum 24-gauge
4. Panel Width: 1'-0"

5. Panel Length: Precut to the length from the eave to the ridge
6. Panel Orientation: Ribs shall run with the pitch of the roof for proper drainage
7. Trim: Matching roof trim and fasteners
8. Finish: Factory pre-finished with Kynar 500® paint system; color to be selected by Owner from standard color chart
9. Underlayment: NovaSeal Premium or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site earthwork has been performed as required for satisfactory installation.

3.2 PREPARATION

- A. Install footings and column anchors of size, design, and location as specified by shelter manufacturer on approved shop drawings.

3.3 INSTALLATION

- A. Perform installation in accordance with applicable federal, State, and local building and safety codes.
- B. Structural special inspections, if required, are to be arranged and paid for by the Contractor.
- C. Install shelter in accordance with manufacturer's approved shop drawing and good construction practices.
- D. Install slab in accordance and dimensions as shown on the structural drawings.

3.4 CLEANING AND PROTECTION

- A. Clean installed work to like-new condition.
- B. Protect installed products until completion of project.
- C. Touch-up, repair, or replace damaged finishes before Substantial Completion. Touch up paint provided by manufacturer.

END OF SECTION

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SECTION 10 73 47

PRE-FABRICATED CONCRETE SITE BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Design, fabrication, finishing, delivery and installation of pre-engineered, factory-fabricated precast multi-purpose buildings.
- B. Site work related to installation, by Contractor, including:
 - 1. Unloading and temporary storage, if any.
 - 2. Site preparation.
 - 3. Erection.
 - 4. Field touch-up painting of factory finishes, if necessary.

1.2 SYSTEM DESCRIPTION

- A. Design shall meet or exceed the following criteria: The design criteria are to ensure that they not only will withstand the forces of nature listed below but will provide protection from vandalism and other unforeseen hazards. Building will be manufactured using precast concrete including the roof. Design will also meet all applicable accessibility and building code requirements.
 - 1. Roof Snow Load:
 - a. The buildings are designed to withstand a 350 pounds per square foot snow load.
 - 2. Floor Load
 - a. The buildings are designed to withstand 400 pounds per square foot floor load.
 - 3. Wind Load
 - a. The buildings will withstand the effects of 150 miles per hour (3-second gust) wind exposure C.
 - 4. Earthquake
 - a. The buildings will withstand the effects of a seismic design category E earthquake.
 - 5. Additional Design Standards
 - a. The buildings are an all concrete design with a minimum 3/12 roof pitch.
 - b. The buildings shall have a minimum 4" wall, 4-1/2" roof, and 5" floor thickness.
 - c. All wall-to-floor interior surface seams shall have a minimum 1" radius coving made of high strength grout.

- B. Pre-fabricated package shall include structural concrete walls, structural concrete roof, concrete floor, interior furring & insulation, door & hardware, electrical and mechanical unit.
- C. Field labor required to install the pre-fabricated building.

1.3 REFERENCES

- A. American Society of Testing Material (ASTM)
 - ASTM C33Concrete Aggregates
 - ASTM C39Method of Test for Compressive Strength of
Cylindrical Concrete Specimens
 - ASTM C94Standard Specification for Ready-Mixed Concrete
 - ASTM C143Method of Test for Slump of Concrete
 - ASTM C150Standard Specification for Portland Cement
 - ASTM C172Standard Practice for Sampling Freshly Mixed Concrete
 - ASTM A185Standard Specification for Steel Welded Wire
Reinforcement, Plain, or Concrete
 - ASTM C192Method of Making and Curing Test Specimens in the
Laboratory
 - ASTM C231Standard Test Method for Air Content of Freshly Mixed
Concrete by the Pressure Method
 - ASTM C309Standard Specifications for Liquid Membrane-Forming
Compounds for Curing Concrete
 - ASTM C494Standard Specification for Chemical Admixtures for
Concrete
 - ASTM A615Standard Specification for Deformed and Plain Carbon-
Steel bars for Concrete Reinforcement
 - ASTM C618Standard Specification for Coal Fly Ash and Raw or
Calcined Natural Pozzolan for Use in Concrete
 - ASTM C979Standard Specification for Pigments for Integrally
Colored Concrete
 - ASTM D1557Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Modified Effort
 - ACI 211.1Standard Practice for Selecting Proportions for
Normal, Heavyweight, and Mass Concrete
 - ACI 306Cold Weather Concreting
 - ACI 318Building Code Requirements Structural Concrete and
Commentary (includes Errata)

PCI MNL 116Quality Control for Plants and Production of Precast
Prestressed Concrete Products

B. OSHA Standards

1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State where the Project is located.
- B. Manufacturer Qualifications: Company experienced in design and manufacture of shelters of the type specified, and having the following:
 - 1. Minimum five years of experience in design and fabrication of pre-fabricated steel shelters.
 - 2. Three references of similar shelters completed within the past year.
 - 3. Fabricator membership in American Institute of Steel Construction (AISC), requiring quality control documentation and procedures. Provide current AISC shop certification upon request.
 - 4. All welding to be performed to AWS standards by AWS certified welders. Provide welding certification upon request.
- C. Perform the work in accordance with applicable federal, State, and local building and safety codes and regulations.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 - 1. Provide the licensed professional engineer's state stamp or seal on the shop drawings.
 - 2. Provide the licensed professional engineer's state stamp or seal on the structural calculations.
- B. Selection Samples: For each finish product specified, color charts representing manufacturer's full range of available colors.
- C. Warranty
 - 1. Provide minimum twenty year warranty on all concrete components against manufacturer defects.
 - 2. Provide minimum one year warranty on all non-concrete components.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Package factory-finished buildings in stretch wrap to protect the finish during transit.
- B. Deliver products to project site in manufacturer's protective packaging.

- C. Follow buildings manufacturer's recommendations and instructions, including those printed on the shop drawings. To minimize damage during unloading, use only padded forks or non-marring slings.
- D. Store products in manufacturer's unopened packaging well off the ground and covered out of weather until ready for installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Model: Approved similar or equal to the Schweitzer II multi-purpose building (Pumphouse building and Storage building (3-sided)) and the Cortez toilet building as manufactured by CXT Incorporated. See architectural drawings for building size and layout.
- B. Size and dimensions
 - 1. Shape: rectangular
 - 2. Dimensions: Schweitzer II -10'-6" X 20'-0"; Cortez -10'-3" X 19'-0".
 - 3. Roof Style: gable
 - 4. Roof Pitch: 3:12
 - 5. Peak Height: Schweitzer II -10'-2"; Cortez -9'-9"
- C. Colors and textures
 - 1. Exterior walls to be 'Split Face Block' texture.
 - 2. Exterior roof to be 'Delta' texture, color Raven Black.

2.2 STRUCTURAL COMPONENTS

- A. Concrete - General
 - 1. The concrete mix design is designed to ACI 211.1 to produce concrete of good workability.
 - 2. Concrete will contain a minimum of 675 pounds of cementitious material per yard. Cement is a low alkali type I/II or III conforming to ASTM C-150.
 - 3. Coarse aggregates used in the concrete mix design will conform to ASTM C33 with the designated size of coarse aggregate #67.
 - 4. Maximum water/cement ratio will not exceed .45.
 - 5. Air-entraining admixtures will conform to ASTM C260. Water reducing admixtures will conform to ASTM C494, Type A.
 - 6. If Self Compacting Concrete (SCC) is used, it must conform to ASTM C1611.
- B. Concrete - Colored
 - 1. Color additives will conform to ASTM C979. A 12" x 12" x 1" color sample is supplied for VA approval.
 - 2. The following will contain colored concrete:

PRE-FABRICATED SITE SHELTERS

- a. Building roof panels.
 - b. Building walls.
- 3. The same brand and type of color additive are used throughout the manufacturing process.
- 4. All ingredients are weighed and the mixing operation are adequate to ensure uniform dispersion of the color.
- C. Concrete - Cold Weather
 - 1. Cold weather concrete placement is in accordance with ACI 306.
 - 2. Concrete will not be placed if ambient temperature is expected to be below 35°F during the curing period unless heat is readily available to maintain the temperature of the concrete at least 50°F.
 - 3. Materials containing frost or lumps of frozen materials will not be used.
- D. Concrete - Hot Weather
 - 1. The temperature of the concrete will not exceed 90°F at the time of placement. When the ambient reaches 90°F the concrete is protected with moist covering.
- E. Concrete Reinforcement
 - 1. All reinforcing steel will conform to ASTM A615. All welded wire fabric will conform to ASTM A185.
 - 2. All reinforcement is new, free of dirt, oil, paint, grease, loose mill scale and loose or thick rust when placed.
 - 3. Details not shown on drawings or specified are to ACI318.
 - 4. Steel reinforcement is centered in the cross-sectional area of the walls and will have at least 1¼" of cover on the under surface of the floor.
 - 5. The maximum allowable variation for center-center spacing of reinforcing steel is 1/2".
 - 6. Full lengths of reinforcing steel are used when possible. When splices are necessary on long runs, splices are alternated from opposite sides of the components for adjacent steel bars.
 - a. Lap bars under #4 a minimum of 12" bar diameters.
 - b. Lap bars larger than #4 a minimum of 24" bar diameters.
 - 7. Reinforcing bars are bent cold. No bars partially embedded in concrete are field bent unless approved by the customer.
- F. Caulking, Grout, Adhesive and Sealer
 - 1. Caulking service temperatures from -40°F to +194°F.
 - 2. Interior and exterior joints are caulked with a paintable polyurethane sealant.

3. Grout is a non-shrink type and are painted to match the color of surrounding concrete as nearly as possible.
4. Cement base coating is formulated with a very fine aggregate system and is a built-in bonding agent.

G. Interior Furring

1. Walls -3 5/8" Galvanized Metal Studs with min R-21 batt insulation
2. Ceilings -6" Galvanized Metal Studs with min R-30 rigid foam insulation
3. 3/4" ACX fire retardant plywood. Caulk all interior seams.
4. 2 coats white fire-retardant semi-gloss.
5. Cortez toilet rooms to have pebble textured (FRP) fiber reinforced panels over plywood full height.
6. 4" Vinyl Base

H. Dead Bolt

1. Certified ANSI/BHMA A156.5-2001 Grade 1.
2. Heavy duty tamper resistant.
3. 2-3/4" backset.
4. U.S. 26D finish.

I. Doors - Steel

1. Doors are flush panel type 1 3/4" thick, insulated, minimum 16-gauge galvanized steel, top painted with DTM ALKYD.
2. Door frames are welded type, single rabbet, minimum 16-gauge prime coated steel top painted with DTM ALKYD, width to suit wall thickness.
3. Weather stripping (bulb type) on all sides of doors.

J. Door Hinges

1. Three (3) per door with dull chrome plating 4 1/2" x 4 1/2", adjustable tension, and automatic closing for each door.

K. Door Sweep

1. Provided at the bottom of door with an adjustable brush.

L. Lockset (HW-1, Privacy Lockset)

1. Meets ANSI A156.2 Series 4000, Grade 1 mortise lockset for exterior door.
2. Lever handle both inside and out.
3. Either handle operates latch unless outside handle is locked by inside push-button.
4. Push-button will automatically release when inside lever handle is turned or door is closed.
5. Keyed on exterior so door can be unlocked from the outside with a VA compatible core.

6. Inside lever always active.
7. Removable astragal as required for double door operation.
8. U.S. 26D finish.

M. Paint

1. All paints and materials will conform to all federal specifications or be similar "top-of-the-line-components."
2. Paints will not contain more than .06% by weight of lead.
3. Type of paints for buildings.
 - a. Inside concrete surfaces.
 - 1) Interior floors - chemical resistant urethane. The color is gray.
 - 2) Interior walls and ceilings - modified acrylic, water repellent penetrating stain. The color is white followed by a clear acrylic anti-graffiti sealer.
 - b. Exterior concrete surfaces.
 - 1) Exterior slab - clear sealer.
 - 2) Exterior walls and roof - water repellent penetrating stain in the same color as the walls or roof followed by a clear acrylic anti-graffiti sealer.
 - c. Metal surfaces (both inside and out).
 - 1) DTM ALKYD.

N. Sealers and Curing Compounds

1. Curing compounds, if used, are colorless, complying with ASTM C309, type I or 1-D.
2. Weatherproofing sealer for exterior of building are a clear water repellent penetrating sealer.

O. Wall Vent

1. Vent cover is 14-gauge, type 304 stainless steel painted with DTM and anchored into the concrete wall with high strength anti-rust tap con fasteners.
2. Vent louver frame and louvers are non-vision, .1" extruded, aluminum jet coat finish.
3. Vent comes with insect screen.
4. Cover to be recessed a minimum 3/4" on exterior walls with a 45-degree bevel. Interior to be flush mounted. Wall vent will not protrude from the wall.

P. Specialties

1. 2 -Sets ADA compliant grab bars.

- 2. 2 -Electric saniflow hand dryers
- 3. 2 -3 roll toilet tissue dispensers.
- 4. 2 -Coat hooks

Q. Mechanical

- 1. 5 -1 Each room, electric wall heaters to keep min. 70 degrees

R. Plumbing (Cortez only)

- 1. 4 Gallon hot water heater.
- 2. 2 -Stainless Steel Toilets
- 3. 2 -Stainless Steel Sinks
- 4. 2 -Floor drains
- 5. All water and sewer lines as required to complete building to building tie-in locations

S. Electrical

(Schweitzer II)

- 1. 100 AMP service panel
- 2. 2 -1x4 LED light fixtures.
- 3. 3 -GFCI outlets @ 12" A.F.F.
- 4. 2 -Outdoor LED light above door on photocell.

(Cortez)

- 1. 100 AMP service panel
- 2. 3 -1x4 LED light fixtures (motion activated in toilet rooms).
- 3. 2 -GFCI outlets @ 42" A.F.F.
- 4. 2 -Outdoor LED light above door on photocell.
- 5. Electrical connection for 2 -Handdryers

PART 3 - EXECUTION

3.1 MANUFACTURE

A. Mixing and Delivery of Concrete

- 1. Mixing and delivery of concrete are in accordance with ASTM C94, Section 12.6 through 12.9.

B. Placing and Consolidating Concrete

- 1. Except for SCC, concrete is consolidated by the use of mechanical vibrators. Vibration are sufficient to accomplish compaction but not to the point that segregation occurs.

PRE-FABRICATED SITE SHELTERS

C. Finishing Concrete

1. Interior floor and exterior slabs are floated and troweled.
2. All exterior building walls and exterior screen walls are any one of the available textures.
3. All exterior surfaces of the roof panels are cast to simulate any one of the available textures. The underside of the overhang will have a smooth finish.

D. Cracks and Patching

1. Cracks in concrete components which are judged to affect the structural integrity of the building are rejected.
2. Small holes, depressions, and air voids are patched with a suitable material. The patch will match the finish and texture of the surrounding surface.
3. Patching will not be allowed on defective areas if the structural integrity of the building is affected.

E. Curing and Hardening Concrete

1. Concrete surfaces will not be allowed to dry out from exposure to hot, dry weather during initial curing period.

3.2 FINISHING AND FABRICATION

A. Structural Joints

1. Wall components are joined together with two (2) welded plate pairs at each joint.
2. Each weld plate is 6" long and located one (1) pair in the top quarter and one (1) pair in the bottom quarter of the seam.
3. Weld plates are anchored into the concrete panel and welded together with a continuous weld.
4. Inside seams are a paintable caulk.
5. Outside seams will use a caulk in a coordinating building color or clear.
6. Walls and roof are joined with weld plates, 3" x 6" at each building corner.
7. The joint between the floor slab and walls are joined with a grout mixture on the inside, a matching colored caulk on the outside and two (2) weld plates 6" long per wall.

B. Painting/Staining

1. An appropriate curing time is allowed before paint is applied to concrete.

2. Some applications may require acid etching. A 30% solution of hydrochloric acid are used, flushed with water, and allowed to thoroughly air dry.
3. Painting will not be done outside in cold, frosty, or damp weather.
4. Painting will not be done outside in winter unless the temperature is 50°F or higher.
5. Painting will not be done in dusty areas.
6. All surface voids are filled prior to painting
7. Schedule of finishes.
 - a. Inside concrete surfaces.
 - 1) Inside floors - one (1) coat of 1-part water based chemical resistant urethane.
 - 2) Interior walls and ceilings - two (2) coats of epoxy paint on gypsum board.
 - b. Exterior concrete surfaces.
 - 1) Exterior walls - two (2) coats of water repellent penetrating stain in the same color as the walls or roof followed by one (1) coat of clear acrylic anti-graffiti sealer.
 - c. Metal surfaces (both inside and out).
 - 1) Two (2) coats of DTM ALKYD.

3.3 TESTING

- A. Testing will only be performed by qualified individuals who have been certified ACI Technician Grade 1.
- B. Sampling is in accordance with ASTM C172.
- C. The following tests are performed on concrete used in the manufacture of toilets. All testing is performed in the CXT (PCI certified) laboratories.
 1. Air content - checked per ASTM C231 on the first batch of concrete. The air content is in the range of 5.0% +/- 1.5%.
 2. Compressive strength of the cylinders - tested to ASTM C39.
 - a. Two (2) are tested at release (minimum strength of 2500 psi).
 - b. One (1) is tested at seven (7) days (minimum strength of 4500 psi).
 - c. Two (2) are tested at 28 days (minimum strength of 5000 psi).
- D. Provide a copy of all test reports as soon as 28-day test results are available.

3.4 INSTALLATION

- A. Scope of Work
 1. Work specified under this section relates to the placement of the building.
- B. Location

1. Provide exact location by stakes or other approved method.
2. Provide clear and level site free of overhead and/or underground obstructions.
3. Provide access to the site for truck delivery and sufficient area for the crane to install and the equipment to perform the contract requirements.
4. Water and electrical site connections to be placed per building shop drawings. Must be placed to easily connect to the building.

C. Compacting

1. The bottom of the area must be compacted after it has been dug out. After the base has been placed, it must be compacted as well. The bearing of the soil and base should be a minimum of 1,500 pounds per square foot.

D. Base

1. After compacting the bottom of the area, a minimum of 30" thick and consist of 3/4" minus crushed rock (i.e. road base material) compacted to 95% of optimal density in accordance with ASTM D1557. Finished surface of sub-base shall be flat and level, with a maximum deviation of -1/2", +0" from a true horizontal plane.
2. The base should be placed for support, leveling and drainage purposes and also to limit frost action. The base must be confined so as to prevent washout, erosion, or any other undermining.

E. Access to Site

1. Delivery to site made on normal highway trucks and trailers.

3.5 CLEANING AND PROTECTION

- A. Clean installed work to like-new condition.
- B. Protect installed products until completion of project.
- C. Touch-up, repair, or replace damaged finishes before Substantial Completion. Touch up paint provided by manufacturer.

END OF SECTION

PART 1 BID DOCUMENT Submittal
National Cemetery Development
Cedar City Rural Initiative

Project No. 942CM3001
22 July 2022

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SECTION 10 75 00
FLAGPOLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials, shipping and delivery protection, storage, handling, and installation of flagpoles to be installed in the project area indicated. Flagpoles shall be deluxe internal halyard fixed high dimensional, ground set, cone tapered, seamless tube flag poles together with concealed halyard, revolving truck, finial ball, flashing collar, anchors, fittings, and accessories.

1.2 RELATED WORK

- A. Excavation and backfill: Section 31 20 00, EARTH MOVING.
B. Concrete for ground set flagpole: Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Shop Drawings: Flagpole details of all parts & accessories, and list of all materials, including but not limited to: base with support plate and grounding spike, lightning kit, pole, flash collar, revolving truck, internal halyard, cable assembly, winch detail w/lock, hooks, beaded retainer ring, counterweight, winch handle and finial ball, along with construction and installation details. Flagpole components shall match those for the main pole.
C. Manufacturer's Literature and Data: Flagpole, base and all parts and accessories.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
B. American Society for Testing and Materials (ASTM):
A167-99 (R2009)Stainless and Heat-resisting Chromium-Nickel
Steel Plate, Sheet and Strip
B209-10Aluminum and Aluminum Alloy-Sheet and Plate
B241/B241M-12Aluminum and Aluminum-Alloy Seamless Pipe and
Seamless Extruded Tube
C. American National Standards Institute Inc. (ANSI):

ANSI/NAAMM 1001-97Guide Specifications for Design of Metal
Flagpoles Manual.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of metal flagpoles and accessories of the types, size and configurations required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects having flagpole installation work similar to that required for this project.
- C. Design Criteria: Flagpole shall be designed to withstand the wind speeds and conditions indicated herein for the specific flagpole and flag sizes indicated.
 - 1) The 50-foot flag pole shall be designed based upon a minimum sustained 100 mph wind velocity and minimum wind gust velocity of 120 mph when flying a flag 12'x18' in size in accordance with ANSI/NAAMM 1001-97, with the pole wall thickness being in conformance with the design standards but with a minimum wall thickness of 0.188 inches, whichever causes the stronger flagpole. The flagpole foundation(s) has/have been designed based upon applicable conditions for the project specific location of the respective flagpole.
 - 2) The 30-foot flag pole shall be designed based upon a minimum sustained 100 mph wind velocity and minimum wind gust velocity of 120 mph when flying a flag 5'x8' in size in accordance with ANSI/NAAMM 1001-97, with the pole wall thickness being in conformance with the design standards but with a minimum wall thickness of 0.188 inches, whichever causes the stronger flagpole. The flagpole foundation(s) has/have been designed based upon applicable conditions for the project specific location of the respective flagpole.

1.7 PROTECTION AND SHIPPING

- A. Package flagpole for shipping with spiral wrap protective covering and pack in shipping tubes acceptable to owner's designated representative and per manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum, Extruded: ASTM B241, alloy 6063 - T6.
- B. Aluminum, Plate and Sheet: ASTM B209, alloy 1100.
- C. Stainless Steel: ASTM A167, Class 302 or 304.

2.2 FABRICATION

- A. Fabricate flagpole of seamless extruded aluminum tube, uniform conical taper of approximately 1 in 70, one inch in every 6 feet. Taper shall not exceed 50 percent of outside diameter of pole. When flagpoles are shipped in more than one section, provide self-aligning sleeves for field joint.
- B. Base: Aluminum plate of stock design similar to that shown.
- C. Finial Ball: 0.0747 inch thick spun aluminum sphere, with seams of ball welded flush and watertight. Mount ball on threaded rod to fit truck. Diameter of ball shall be approximately same as pole butt diameter.
- D. Truck: Equip pole with extra heavy, revolving, non-fouling, ball bearing type truck with cast aluminum body and designed to accept an ornament on top.
- E. Halyards: Internal type cable assemblies. 3/16" stainless steel aircraft cable incorporating a stainless steel swivel, upper cable section, and flag arrangement with cable and two stainless steel quick links and two stainless steel swivel snaps. The cable assemblies shall be constructed to fit the flagpole size and flag size specified.
- F. Beaded Retainer Ring and Counterweights: Provide as recommended by manufacturer based on the pole size, flag size and design wind velocity. Provide recommended connection accessories.
- G. Internal Halyard Accessories: Furnish and install a gearless, self-locking at any point, direct-drive winch that does not require welding for installation and does not require monthly application of lubrication and is attached to the pole with one stainless steel bolt on the back side of the pole. The unit shall be silver in color. Provide locking mechanism and two keys. Provide a winch handle designed for the unit. Pole shall be reinforced through the area of the winch opening by the manufacturer's standard reinforcement method.
- H. Foundation Tube: Hot dipped galvanized corrugated steel tube. Tube shall have a steel base plate and centering wedges and support plate

for connection of lightening kit. Bottom plate shall be a minimum of 3/16" thickness.

- I. Lightning Kit: Provide a complete kit (maximum protection available) for each pole. Configuration and components for the kit shall be as recommended by the pole manufacturer for use on the pole selected.

2.3 FINISH

- A. Finish exposed surfaces of flagpoles.
- B. Flagpole shaft: Satin brushed aluminum, then heavily waxed.
- C. Finial ball: Gold anodized aluminum, then heavily waxed.
- D. Base and cleats: Finish to match flagpole.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that concrete foundation work is correctly sized and positioned.
- B. Repair or replace defective foundation work as directed by owner's designated representative.

3.2 PREPARATION

- A. Coat portions of flagpole below grade and in surfaces in contact with dissimilar metals with black asphaltum paint, as recommended by manufacturer.

3.3 INSTALLATION

- A. Install galvanized, corrugated steel sleeve or tube of detailed length, welded to steel base plates for installation in concrete. Set base plate and Lightning Kit in place before concrete is placed. Follow the manufacturer's recommendations for the installation of the lightning kits.
- B. Install foundation plate and centering wedges for flagpole base in concrete base and fasten.
- C. Install concrete foundation work to dimensions indicated in accordance with Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- D. Wrap top of sleeve with two layers of asphalt felt for distance of 2 feet down.
- E. Install flagpole in accordance with manufacturers written installation instructions. Install pole plumb using centering wedges.
- F. Backfill and compact excavation around flagpole base in accordance with Section 31 20 00, EARTH MOVING.
- G. Fill and thoroughly compact dry fine sand into the space between pole and steel sleeve and tamp to within 2 inches of top of sleeve.

- H. Remove temporary wood positioning wedges and fill upper 2-inch space between pole and steel sleeve with specified or manufacturer recommended waterproofing compound.
- I. Install fittings in accordance with manufacturer's written installation instructions.
- J. Check and adjust installed fittings for smooth operation of halyards.

3.2 LIGHTNING ROD

- A. Weld lightning ground rod of 3/4-inch diameter galvanized steel to base plate at bottom of sleeve or tube, and to steel support plate at grade.

3.3 CLEANUP

- A. After installation, carefully clean the flagpole and appurtenances, removing all dirt stains, and all other incident defacements.
 - 1. Fabricator should be contacted regarding the use of any cleaners and must approve of them before use.
 - 2. Protection of Finished Work: Flagpoles for this project shall be protected at all times during construction.
- B. Clean up area of excess material and debris.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial

standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory (NRTL): Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

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

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

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests.

The Contractor shall notify the Government through the COR a minimum of 15 working days prior to the manufacturer's performing the factory tests.

2. Four copies of certified test reports shall be furnished to the COR two weeks prior to final inspection and not more than 90 days after completion of the tests.
3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

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

1.8 MATERIALS AND EQUIPMENT PROTECTION

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

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J - General Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.

- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 - 2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the COR and NCA staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
 - 3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Paragraph 1.6, OPERATIONS AND STORAGE AREAS under Section 01 00 02, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 02, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.

2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

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

- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
 - 1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, and building; name of Contractor, and contract name and number. Include in the manual the names,

- addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory-approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
 - G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
 - H. After approval and prior to installation, furnish the COR with one sample of each of the following:
 1. A minimum 300 mm (12-inch) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 2. Each type of conduit coupling, bushing, and termination fitting.
 3. Conduit hangers, clamps, and supports.
 4. Duct sealing compound.

5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

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

1.14 ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.15 WARRANTY

- A. All work performed, and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.16 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation and shall be trained in operating theory as well as practical operation and maintenance procedures.

C. A training schedule shall be developed and submitted by the Contractor
and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- - - - END - - - -

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. 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.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.
- D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.

2. Certifications: Two weeks prior to final inspection, submit the following:

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

B. American Society of Testing Material (ASTM):

D2301-10Standard Specification for Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape

D2304-10Test Method for Thermal Endurance of Rigid
Electrical Insulating Materials

D3005-10Low-Temperature Resistant Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape

C. National Electrical Manufacturers Association (NEMA):

WC 70-09Power Cables Rated 2000 Volts or Less for the
Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-11National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-10Thermoset-Insulated Wires and Cables

83-08Thermoplastic-Insulated Wires and Cables

467-07Grounding and Bonding Equipment

486A-486B-03Wire Connectors

486C-04Splicing Wire Connectors

486D-05Sealed Wire Connector Systems

486E-09Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors

493-07Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cables

514B-04Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

- D. Color Code:

- 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75-inch) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

| 208/120 V | Phase | 480/277 V |
|--|---------|-----------|
| Black | A | Brown |
| Red | B | Orange |
| Blue | C | Yellow |
| White | Neutral | Gray * |
| * or white with colored (other than green) tracer. | | |

- 6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. Contractor to propose "traveling wires" color. This shall be confirmed in an RFI to the VA and then included within the low voltage wiring submittal.

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

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
 4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
 1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- E. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.

- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

2.4 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use non-flammable expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 2. Use nonmetallic pull ropes.
 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 4. All conductors in a single conduit shall be pulled simultaneously.
 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

3.3 SPLICE AND TERMINATION INSTALLATION

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

3.4 CONDUCTOR IDENTIFICATION

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

3.5 FEEDER CONDUCTOR IDENTIFICATION

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

3.6 CONTROL WIRING INSTALLATION

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

3.7 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each handhole, install embossed brass tags to identify the system served and function.

3.9 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.

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

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.
- E. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Lightning protection.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COR.

3. Certifications:

- a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
- B1-07Standard Specification for Hard-Drawn Copper Wire
- B3-07Standard Specification for Soft or Annealed Copper Wire
- B8-11Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-83IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
- 70-11National Electrical Code (NEC)
- 70E-12National Electrical Safety Code
- 99-12Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-10Thermoset-Insulated Wires and Cables
- 83-08Thermoplastic-Insulated Wires and Cables
- 467-07Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall

be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

A. Steel or copper clad steel, 19 mm (0.75 inches) diameter by 3 M (10 feet) long.

B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE

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

2.4 GROUND CONNECTIONS

A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes, smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2. Connection to Building Steel: Exothermic-welded type connectors.

3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inches) thick x 19 mm (0.75 inches)

wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

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

2.7 GROUNDING BUS BAR

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inches) 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. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
- B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding

provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

C. Pad-Mounted Transformers:

1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
2. Ground the secondary neutral.

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

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

C. Panelboards, and other electrical equipment:

1. Connect the equipment grounding conductors to the ground bus.
2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

D. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

3.5 RACEWAY

A. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to

- interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.6 CORROSION INHIBITORS

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

3.7 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.8 LIGHTNING PROTECTION SYSTEM

A. Bond the lightning protection system to the electrical grounding electrode system.

3.9 MAIN ELECTRICAL ROOM GROUNDING

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

3.10 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.

3.11 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.

3.12 ACCEPTANCE CHECKS AND TESTS

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

- - - END - - -

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- C. Section 26 05 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 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Size and location of main feeders.
 - b. Size and location of panels and pull-boxes.
 - c. Submit the following data for approval:
 - 1) Raceway types and sizes.
 - 2) Conduit bodies, connectors and fittings.
 - 3) Junction and pull boxes, types and sizes.
 - 2. Certifications: Two weeks prior to final inspection, submit the following:

- a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
 - C80.1-05Electrical Rigid Steel Conduit
 - C80.3-05Steel Electrical Metal Tubing
 - C80.6-05Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - 1-05Flexible Metal Conduit
 - 5-11Surface Metal Raceway and Fittings
 - 6-07Electrical Rigid Metal Conduit - Steel
 - 50-95Enclosures for Electrical Equipment
 - 360-13Liquid-Tight Flexible Steel Conduit
 - 467-13Grounding and Bonding Equipment
 - 514A-13Metallic Outlet Boxes
 - 514B-12Conduit, Tubing, and Cable Fittings
 - 514C-07Nonmetallic Outlet Boxes, Flush-Device Boxes
and Covers
 - 651-11Schedule 40 and 80 Rigid PVC Conduit and
Fittings
 - 651A-11Type EB and A Rigid PVC Conduit and HDPE
Conduit
 - 797-07Electrical Metallic Tubing
 - 1242-06Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):

- TC-2-13Electrical Polyvinyl Chloride (PVC) Tubing and
Conduit
- TC-3-13PVC Fittings for Use with Rigid PVC Conduit and
Tubing
- FB1-12Fittings, Cast Metal Boxes and Conduit Bodies
for Conduit, Electrical Metallic Tubing and
Cable
- FB2.10-13Selection and Installation Guidelines for
Fittings for use with Non-Flexible Conduit or
Tubing (Rigid Metal Conduit, Intermediate
Metallic Conduit, and Electrical Metallic
Tubing)
- FB2.20-12Selection and Installation Guidelines for
Fittings for use with Flexible Electrical
Conduit and Cable
- F. American Iron and Steel Institute (AISI):
 - S100-2007North American Specification for the Design of
Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 0.75-inch.
Where permitted by the NEC, 0.75-inch flexible conduit may be used for
tap connections to recessed lighting fixtures.
- B. Conduit:
 - 1. Size: In accordance with the NEC, but not less than 0.75-inch.
 - 2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
 - 3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242
and ANSI C80.6.
 - 4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI
C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be
permitted only with cable rated 600 V or less.
 - 5. Flexible Metal Conduit: Shall conform to UL 1.
 - 6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
 - 7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A,
heavy wall PVC or high-density polyethylene (PE).
 - 8. Surface Metal Raceway: Shall conform to UL 5.
- C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Electrical Metallic Tubing Fittings:
 - a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Indent-type connectors or couplings are prohibited.
 - d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible Metal 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 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: Fittings shall meet the requirements of UL 514C and NEMA TC3.
- 6. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
- 7. Expansion and Deflection Couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 - 1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 - 1. UL-50 and UL-514A.
 - 2. Rustproof cast metal where required by the NEC or shown on drawings.
 - 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR where working space is limited.
- B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
 2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
 3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 5. Cut conduits square, ream, remove burrs, and draw up tight.
 6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.

7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
 8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
 9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
 10. Conduit installations under fume and vent hoods are prohibited.
 11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 12. Conduit bodies shall only be used for changes in direction and shall not contain splices.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.
 - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

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

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.

- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8-foot) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.

3.5 DIRECT BURIAL INSTALLATION

Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 WET OR DAMP LOCATIONS

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

3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.8 EXPANSION JOINTS

- A. Conduits 75 mm (3 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 flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5-inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.

3.9 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, Rowlplug®, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
1. Flush-mounted.
 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of (4) 90-degree bends are necessary.
- C. Locate pull boxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24-inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example, "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

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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 underground ducts and raceways, and pullboxes to form a complete underground electrical raceway system.
- B. The terms "duct" and "conduit" are used interchangeably in this section.

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 31 20 00, EARTH MOVING: Trenching, backfill, and compaction.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, and pullboxes with final arrangement of other utilities, site grading, and surface features.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit information on manholes, pullboxes, ducts, and hardware. Submit manhole plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.
 - c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pullboxes, or duct banks at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the COR for approval prior to construction.

2. Certifications: Two weeks prior to the final inspection, submit the following:

- a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Concrete Institute (ACI):

Building Code Requirements for Structural Concrete

318-11/318M-11Building Code Requirements for Structural
Concrete & Commentary

SP-66-04ACI Detailing Manual

C. American National Standards Institute (ANSI):

77-10Underground Enclosure Integrity

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

C478-12Standard Specification for Precast Reinforced
Concrete Manhole Sections

C858-10e1Underground Precast Concrete Utility Structures

C990-09Joints for Concrete Pipe, Manholes and Precast
Box Sections Using Preformed Flexible Joint
Sealants.

E. National Electrical Manufacturers Association (NEMA):

TC 2-03Electrical Polyvinyl Chloride (PVC) Conduit

TC 3-04Polyvinyl Chloride (PVC) Fittings for Use With
Rigid PVC Conduit And Tubing

TC 6 & 8-03Polyvinyl Chloride (PVC) Plastic Utilities Duct
For Underground Installations

TC 9-04Fittings For Polyvinyl Chloride (PVC) Plastic
Utilities Duct For Underground Installation

F. National Fire Protection Association (NFPA):

70-11National Electrical Code (NEC)

70E-12National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

- | | | |
|---------|-------|--|
| 6-07 | | Electrical Rigid Metal Conduit-Steel |
| 467-07 | | 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 |
| 651B-07 | | Continuous Length HDPE Conduit |

PART 2 - PRODUCTS

2.1 PULLBOXES

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL, as applicable. Pullboxes shall comply with the requirements of ANSI 77 Tier 15 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.
- B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.

2.2 DUCTS

- A. Number and sizes shall be as shown on the drawings.
- C. Ducts (direct-burial):
1. Plastic duct:
 - a. NEMA TC2 and TC3 Schedule 80 PVC or HDPE conduit.
 - 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 (200 lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 MANHOLE AND PULLBOX INSTALLATION

- A. Assembly and installation shall be per the requirements of the manufacturer.
 - 1. Install manholes and pullboxes level and plumb.
 - 2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
- B. Access: Ensure the top of frames and covers are flush with finished grade.

3.2 TRENCHING

- A. Refer to Section 31 20 00, EARTH MOVING for trenching, backfilling, and compaction.
- C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- F. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the COR.

3.3 DUCT INSTALLATION

- A. General Requirements:
 - 1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
 - 2. Join and terminate ducts with fittings recommended by the manufacturer.
 - 3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
 - 4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.

5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times the conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water.
10. Clearances between individual ducts:
 - a. For similar services, not less than 75 mm (3 inches).
 - b. For power and signal services, not less than 150 mm (6 inches).
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.

17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. 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. 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 partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

A. Duct Testing and Cleaning:

1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
2. The mandrel shall be not less than 300 mm (12 inches) long and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.

3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the COR at no cost to the Government.
4. Mandrel pulls shall be witnessed by the 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 1.4, 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 software program to be used for the study.
Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
 - 2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
 - 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.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 241-90Recommended Practice Electrical Systems in Commercial Buildings
 - 242-01Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 399-97Recommended Practice for Industrial and Commercial Power Systems Analysis
 - 1584-02Performing Arc-Flash Hazards Calculations
 - 1584A-04Performing Arc-Flash Hazards Calculations - Amendment 1
 - 1584B-11Performing Arc-Flash Hazards Calculations - Amendment 2

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. 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. 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 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:
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY:
Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, 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-12International Building Code
- C. National Electrical Manufacturers Association (NEMA):
PB 1-11Panelboards
250-08Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
70-11National Electrical Code (NEC)
70E-12Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
50-95Enclosures for Electrical Equipment
67-09Panelboards
489-09Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
- J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with sub feed 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 pre-punched knockouts on top and bottom endwalls. Panelboards scheduled to be in finished rooms or areas shall have no pre-punched knockouts on top and bottom endwalls of the enclosure. The enclosure shall be paintable and shall be painted to match color of front trim.
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.
6. All trims/doors shall be lockable and they all shall have matching keys.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
 1. 120/208 V Panelboard: 10,000 A symmetrical.
 2. 120/240 V Panelboard: 10,000 A symmetrical.
 3. 277/480 V Panelboard: 14,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field, based on an approved protective device study.
- E. Circuit breaker features shall be as follows:
 1. A rugged, integral housing of molded insulating material.
 2. Silver alloy contacts.

3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, 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.

2.4 SURGE PROTECTIVE DEVICES

- A. Where shown on the drawings, furnish panelboards with integral surge protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards.
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.
- F. 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.
- G. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage and required area clearances.
- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

- - - END - - -

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.

- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following:
 - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code (NEC)
 - 99-12Health Care Facilities
- C. National Electrical Manufacturers Association (NEMA):
 - WD 1-10General Color Requirements for Wiring Devices
 - WD 6-08Wiring Devices - Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-11Surface Metal Raceways and Fittings
 - 20-10General-Use Snap Switches
 - 231-07Power Outlets
 - 467-07Grounding and Bonding Equipment
 - 498-07Attachment Plugs and Receptacles
 - 943-11Ground-Fault Circuit-Interrupters
 - 1449-07Surge Protective Devices
 - 1472-96Solid 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 plated 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: 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 Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring.
 - a. Ground fault interrupter shall consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
 - b. Ground Fault Interrupter Duplex Receptacles (not hospital-grade) shall be the same as ground fault interrupter hospital-grade receptacles except for the hospital-grade listing.
 4. Safety Type 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.

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

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts and minimum single transient pulse energy dissipation of 210 Joules.

2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

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 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel and shall have tamperproof screws and beveled edges. 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.

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, commercial grade. See paragraph 2.1, 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 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.
5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
6. Bond the assemblies to the branch circuit conduit system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multi-gang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.

- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin up. 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. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Inspect physical and electrical condition.
 - 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 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

- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. 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-12International Building Code
- C. National Electrical Manufacturers Association (NEMA):
FU 1-07Low Voltage Cartridge Fuses
KS 1-06Enclosed and Miscellaneous Distribution
Equipment Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):
70-11National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
98-07Enclosed and Dead-Front Switches
248-00Low Voltage Fuses
489-09Molded 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 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.4 CARTRIDGE FUSES

- A. Shall be in accordance with NEMA FU 1.
- B. Service Entrance: Class RK1, fast acting.

- C. Feeders: Class RK1, fast acting.
- D. Motor Branch Circuits: Class RK1, time delay.
- E. Other Branch Circuits: Class RK1, time delay.
- F. Control Circuits: Class CC, fast acting.

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. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

- - - END - - -

SECTION 26 41 00
FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing and installation of a complete UL master labeled lightning protection system.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4, QUALIFICATIONS, (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Show locations of air terminals, connections to required metal surfaces, down conductors, and grounding means.
 - c. Show the mounting hardware and materials used to attach air terminals and conductors to the structure.
 2. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the lightning protection system conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the lightning protection system has been properly installed and inspected.
 - c. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced.
- B. National Fire Protection Association (NFPA):
- 70-11National Electrical Code (NEC)
 - 780-11Standard for the Installation of Lightning Protection Systems
- C. Underwriters Laboratories, Inc. (UL):
- 96-05Lightning Protection Components
 - 96A-07Installation Requirements for Lightning Protection Systems
 - 467-07Standard for Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Lightning protection components shall conform to NFPA 780 and UL 96, for use on Class I structures. Aluminum materials are not allowed.
1. Class I conductors: Copper.
 2. Class I air terminals: Solid copper, 18 inches long, not less than 9.5 mm (3/8 inch) diameter, with blunt nickel-plated points.
 4. Ground rods: Copper-clad steel, 0.75 in diameter by 10 feet long.
 5. Ground plates: Solid copper, not less than 20 gauge.
 6. Bonding plates: Bronze, 50 square cm (8 square inches).
 7. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
 8. Down conductor guards: Stiff copper or brass.
 9. Anchors and fasteners: Bronze bolt and clamp type shall be used for all applications except for membrane roof. Adhesive type are allowed only for attachment to membrane roof materials, using adhesive that is compatible with the membrane material.
 10. Connectors: Bronze clamp-type connectors shall be used for roof conductor splices, and the connection of the roof conductor to air terminals and bonding plates. Crimp-type connectors are not allowed.
 11. Exothermic welds: Exothermic welds shall be used for splicing the roof conductor to the down conductors, splices of the down conductors, and for connection of the down conductors to ground rods, ground plates, and the ground ring.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be coordinated with the roofing manufacturer and installer.
- B. Install the conductors as inconspicuously as practical.
- C. Install the down conductors within the concealed cavity of exterior walls where practical. Run the down conductors to the exterior at elevations below the finished grade.
- D. Where down conductors are subject to damage or are accessible near grade, protect with down conductor guards to 2.4 m (8 feet) above grade. Bond down conductor guards to down conductor at both ends.
- E. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
- F. Install ground rods and ground plates not less than 2 feet deep and a distance not less than 900 mm (3 feet) nor more than 2.5 m (8 feet) from the nearest point of the structure. Exothermically weld the down conductors to ground rods and ground plates in the presence of the COR.
- G. Bond down conductors to metal main water piping where applicable.
- H. Bond down conductors to building structural steel.
- I. Connect roof conductors to all metallic projections and equipment above the roof as indicated on the drawings.
- J. Connect exterior metal surfaces, located within 900 mm (3 feet) of the conductors, to the conductors to prevent flashovers.
- K. Maintain horizontal or downward coursing of main conductor and ensure that all bends have at least an 200 mm (8 inches) radius and do not exceed 90 degrees.
- L. Conductors shall be rigidly fastened every 900 mm (3 feet) along the roof and down to the building to ground.
- M. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the structure.
- N. Install air terminal bases, cable holders and other roof-system supporting means without piercing membrane or metal roofs.
- P. Down conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the

case of long vertical members, an additional connection shall be made at intervals not exceeding 30 M (100 feet).

- Q. A counterpoise or ground ring, where shown, shall be of No. 1/0 copper cable having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm (2 feet) deep at a distance not less than 900 mm (3 feet) nor more than 2.5 M (8 feet) from the nearest point of the structure.
- R. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for lightning to ground.
- S. Where shown, use the structural steel framework or reinforcing steel as the down conductor.
 - 1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
 - 2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
 - 3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 18 m (60 foot) intervals.
 - 4. Install ground connections to earth at not more than 18 m (60 foot) intervals around the perimeter of the building.
 - 5. Weld or braze bonding plates to cleaned sections of the steel and connect the conductors to the plates.
 - 6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL 96A.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. A UL representative shall inspect the lightning protection system. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the COR.

- - - END - - -

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

1.2 RELATED WORK

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
- a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.
 - f. Energy efficiency data.
 - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

- h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
 - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
 - j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following:
- a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
 - C78.1-91Rapid-Start Types - Dimensional and Electrical Characteristics
- C. American Society for Testing and Materials (ASTM):
 - C635-07Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
- D. Environmental Protection Agency (EPA):
 - 40 CFR 261Identification and Listing of Hazardous Waste
- E. Federal Communications Commission (FCC):
 - CFR Title 47, Part 15 ..Radio Frequency Devices
 - CFR Title 47, Part 18 ..Industrial, Scientific, and Medical Equipment

F. Illuminating Engineering Society (IES):

- LM-79-08Electrical and Photometric Measurements of
Solid-State Lighting Products
- LM-80-08Measuring Lumen Maintenance of LED Light
Sources
- LM-82-12Characterization of LED Light Engines and LED
Lamps for Electrical and Photometric Properties
as a Function of Temperature

G. Institute of Electrical and Electronic Engineers (IEEE):

- C62.41-91Surge Voltages in Low Voltage AC Power Circuits

H. International Code Council (ICC):

- IBC-12International Building Code

I. National Fire Protection Association (NFPA):

- 70-11National Electrical Code (NEC)
- 101-12Life Safety Code

J. National Electrical Manufacturer's Association (NEMA):

- SSL-1-10Electronic Drivers for LED Devices, Arrays, or
Systems

K. Underwriters Laboratories, Inc. (UL):

- 496-08Lampholders
- 844-12Luminaires for Use in Hazardous (Classified)
Locations
- 924-12Emergency Lighting and Power Equipment
- 1029-94High-Intensity-Discharge Lamp Ballasts
- 1029A-06.....Ignitors and Related Auxiliaries for HID Lamp
Ballasts
- 1598-08Luminaires
- 1574-04.....Track Lighting Systems
- 2108-04.....Low-Voltage Lighting Systems
- 8750-09.....Light Emitting Diode (LED) Light Sources for
Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

E. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

F. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion-resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light-reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

G. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

H. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

2.2 EMERGENCY LIGHTING UNIT

A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.

1. Enclosure: Shall be cast aluminum. Enclosure shall be suitable for the environmental conditions in which installed.
2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
3. Lamps: Shall be sealed-beam MR-16 halogen, rated not less than 12 watts at the specified DC voltage.
4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.3 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: ≥ 0.95.
 - f. Total Harmonic Distortion: ≤ 20%.
 - g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- B. LED Downlights:
 1. Housing, LED driver, and LED module shall be products of the same manufacturer.
- C. LED Troffers:
 1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
 2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20-gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
- D. Lighting Fixture Supports:
 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 2. Shall maintain the fixture positions after cleaning and relamping.
 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.
- I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform the following:
 - 1. Visual Inspection:
 - a. Verify proper operation by operating the lighting controls.
 - b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
 - 2. Electrical tests:
 - a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the SRE. Observe for visually detectable flicker over full dimming range and replace defective components at no cost to the Government.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

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SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior fixtures, poles, and supports. The terms "lighting fixtures", "fixture" and "luminaire" are used interchangeably.

1.2 RELATED WORK

- A. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- B. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- 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 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- G. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.

- e. Installation details.
 - f. Energy efficiency data.
 - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
 - h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
 - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
 - j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
 - k. Submit site plan showing all exterior lighting fixtures with fixture tags consistent with Lighting Fixture Schedule as shown on drawings. Site plan shall show computer generated point-by-point illumination calculations. Include lamp lumen and light loss factors used in calculations.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the Contractor that the exterior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Aluminum Association Inc. (AA):
AAH35.1-06Alloy and Temper Designation Systems for
Aluminum

- C. American National Standards Institute (ANSI):
C81.61-09Electrical Lamp Bases - Specifications for
Bases (Caps) for Electric Lamps
- D. American Society for Testing and Materials (ASTM):
A123/A123M-12Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A153/A153M-09Zinc Coating (Hot-Dip) on Iron and Steel
Hardware
B108-03a-08Aluminum-Alloy Permanent Mold Castings
C1089-13Spun Cast Prestressed Concrete Poles
- E. Illuminating Engineering Society of North America (IESNA):
HB-9-00Lighting Handbook
RP-8-05Roadway Lighting
LM-52-03Photometric Measurements of Roadway Sign
Installations
LM-72-10Directional Positioning of Photometric Data
LM-79-08Approved Method for the Electrical and
Photometric Measurements of Solid-State Lighting
Products
LM-80-08Approved Method for Measuring Lumen Maintenance
of LED Light Sources
TM-15-07Backlight, Uplight and Glare (BUG) Ratings
- F. National Electrical Manufacturers Association (NEMA):
C136.3-05For Roadway and Area Lighting Equipment -
Luminaire Attachments
ICS 2-00 (R2005)Controllers, Contactors and Overload Relays
Rated 600 Volts
ICS 6-93 (R2006)Enclosures
- G. National Fire Protection Association (NFPA):
70-11National Electrical Code (NEC)
- H. Underwriters Laboratories, Inc. (UL):
496-08Lampholders
773-95Plug-In, Locking Type Photocontrols for Use
with Area Lighting
773A-06Nonindustrial Photoelectric Switches for
Lighting Control
1598-08Luminaires

8750-09Light Emitting Diode (LED) Equipment for Use in
Lighting Products

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

Luminaires, materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.4 LUMINAIRES

- A. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and re-lamping.
- B. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Pre-wire internal components to terminal strips at the factory.
- F. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- G. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- H. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- I. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.5 LAMPS

- A. Install the proper lamps in every luminaire installed as shown on the drawings.
- B. Lamps shall be general-service, outdoor lighting types.
- C. LED sources shall meet the following requirements:

1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
2. Correlated Color Temperature (CCT): 4000K.
3. Color Rendering Index (CRI): ≥ 85 .
4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

D. Mercury vapor lamps shall not be used.

2.6 LED DRIVERS

- A. LED drivers shall meet the following requirements:
1. Drivers shall have a minimum efficiency of 85%.
 2. Starting Temperature: -40 degrees C (-40 degrees F).
 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90 .
 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Install lamps in each luminaire.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

- - - E N D - - -

SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to physical access control, video assessment and surveillance, video recording and storage, equipment cabinetry, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall be required as part of the Security Contractors. The Security Contractor shall be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire

and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:

1. Description of Work for Electronic Security Systems,
2. Electronic security equipment coordination with relating Divisions,
3. Submittal Requirements for Electronic Security,
4. Miscellaneous Supporting equipment and materials for Electronic Security,
5. Electronic security installation requirements.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- K. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- L. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- M. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- N. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- P. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

- Q. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- R. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- X. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.3 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel - component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.

- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion - Joint Photographic Experts Group.
- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.
- HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: An TIA/EIA standard for multipoint communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System - A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply
- WW. UTP: Unshielded Twisted Pair
- XX. Workstation: A PC with software that is configured for specific limited security system functions.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the

equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity.

1.5 GENERAL ARANGEMENT OF CONTRACT DOCUMENTS

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- D. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to

ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COR and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the COR for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders,

sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

- 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
- 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 02, GENERAL REQUIREMENTS.

- 1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
- 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
- 3) The manuals shall include:
 - a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b) A control sequence describing start-up, operation, and shutdown.
 - c) Description of the function of each principal item of equipment.
 - d) Installation and maintenance instructions.
 - e) Safety precautions.
 - f) Diagrams and illustrations.
 - g) Testing methods.
 - h) Performance data.
 - i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation.

Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
 - n. Calculations: Provide a section for circuit and panel calculations.
 - o. Loading Sheets: Provide a section for DGP Loading Sheets.
 - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list

of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:

- a. General - Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
- b. Cover Sheet - Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
- c. General Information Sheets - General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
- d. Floor Plans - Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) Security devices by symbol,
 - 2) The associated device point number (derived from the loading sheets),
 - 3) Wire & cable types and counts
 - 4) Conduit sizing and routing
 - 5) Conduit riser systems
 - 6) Device and area detail call outs
- e. Architectural details - Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,

- f. Riser Diagrams - Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
- g. Block Diagrams - Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams - Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - 1) Panel Assembly Detail - For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - 2) Panel Details - Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details - Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - 6) Sensor detection patterns - Each system sensor shall have associated detection patterns.
 - 7) Equipment Rack Detail - For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be

- employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room - The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console - The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.
Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room - Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule - Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the COR to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
- a. Item Number
 - b. Camera Number
 - c. Naming Conventions
 - d. Description of Camera Coverage
 - e. Camera Location
 - f. Floor Plan Sheet Number

- g. Camera Type
- h. Mounting Type
- i. Standard Detail Reference
- j. Power Input & Draw
- k. Power Panel Location
- l. Remarks Column for Camera

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ International Code Council (ICC):
- A117.1Standard on Accessible and Usable Buildings and Facilities
- C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
- AC-03Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
 - CP-01-00Control Panel Standard-Features for False Alarm Reduction
 - PIR-01-00Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
- D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
- 330-09Electrical Performance Standards for CCTV Cameras
 - 375A-76Electrical Performance Standards for CCTV Monitors
- E. American National Standards Institute (ANSI):
- ANSI S3.2-99Method for measuring the Intelligibility of Speech over Communications Systems
- F. American Society for Testing and Materials (ASTM)
- B1-07Standard Specification for Hard-Drawn Copper Wire

- B3-07Standard Specification for Soft or Annealed
Copper Wire
- B8-04Standard Specification for Concentric-Lay-
Stranded Copper Conductors, Hard, Medium-Hard,
or Soft
- C1238-97 (R03)Standard Guide for Installation of Walk-Through
Metal Detectors
- D2301-04Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical
Insulating Tape
- G. Architectural Barriers Act (ABA), 1968
- H. Department of Justice: American Disability Act (ADA)
28 CFR Part 36-2010 ADA Standards for Accessible Design
- I. Department of Veterans Affairs:
VHA National CAD Standard Application Guide, 2006
VA BIM Guide, V1.0 10
- J. Federal Communications Commission (FCC):
(47 CFR 15) Part 15 Limitations on the Use of Wireless
Equipment/Systems
- K. Federal Information Processing Standards (FIPS):
FIPS-201-1Personal Identity Verification (PIV) of Federal
Employees and Contractors
- L. Federal Specifications (Fed. Spec.):
A-A-59544-08Cable and Wire, Electrical (Power, Fixed
Installation)
- M. Government Accountability Office (GAO):
GAO-03-8-02Security Responsibilities for Federally Owned
and Leased Facilities
- N. Homeland Security Presidential Directive (HSPD):
HSPD-12Policy for a Common Identification Standard for
Federal Employees and Contractors
- O. Institute of Electrical and Electronics Engineers (IEEE):
81-1983IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface Potentials
of a Ground System
- 802.3af-08Power over Ethernet Standard
- 802.3at-09Power over Ethernet (PoE) Plus Standard

- C2-07National Electrical Safety Code
- C62.41-02IEEE Recommended Practice on Surge Voltages in
Low-Voltage AC Power Circuits
- C95.1-05Standards for Safety Levels with Respect to
Human Exposure in Radio Frequency
Electromagnetic Fields
- Q. National Electrical Contractors Association
- 303-2005Installing Closed Circuit Television (CCTV)
Systems
- R. National Electrical Manufacturers Association (NEMA):
- 250-08Enclosures for Electrical Equipment (1000 Volts
Maximum)
- TC-3-04PVC Fittings for Use with Rigid PVC Conduit and
Tubing
- FB1-07Fittings, Cast Metal Boxes and Conduit Bodies
for Conduit, Electrical Metallic Tubing and
Cable
- S. National Fire Protection Association (NFPA):
- 70-11 National Electrical Code (NEC)
- 731-08Standards for the Installation of Electric
Premises Security Systems
- 99-2005Health Care Facilities
- T. National Institute of Justice (NIJ)
- 0601.02-03Standards for Walk-Through Metal Detectors for
use in Weapons Detection
- 0602.02-03Hand-Held Metal Detectors for Use in Concealed
Weapon and Contraband Detection
- U. National Institute of Standards and Technology (NIST):
- IR 6887 V2.1Government Smart Card Interoperability
Specification (GSC-IS)
- Special Pub 800-37Guide for Applying the Risk Management
Framework to Federal Information Systems
- Special Pub 800-63Electronic Authentication Guideline
- Special Pub 800-73-3 ...Interfaces for Personal Identity Verification
(4 Parts)

-Pt. 1- End Point PIV Card Application
Namespace, Data Model & Representation
-Pt. 2- PIV Card Application Card Command
Interface
-Pt. 3- PIV Client Application Programming
Interface
-Pt. 4- The PIV Transitional Interfaces & Data
Model Specification
- Special Pub 800-85B-1 ..DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2 ..PIV Card Application and Middleware Interface
Test Guidelines (SP 800-73-3 compliance)
- Special Pub 800-96PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A ...Scheme for PIV Visual Card Topography
- V. Occupational and Safety Health Administration (OSHA):
 - 29 CFR 1910.97Nonionizing radiation
- W. Section 508 of the Rehabilitation Act of 1973
- X. Security Industry Association (SIA):
 - AG-01Security CAD Symbols Standards
- Y. Underwriters Laboratories, Inc. (UL):
 - 1-05Flexible Metal Conduit
 - 5-04Surface Metal Raceway and Fittings
 - 6-07Rigid Metal Conduit
 - 44-05Thermoset-Insulated Wires and Cables
 - 50-07Enclosures for Electrical Equipment
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 294-99The Standard of Safety for Access Control
System Units
 - 305-08Standard for Panic Hardware
 - 360-09Liquid-Tight Flexible Steel Conduit
 - 444-08Safety Communications Cables
 - 464-09Audible Signal Appliances
 - 467-07Electrical Grounding and Bonding Equipment
 - 486A-03Wire Connectors and Soldering Lugs for Use with
Copper Conductors
 - 486C-04Splicing Wire Connectors
 - 486D-05Insulated Wire Connector Systems for
Underground Use or in Damp or Wet Locations

486E-00Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
493-07Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable
514A-04Metallic Outlet Boxes
514B-04Fittings for Cable and Conduit
51-05Schedule 40 and 80 Rigid PVC Conduit
609-96Local Burglar Alarm Units and Systems
634-07Standards for Connectors with Burglar-Alarm
Systems
636-01Standard for Holdup Alarm Units and Systems
639-97Standard for Intrusion-Detection Units
651-05Schedule 40 and 80 Rigid PVC Conduit
651A-07Type EB and A Rigid PVC Conduit and HDPE
Conduit
752-05Standard for Bullet-Resisting Equipment
797-07Electrical Metallic Tubing
827-08Central Station Alarm Services
1037-09Standard for Anti-theft Alarms and Devices
1635-10Digital Alarm Communicator System Units
1076-95Standards for Proprietary Burglar Alarm Units
and Systems
1242-06Intermediate Metal Conduit
1479-03Fire Tests of Through-Penetration Fire Stops
1981-03Central Station Automation System
2058-05High Security Electronic Locks
60950Safety of Information Technology Equipment
60950-1Information Technology Equipment - Safety -
Part 1: General Requirements

Z. Uniform Federal Accessibility Standards (UFAS) 1984

AA. United States Department of Commerce:

Special Pub 500-101 ...Care and Handling of Computer Magnetic Storage
Media

1.8 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and
security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

1.10 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.

- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 DELIVERY, STORAGE, & HANDLING

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.
- B. Central Station, Workstations, and Controllers:
1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
 2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.12 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled

interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.

2. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.

4. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.13 EQUIPMENT AND MATERIALS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1.14 ELECTRICAL POWER

A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring

primary power required by the security system shall be shown as part of these contract documents.

1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
- B. Grounding and Surge Suppression
1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
 2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
 3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.

4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

1.16 COMPONENT ENCLOSURES

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with top holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof

Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).

B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.

1. Vertical Equipment Racks:

- a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
- b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
- c. d. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.

2. Console racks:

- a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
- b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.

1.17 ELECTRONIC COMPONENTS

A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.18 SUBSTITUTE MATERIALS & EQUIPMENT

A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP

DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The COR shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the COR stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:

1. Identity of the material or devices specified for which there is a proposed substitution.
2. Description of the segment of the specification where the material or devices are referenced.
3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.

C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the COR shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The COR shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security

specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.19 LIKE ITEMS

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.20 WARRANTY

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COR on conditions and findings of the system and device(s). In addition,

the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it's failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.22 SINGULAR NUMBER

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

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of [8] <insert hours> hours of run time in the event of a loss of primary power to the facility.

- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

A. Wires and Cables:

- 1. Shall meet or exceed the manufactures recommendation for power and signals.
- 2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
- 3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
- 4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
- 5. Conduit fills shall not exceed 50 percent unless otherwise documented.
- 6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
- 7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
- 8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.

2.3 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESION

A. Transient Voltage Surge Suppression

- 1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed

in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
- c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
- d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

E. Video Surveillance System

1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:

- a. Head-End Power
 - 1) UL 1778, cUL (Battery Back Up)
 - 2) Minimum Surge Current Capacity: 65,000 Amps (8x20µsec)
 - 3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
 - 4) All modes protected (L-N, L-G, N-G)

- 5) EMI/RFI Filtering
- 6) Maximum Continuous Current: 12 Amps

b. Camera Power

- 1) Minimum Surge Current Capacity: 1,000 Amps (8X20μsec); 240 Amps for IP Video/PoE cameras
- 2) Screw Terminal Connection
- 3) All protection modes L-G (all Lines)
- 4) MCOV <40VAC

c. Video And Data

- 1) Surge Current Capacity 1,000 Amps per conductor
- 2) "BNC" Connection (Coax)
- 3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)
- 4) Band Pass 0-2GHz
- 5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression

- 1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
- 2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
- 3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
- 4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
- 5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
- 6. AC power receptacles are not to be used as a ground reference point.
- 7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufacturers' installation instructions.

G. 120 VAC Surge Suppression

- 1. Continuous Current: Unlimited (parallel connection)

2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

2.4 INSTALLATION KIT

A. General:

1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
2. System Grounding:
 - a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
 - b. This includes, but is not limited to:
 - 1) Coaxial Cable Shields
 - 2) Control Cable Shields
 - 3) Data Cable Shields
 - 4) Equipment Racks
 - 5) Equipment Cabinets
 - 6) Conduits
 - 7) Cable Duct blocks
 - 8) Cable Trays
 - 9) Power Panels
 - 10) Grounding

11) Connector Panels

3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.

3.5 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to

its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.6 SYSTEM PROGRAMMING

A. General Programming Requirements

1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems. System programming for existing or new SMS servers shall not be conducted at the project site.

| Description of Tasks | | | | | | | |
|----------------------|--|--|--|--|--|--|--|
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| | | | | | | | |

| | | | | | | | |
|----------------------------------|---|--|--|--|---|---|---|
| Electronic Entry Control Systems | e.g., setup of device, door groups & schedules, REX, Locks, link graphics | e.g., confirming device configurations, naming conventions, event description and narratives | e.g., enter data from loading sheets; configure components, link events, cameras, and graphics | | e.g., setup of device, door groups & schedules, REX, Locks, link graphics | e.g., performing entry testing to confirm correct setup and configuration | e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations |
|----------------------------------|---|--|--|--|---|---|---|

| | | | | | | | |
|---|---|--|---|--|--|---|---|
| Intru sion Dete ction Syste ms | e.g., enter door groups & schedule s, link devices - REX, lock, & graphics | e.g., confir m g device configur ations, naming conventi ons, event descript ion and narrativ es | e.g., enter data from loading sheets; configur e componen ts, link events, cameras, and graphics | | e.g., , ente r door grou ps & sche dule s, link devi ces - REX, lock , & grap hics | e.g., walk test, device positi on, and maskin g | e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages, |
|---|---|--|---|--|--|---|---|

| | | | | | | | |
|--|--------------------------------------|--|---|--|--------------------------------------|---|--|
| CCTV Systems | e.g., programming call-ups recording | e.g., confirming device configurations, naming conventions | e.g., enter data from loading sheets; camera naming convention, sequence s, configure components) | | e.g., programming call-ups recording | e.g., confirm area of coverage, call-up per event generated and recording rates | e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups |
| | | | | | | | |
| | | | | | | | |
| Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals. | | | | | | | |

Table 1 Contractor Level of Effort

3.7 TESTING AND ACCEPTANCE

A. Performance Requirements

1. General:

- a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the COR at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
- b. The COR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the COR before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the COR at the

conclusion of each phase of testing and prior to COR approval of the test.

2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the COR within seven (7) calendar days after completion of each test.

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SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.
- D. Section 31 20 00 - EARTH MOVING. For excavation and backfill for cables that are installed in conduit.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.
- H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

J. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

A. See section 28 05 00, Paragraph 1.4.

1.5 SUBMITTALS

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
4. Wiring Diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical
Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-08Cable and Wire, Electrical (Power, Fixed
Installation)

D. National Fire Protection Association (NFPA):

70-11National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-05Thermoset-Insulated Wires and Cables
83-08Thermoplastic-Insulated Wires and Cables
467-07Electrical Grounding and Bonding Equipment
486A-03Wire Connectors and Soldering Lugs for Use with
Copper Conductors
486C-04Splicing Wire Connectors
486D-05Insulated Wire Connector Systems for
Underground Use or in Damp or Wet Locations
486E-00Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
493-07Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable
514B-04Fittings for Cable and Conduit
1479-03Fire Tests of Through-Penetration Fire Stops

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

3. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Support of Open Cabling: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars and spools.
 - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems." [Flexible metal conduit shall not be used.]
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications3.
 - Comply with TIA/EIA-568-B.2, Category 6A.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG
 - b. Communications Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: 110-style for Category 6A Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 COAXIAL CABLE

- A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG59/U: NFPA 70, Type CATVR.
 - 1. No. 20AWG, solid, silver-plated, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 - 4. Color-coded PVC jacket.
- D. RG59/U: NFPA 70, Type CATV.
 - 1. No. 20AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 - 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 - 3. PVC jacket.
- E. RG59/U (Plenum Rated): NFPA 70, Type CMP.
 - 1. No. 20AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 - 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 - 3. Copolymer jacket.
- G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
 - 1. CATV Cable: Type CATV

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

3. CATV Riser Rated: Type CATVRcomplying with UL 1666.

4. CATV Limited Rating: Type CATVX.

2.6 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.7 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

2.8 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable:
 - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - c. Use ropes made of nonmetallic material for pulling feeders.
 - d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COTR.
 - e. Pull in multiple cables together in a single conduit.
- C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
 1. Splices and terminations shall be mechanically and electrically secure.
 2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
- D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

- E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
- J. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- L. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1525 mm)] <Insert dimension> apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- O. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION - NOT USED

3.3 CONTROL CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

- #### **A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.**

- B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

3.5 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting

bars in connection blocks. Test cables after termination but not cross connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

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SECTION 28 05 26
GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.
- C. The terms "connect", and "bond" are used interchangeably in this specification and have the same meaning

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- C. Section 28 05 00 - REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.
- D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Shop Drawings:
 - 1. Clearly present enough information to determine compliance with drawings and specifications.
 - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
 - 2. Certification by the contractor that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
- B1-07Standard Specification for Hard-Drawn Copper Wire
 - B3-07Standard Specification for Soft or Annealed Copper Wire
 - B8-04Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-1983IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
 - C2-07National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
- 70-11National Electrical Code (NEC)
 - 99-2005Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-05Thermoset-Insulated Wires and Cables
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 467-07Grounding and Bonding Equipment
 - 486A-486B-03Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

2.2 GROUND RODS

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections
- B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Below Grade: Exothermic-welded type connectors.
- D. Above Grade:
 - 1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
 - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
 - 5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - a) Pipe Connectors: Clamp type, sized for pipe.
 - 6. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8-inch x ¾ inch).

2.5 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.6 SPLICE CASE GROUND ACCESSORIES

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.7 COMPUTER ROOM GROUND

- A. Provide 50mm² (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 CORROSION INHIBITORS

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

3.4 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:

1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.6 LIGHTNING PROTECTION SYSTEM

- A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third of fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connect the lightning protection system at the direction of the COR certified by an independent certified grounding contractor.

3.7 EXTERIOR LIGHT/CAMERA POLES

- A. Provide 20 ft [6.1 M] of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.8 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made

before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COTR prior to backfilling. The contractor shall notify the COTR 24 hours before the connections are ready for inspection.

3.9 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.11 LABELING

- A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
 2. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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SECTION 28 05 28.33
CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 92 00 - JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- C. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.
- D. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.
- E. Section 31 20 00 - EARTH MOVING. For bedding of conduits.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.

- F. LFMC: Liquid-tight flexible metal conduit.
- G. LFNC: Liquid-tight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

1.5 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:
- B. Shop Drawings:
 - 1. Size and location of main feeders.
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed, and its area of application shall be identified on the catalog cuts.
- C. Certification: Prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
- D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. Handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.

- G. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- H. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified [and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event]."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- I. Source quality-control test reports.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
- TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and
Tubing
- FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies
for Conduit, Electrical Metallic Tubing and
Cable
- C. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

1-05.....Flexible Metal Conduit
5-04.....Surface Metal Raceway and Fittings
6-07.....Rigid Metal Conduit
50-07.....Enclosures for Electrical Equipment
360-09.....Liquid-Tight Flexible Steel Conduit
467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Fittings for Cable and Conduit
514C-02.....Nonmetallic Outlet Boxes, Flush-Device Boxes and
Covers
651-05.....Schedule 40 and 80 Rigid PVC Conduit
651A-07.....Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07.....Electrical Metallic Tubing
1242-06.....Intermediate Metal Conduit

PART 2 - PRODUCTS

2.1 GENERAL

A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

2.2 CONDUIT

- A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
- B. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
- C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
- D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3.
Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
- E. Flexible galvanized steel conduit: Shall Conform to UL 1.
- F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).

2.3 WIREWAYS AND RACEWAYS

A. Surface metal raceway: Shall Conform to UL 5.

2.4 CONDUIT FITTINGS

A. Rigid steel and IMC conduit fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
4. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
5. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
6. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

B. Rigid aluminum conduit fittings:

1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel, or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
2. Locknuts and bushings: As specified for rigid steel and IMC conduit.
3. Set screw fittings: Not permitted for use with aluminum conduit.

C. Electrical metallic tubing fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

4. Indent type connectors or couplings are prohibited.
5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- D. Flexible steel conduit fittings:
 1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 2. Clamp type, with insulated throat.
- E. Liquid-tight flexible metal conduit fittings:
 1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 2. Only steel or malleable iron materials are acceptable.
 3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- F. Direct burial plastic conduit fittings:
 1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 2. As recommended by the conduit manufacturer.
- G. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- H. Expansion and deflection couplings:
 1. Conform to UL 467 and UL 514B.
 2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

2.5 CONDUIT SUPPORTS

- A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.

- D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

2.6 OUTLET, JUNCTION, AND PULL BOXES

- A. UL-50 and UL-514A.
- B. Cast metal where required by the NEC or shown and equipped with rustproof boxes.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Sheet metal boxes: Galvanized steel, except where otherwise shown.
- E. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

2.7 CABINETS

- A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinge.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

2.8 WIREWAYS

- A. Equip with hinged covers, except where removable covers are shown.

2.9 WARNING TAPE

- A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover:

Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover:

Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

2.11 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

2.12 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.

2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not

allowed, except where permitted by the COR as required by limited working space.

- B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

3.2 INSTALLATION, GENERAL

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.

2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inch) thick is prohibited.
 - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.

- b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
- 3. Align and run conduit parallel or perpendicular to the building lines.
- 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
- 5. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
 - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, "PAINTING".
 - 2. Paint all conduits containing cables rated over 600 volts safety orange. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes

with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

3.6 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports, or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example, "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90-degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

- H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90-degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

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

- J. Furnish and install 19 mm (3/4 inch) thick fire-retardant plywood specified in on the wall of communication closets where shown on drawings. Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.
- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

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SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide and install a complete Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.
- B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.
- C. Video surveillance system Video assessment & surveillance system shall be integrated with monitoring and control system specified in Division 28 Section that specifies systems integration.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- C. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- D. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- E. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.
- F. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.G. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- I. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. B/W: Black and white.
- C. CCD: Charge-coupled device.

- D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).
- E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).
- F. H.264 (also known as MPEG4 Part 10): an encoding format that compresses video much more effectively than older (MPEG4) standards.
- G. ips: Images per second.
- H. MPEG: Moving picture experts group.
- I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.
- J. NTSC: National Television System Committee.
- K. UPS: Uninterruptible power supply.
- L. PTZ: refers to a movable camera that has the ability to pan left and right, tilt up and down, and zoom or magnify a scene.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- E. Product Qualification:
 - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples
- B. Provide certificates of compliance with Section 1.4, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 2. Floor plans, site plans, and enlarged plans shall:

- a. Include a title block as defined above.
 - b. Define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
 - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
 - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).

- c. Mounting type (e.g. flush, wall, surface, etc.).
- d. Power supply or circuit breaker and power panel number.
- e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
- 6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
 - 1. 35 percent
 - 2. 65 percent
 - 3. 90 percent
 - 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 02, GENERAL REQUIREMENTS.
- H. Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician, and dated on the date of completion.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
 - 330-09Electrical Performance Standards for CCTV Cameras

375A-76Electrical Performance Standards for CCTV
Monitors

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41-02IEEE Recommended Practice on Surge Voltages in
Low-Voltage AC Power Circuits

802.3af-08Power over Ethernet Standard

D. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Contractors Association (NECA):

303-2005Installing Closed Circuit Television (CCTV)
Systems

F. National Fire Protection Association (NFPA):

70-08Article 780-National Electrical Code

G. Federal Information Processing Standard (FIPS):

140-2-02Security Requirements for Cryptographic Modules

H. Underwriters Laboratories, Inc. (UL):

983-06Standard for Surveillance Camera Units

3044-01Standard for Surveillance Closed Circuit
Television Equipment

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of video surveillance equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So, connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

1.8 WARRANTY OF CONSTRUCTION

- A. Warrant VASS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

PART 2 - PRODUCTS

- A. Products shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

2.1 GENERAL

- A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- C. Power Connections: Comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2, as recommended by manufacturer for type of line being protected.
- D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 CAMERAS

- A. All Cameras will be EIA 330 and UL 1. Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.
- B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:
 - 1. Will be charge coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.

2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and are to be utilized to complement the fixed cameras.
3. Shall be powered by either 12 volts direct current (VDC) or 24 volts alternate current (VAC). Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
5. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
6. Will be home run to a monitoring and recording device via a controlling device such as a matrix switcher or network server and monitored on a 24- hour basis at a designated Security Management System location.
7. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
8. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
9. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
10. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
11. P/T/Z cameras shall be utilized in a manner that they complement fixed cameras and shall not be used as a primary means of monitoring activity.
12. Dummy or fake cameras will not be utilized at any time.

13. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.
14. Shall come with built-in infrared night vision feature.

2.3 DIGITAL BASED VIDEO MANAGEMENT SYSTEM

A. Key Features

1. Open Platform: Open API/SDK, supports seamless integration with third party applications.
2. Multi-server and multi-site video surveillance solution: Unlimited recording of video from IP cameras, IP video encoders and selected DVRs with analog cameras.
3. Optimized Recording Storage Management: Unique data storage and archiving solution that combines superior performance and scalability and cost-efficient long-term video storage
4. Wide IP camera and device support: Supports connection of more than 839 IP cameras, IP video encoders and selected DVR models from over 79 different vendors through dedicated device integration
5. ONVIF™ and PSIA compliant: Supports ONVIF™ and PSIA compliant cameras and devices
6. Wide compression technology support: Supports the news compression methods; MPEG4 ASP, MxPEG and H.264, besides MJPEG and MPEG4
7. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration
8. Sequence Explorer: Displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
9. Overlay buttons: Intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
10. Independent Playback: Instant and independent playback function allows you to independently playback recorded video for one or more cameras, while in live viewing or playback mode
11. Built-in Video Motion Detection: Independent of camera model and supporting up to 64 cameras simultaneously per server
12. Multiple language support: Let operators use the system in their native language with support for 20 different languages

13. Multi-channel, two-way audio: Communicate with people at gates/entrances or broadcast messages to many people at once with multichannel, two-way audio
14. Fast evidence export: Quickly deliver authentic evidence to public authorities by exporting video to various formats, including video from multiple cameras with viewer, logs, and user notes included

B. Administration Features

1. Single Management Application: A new Management Application provides a consolidated single point management access to Recording Servers.
2. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration.
3. Automated device discovery: Enables fast discovery of camera devices using methods such as Universal Plug and Play, Broadcast and IP Range scanning.
4. Smart bulk configuration option: Change settings across multiple devices simultaneously and in a very few clicks.
5. Adaptable application behavior: Guides novice users, while expert users can optimize the application for efficient use.
6. Export/import of system and user configuration data: System backup for reliable system operation and fast system recovery. System cloning for efficient rollout of multiple systems with the same, or similar, configuration.
7. Import of off-line configuration data: Enabling off-line editing of configuration data, including camera and device definitions.
8. Automatic system restores points: A 'Restore Point' is created each time a configuration change is confirmed.
9. Enables easy rollback to previously defined system configuration points and enables cancelation of undesired configuration changes and restoration of earlier valid configurations.

C. Integration Options

1. Open Software Development Kit (SDK) makes it possible to video enable your business processes, through seamless integration of third-party applications, such as video analytics, access systems, etc.
2. Compatible with Central for alarm overviews and operational status in larger video surveillance installations.

3. Integrate with physical access control systems, alarms, gates, building management systems, etc. using hardware I/O, internal events and TCP/IP events
4. Create, import, and use HTML pages for navigation between views or to trigger a Smart Wall preset
5. Develop third party plug-ins for the Smart Client to expand with new functionality

D. Server Modules

1. Recording Server
 - a. Simultaneous digital multi-channel video and audio recording and live viewing (relaying).
 - b. Two-way audio enables integrated control of microphones and speakers connected to IP devices.
 - c. Bandwidth optimized multi-streaming by splitting a single camera video stream to differentiated streams for live view and recording, where each can be optimized independently with respect to frame rate and resolution.
 - d. Connectivity to cameras, video encoders and selected DVRs supports MJPEG, MPEG4, MPEG4 ASP*, H.264* and MxPEG.
 - e. Auto-detect camera models during setup.
2. Flexible multi-site, multi-server license structure charged per camera.
3. Unlimited number of installed cameras; simultaneous recording and live view of up to 64 cameras per server.
4. Recording technology: secure high-speed database holding JPEG images or MPEG4 and MxPEG streams including audio.
5. Recording speed: 30+ frames per second per camera, limited only by hardware.
6. Recording quality depends entirely on camera and video encoder capabilities: no software limitation.
7. Start cameras on live view requests from clients.
8. Unlimited recording capacity with multiple archives possible per day.
9. Hourly to daily database archiving with optional automatic move to network drive saves storage capacity on the local server - with images still available transparently for playback

10. Built-in, real-time, camera independent motion detection (VMD);
fully adjustable sensitivity, zone exclusions, recording activation
with frame rate speed up, and alert activation through email or SMS.
 11. Start recording on event.
 12. Client initiated start of recording based on pre-defined recording
time and access privileges.
 13. Pan Tilt Zoom (PTZ) preset positions, up to 50 per camera.
 14. Absolute* and relative PTZ positioning.
 15. PTZ go-to preset position on events.
 16. Combine PTZ patrolling and go-to positions on events.
 17. Set multiple patrolling schedules per camera per day: i.e. different
for day/night/weekend.
 18. PTZ scanning on supported devices: viewing or recording while moving
slowly between PTZ positions.
 19. VMD-sensitive PTZ patrolling among selected presets allows sending
of Wipe and Wash commands to support PTZ models.
 20. On pre-defined events Matrix remote commands are automatically sent
to display live video remotely on computers running the Matrix
Monitor or the Smart
 21. Client with Matrix Plug-in.
 - a. Flexible notification (sound, e-mail and SMS) and camera
patrolling scheduling, triggered by time or event.
- E. Recording Server Manager
1. Local console management of the Recording Server accessible from the
notification area.
 2. Start and stop Recording Server service.
 3. Access to Recording Server configuration settings.
 4. Access to Recording Server help system.
 5. View system status and log information.
- F. Image Server
1. Remote access for Smart and Remote Clients.
 2. Built-in web server for download and launch of clients and plug-ins.
 3. Set up one Master and multiple Slave Servers.
 4. Authenticate access based on Microsoft Active Directory user
account, or username and password.
 5. Authorize access privileges per Microsoft Active Directory user
account/group, user profile or grant full access.

6. User profiles control access to: Live view, PTZ, PTZ presets, Output control, Events, listen to microphone, Talk to speaker, Manual recording; Playback, AVI export, JPG export, DB export, Sequences, Smart Search, and audio. As well as Set up views, edit private views and Edit shared public views.
 7. Audit logs of exported evidence by user and file.
 8. Audit logs of client user activity by time, locations, and cameras.
- G. Recording Viewer
1. Playback recorded video and audio locally on the
- H. Recording Server.
1. View up to 16 cameras time-synched during playback.
 2. Scrollable activity timeline with magnifying feature.
 3. Instant search on recordings based on date/time and activity/alarm (Video Motion Detection).
 4. 'Smart Search' for highlighted image zones and objects.
 5. Evidence can be generated as a printed report, a JPEG image, an AVI film or in the native database format.
 6. Export audio recordings in WAV or AVI format.
 7. Export video digitally zoomed to view area of interest only and to minimize export footprint size.
 8. Export 'Evidence CD' containing native database and Recording Viewer for instant, easy viewing by authorities.
 9. Encryption & password protection option for exported recordings and files.
 10. Ability to add comments to exported evidence, also encrypted.
 11. Option to send email.
 12. De-interlacing of video from analog cameras.
 13. IPIX technology for PTZ in 360° recorded images.
- I. Smart Client Module
1. Smart Client includes all the features of Remote Client plus more:
 2. Installed per default on Recording Server for local viewing and playback of video and audio.
 3. Start recording on cameras for a pre-defined time (default 5 minutes). Subject to privileges set by administrator.
 4. • Independent Playback capability allows for instant playback of recorded video for one or more cameras, while in live and playback mode

5. Live view digital zoom allows zoomed-out recordings while the operator digitally can zoom in to see details.
6. 'Update on Motion Only' optimizes CPU usage by letting motion detection control whether the image should be decoded and displayed or not. The visual effect is a still image in the view until motion is detected.
7. Shared and private camera views offer 1x1 up to 10x10 layouts in addition to asymmetric views.
8. Views optimized for both 4:3 and 16:9 screen ratios.
9. Multiple computer monitor support with a main window and any number of either windowed or full screen views.
10. Hotspot function for working in details with a camera selected from a view containing multiple cameras.
11. Carousel function allows a specified view to rotate between pre-defined cameras with individual timing and order with multiple appearances. Carousel function can be controlled allowing the operator to pause carousel function and to switch to previous or next camera.
12. Overlay buttons provides intuitive control of cameras, camera-integrated devices, and other integrated systems- directly from the camera view
13. Matrix function to view live video from multiple cameras through the Image Server in any view layout with customizable rotation path, remotely controlled by Smart
14. Clients or Recording Servers sending Matrix remote commands
15. Send Matrix remote commands to display live video remotely on computers running the Matrix Monitor or the Smart Client with Matrix Plug-in.
16. Cameras' built-in audio sources available in live and in playback.
17. Separate pop-up window displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
18. Presents recorded sequences for individual cameras, or all cameras in a view
19. Seamlessly available in both Live and Playback modes
20. Smooth navigation with sliding preview and "drag-and throw" function for video thumbnails

21. Instant playback of video sequences
22. Application Options allows users to adapt the layout and personalize the application to their particular preferences.

J. Minimum System Requirements VMS Server

1. HW Platform:
 - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
 - b. Minimum 1 GB disk space available, excluding space needed for recordings.
2. OS:
 - a. Microsoft® Windows® XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*), Windows Server 2008 R1/R2 (32 bit or 64 bit*), Windows Vista™ Business (32 bit or 64 bit*), Windows Vista Enterprise (32 bit or 64 bit*), Windows Vista Ultimate (32 bit or 64 bit*), Windows 7 Professional (32 bit or 64 bit*), Windows 7 Enterprise (32 bit or 64 bit*) and Windows 7 Ultimate (32 bit or 64 bit*).
3. Software:
 - a. Microsoft .NET 3.5 Framework SP1, or newer.
 - b. DirectX 9.0 or newer required to run Playback Viewer application.

K. Minimum System Requirements PDA Server

1. HW Platform:
 - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
 - b. Minimum 1 GB disk space available.
2. OS:
 - a. Microsoft Windows XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*).
3. Software:
 - a. Microsoft .NET 2.0 (not compatible with newer versions). Internet Information Server (IIS) 5.1.

N. Minimum System Requirements VMS Client

1. HW Platform:
 - a. Minimum 2.4 GHz CPU, 1 GB RAM (more powerful CPU and higher RAM recommended for Smart Clients running high number of cameras and multiple views and displays).
2. Graphics Card:

- a. AGP or PCI-Express, minimum 1024 x 768 (1280 x 1024 recommended), 16-bit colors.
- 3. OS:
 - a. Microsoft Windows XP Professional (32 bit or 64 bit*), Windows Server 2003 (32 bit or 64 bit*), Windows Server 2008 R1/R2 (32 bit or 64 bit*), Windows Vista Business (32 bit or 64 bit*), Windows Vista Enterprise (32 bit or 64 bit*), Windows Vista Ultimate (32 bit or 64 bit*), Windows 7 Professional (32 bit or 64 bit*), Windows 7 Enterprise (32 bit or 64 bit*) and Windows 7 Ultimate (32 bit or 64 bit*).
- 4. Software:
 - a. DirectX 9.0 or newer required to run Playback Viewer application.
 - b. Microsoft .NET 3.5 Framework SP1, or newer.
- O. Licensing Structure
 - 1. Base Server License
 - a. An VMS Base Server license is mandatory for installing the product.
 - 2. The Base Server license contains:
 - a. Unlimited numbers of Recording Server licenses
 - b. Unlimited numbers of Smart Clients, Remote Clients, PDA Clients and Matrix Monitor licenses
 - 3. Camera License
 - a. To connect to a camera, a Device License per camera channel is required
 - b. In total, for all copies of the product installed under a given Base Server license, the product may only be used with as many cameras as you have purchased camera licenses for • Video encoders and DVRs with multiple analog cameras require a license per channel to operate
 - c. Camera Licenses can be purchased in any numbers. To extend the installation with additional Camera Licenses, the Base Server License number (SLC) is required when ordering.
 - 4. Client License:
 - a. All client modules are not licensed and can be installed and used on any number of computers.

2.4 VIDEO DISPLAY EQUIPMENT

A. Video Display Equipment

1. Will consist of color monitors and shall be EIA 375A compliant.
2. Shall be able to display analog, digital, and other images in either NTSC or MPEG format associated with the operation of the Security Management System (SMS).
3. Shall:
 - a. Have front panel controls that provide for power on/off, horizontal and vertical hold, brightness, and contrast.
 - b. Accept multiple inputs, either directly or indirectly.
 - c. Have the capabilities to observe and program the VASS System.
 - d. Be installed in a manner that they cannot be witnessed by the general public.

B. Color Video Monitors Technical Characteristics:

| | |
|-----------------------|-------------------------------------|
| Sync Format | PAL/NTSC |
| Display Tube | 90° deflection angle |
| Horizontal Resolution | 250 TVL minimum, 300 TVL typical |
| Video Input | 1.0 Vp-p, 75 Ohm |
| Front Panel Controls | Volume, Contrast, Brightness, Color |
| Connectors | BNC |

C. Liquid Crystal Display (LCD) Flat Panel Display Monitor

D. The 19 -inch color LCD monitor shall have a flat screen and 19 -inch diagonal viewing area and consists of an LCD panel, bezel, and stand.

E. The monitor shall meet or exceed the following specifications:

1. The monitor shall incorporate a 19 -inch active matrix TFT LCD panel.
 - a. The pixel pitch of the monitor's LCD panel shall be 0.264 mm horizontal and 0.264 mm vertical.
 - b. The monitor shall have a maximum resolution of 500 television lines.
 - c. The contrast ratio shall be 500:1.
 - d. The typical brightness shall be 250 cd/m²
 - e. The monitor shall display at least 16.7 million colors.
 - f. The light source for the LCD panel shall have a lifetime of 50,000hours.

- g. The scan frequency horizontal shall be 30 K to 80 KHz and the scan frequency vertical shall be 56 to 75 Hz.
 - h. The viewing angle for the monitor shall be 170 degrees horizontal and 170 degrees vertical.
- 2. The monitor shall have automatic NTSC or PAL recognition.
- 3. The monitor shall have a picture-in-picture function.
- 4. The monitor shall use the following signal connectors:
 - a. Video 1.0 V peak-to-peak at 75 ohms
 - b. BNC in/out
 - c. Y/C (S-video) in/out
 - d. Audio in/out
 - e. VGA 15-pin D-Sub
- 5. The monitor shall have two audio speaker(s).
 - a. The speaker shall be 0.5 W minimum.
- 6. The monitor shall have the following front control panel buttons:
 - a. Power on/off
 - b. LED indicator
 - c. Mode
 - d. Increase (volume)
 - e. Decrease (volume)
 - f. Up (contrast adjustment)
 - g. Down (brightness adjustment)
 - h. Menu
 - i. Auto
- 7. The monitor shall have the following options for adjustment in an onscreen display menu:
 - a. Color
 - b. Tint
 - 1) NTSC mode only
 - a) Brightness
 - b) Contrast
 - c) Sharpness
 - d) Volume
 - e) Language
 - f) Scan
 - g) Color Temp
 - h) H-Position

i) Recall

F. The electrical specifications for the monitor shall be as follows:

1. Input voltage shall be 12 VDC/3 A.
2. Power consumption shall be 50 W maximum.

G. The environmental specifications for the monitor shall be as follows:

1. Operating temperature shall be 32 to 104 degrees Fahrenheit or 0 to 40 degrees Celsius.
2. Operating humidity shall be 10 to 85 percent.

H. The physical specifications for the monitor shall be as follows:

I. The monitor shall conform to these compliance standards:

1. FCC
2. CE (EMC/LVD)
3. UL

2.5 CONTROLLING EQUIPMENT

- A. Shall be utilized to call up, operate, and program all cameras associated VASS System components.
- B. Will have the ability to operate the cameras locally and remotely. A matrix switcher or a network server shall be utilized as the VASS System controller.
- C. The controller shall be able to fit into a standard 47.5 cm (19 inch) equipment rack.
- D. Control and programming keyboards shall be provided with its own type of switcher. All keyboards shall:
 1. Be located at each monitoring station.
 2. Be addressable for programming purposes.
 3. Provide interface between the operator and the VASS System.
 4. Provide full control and programming of the switcher.
 5. Have the minimum following controls:
 - a. programming
 - b. switching
 - c. lens function
 - d. P/T/Z
 - e. environmental housing
 - f. annotation

2.6 VIDEO CAMERAS

- A. The cameras shall be high-resolution color video cameras with wide dynamic range capturing capability.
- B. The camera shall meet or exceed the following specifications:

1. The image capturing device shall be a 1/4-inch image sensor designed for capturing wide dynamic images.
 - a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
 - b. The image capturing device shall sample each pixel multiple times per second.
 - c. The dynamic range shall be 95 dB typical and 120 dB maximum.
3. The camera shall optimize each pixel independently.
4. The camera shall have onscreen display menus for programming of the camera's settings.
5. The signal system shall be NTSC.
- C. The camera shall have composite video output.
- D. The camera shall come with a manual varifocal lens.
- E. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.
11. Camera accessories shall include:
 - a. Surface mount adapter
 - b. Wall mount adapter
 - c. Flush mount adapter

2.7 AUTOMATIC COLOR DOME CAMERA

- A. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
- B. Comply with UL 639.
- C. Pickup Device: 1/4 CCD interline transfer.
- D. Horizontal Resolution: 480 lines.
- E. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
- F. With AGC, manually selectable on or off.
- G. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination
- H. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. The illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with the camera AGC off.
- I. Manually selectable modes for backlight compensation or normal lighting.
- J. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be variable controlled by

operator. Movement from preset positions shall be not less than 300 degrees per second.

K. Preset positioning: 64 user-definable scenes. Controls shall include the following:

1. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.

2. Motion detection shall be available at each camera position.

L. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

M. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

N. Motion Detector: Built-in digital.

O. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

P. Automatic Color Dome Camera Technical Characteristics:

| | |
|------------------------|--|
| Effective Pixels | 768 (H) x 494 (V) |
| Scanning Area | 1/4-type CCD |
| Synchronization | Internal/Line-lock/Multiplexed Vertical Drive (VD2) |
| Video Output | 1.0 v[p-p] NTSC composite/75 ohm |
| H. Resolution | 570-line at B/W, or 480-line at color imaging |
| Signal-to-noise Ratio | 50dB (AGC off, weight on) |
| Super Dynamic II | 64 times (36dB) (selectable on/off) |
| Minimum Illumination | 0.06 lx (0.006 fc) at B/W, 1 lx(0.1 fc) |
| Zoom Speed | Approx. 2.1s (TELE/WIDE) in sequence mode |
| Focus Speed | Approx. 2s (FAR/NEAR) in sequence mode |
| Iris | Automatic (Open/Close is possible)/manual |
| Maximum Aperture Ratio | 1:1.6 (Wide) ~ 3.0 (Tele) |
| Focal Length | 3.79 ~ 83.4 mm |
| Angular Field of View | H 2.6° ~ 51.7° V 2.0° ~ 39.9° |
| Electronic Shutter | 1/60 (off), 1/100, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 s |

| | |
|-----------------|---|
| Zoom Ratio | Optical 22x w/10x electronic zoom |
| Iris Range | F1.6 ~ 64, Close |
| Panning Range | 360° endless |
| Panning Speed | Manual: Approx. 0.1°/s ~ 120°/s 16 steps |
| Tilting Range | 0 ~ 90° (Digital Flip off), 0 ~180° (Digital Flip on) |
| Tilting Speed | Manual: Approx. 0.1°/s ~ 120°/s. 16 steps |
| Pan/Tilt | Manual/Sequential position/Auto Pan |
| Controls | Pan/Tilt, Lens, 64 Preset Positions, Home Position |
| Video Connector | BNC |
| Controller I/F | Multiplex-coaxial |

Q. Camera accessories shall include:

1. Surface mount adapter
2. Wall mount adapter
3. Flush mount adapter

R. Indoor/Outdoor Camera Dome System

1. The indoor/outdoor camera dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The indoor/outdoor camera dome system shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor VASS camera dome system shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360° rotation; 1/4-inch high resolution color, or color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus; and an enclosure consisting of a back box, lower dome, and a quick-install mounting.
4. Accessories
 - a. Pendant mount
 - b. Wall mount for pendant
 - c. Corner adapter for wall mount
 - d. Pole adapter for wall mount

S. LENSES

1. Camera Field of View shall be set by the Contractor to produce full view of door or window opening and anyone entering or leaving through it. Follow the project construction drawings for design intent.
2. Camera Lenses shall be of the type supplied with the camera from the manufacture. All cameras which are not supplied with lenses from the factory are specified in this specification. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto-iris, DC iris, or motor zoom functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lenses shall be provided with pre-set capability.
3. Lenses shall have optical-quality coated optics, designed specifically for video surveillance applications, and matched to specified camera. Provide color-corrected lenses with color cameras, megapixel lenses for megapixel cameras, and lenses with day/night for color/b&w cameras.
4. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
5. Zoom Lenses: Motorized, remote-controlled units, rated as "quiet operating." Features include the following:
 - a. Electrical Leads: Filtered to minimize video signal interference.
 - b. Motor Speed: Variable.
 - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.
6. Lenses: Shall be utilized in a manner that provides maximum coverage of the area being monitored by the camera. The lenses shall:
 - a. Be 1/3" to fit CCD fixed camera.
 - b. Be all glass with coated optics.
 - c. Have mounts that are compatible with the camera selected.
 - d. Be packaged and supplied with the camera.
 - e. Have a maximum f-stop of f/1.3 for fixed lenses, and a maximum f-stop of f/1.6 for variable focus lenses.

- f. Be equipped with an auto-iris mechanism.
 - g. Have sufficient circle of illumination to cover the image sensor evenly.
 - h. Not be used on a camera with an image format larger than the lens is designed to cover.
 - i. Be provided with pre-set capability.
7. Two types of lenses shall be utilized for both interior and exterior fixed cameras:
- a. Manual Variable Focus
 - b. Auto Iris Fixed
8. Manual Variable Focus:
- a. Shall be utilized in large areas that are being monitored by the camera. Examples of this are perimeter fence lines, vehicle entry points, parking areas, etc.
 - b. Shall allow for setting virtually any angle of field, which maximizes surveillance effects.
 - c. Technical Characteristics:

| | |
|--------------------------|-------------------|
| Image format | 1/3 inch |
| Focal length | 5-50mm |
| Iris range | F1.4 to close |
| Focus range | 1m (3.3 ft) |
| Back focus distance | 10.05 mm (0.4 in) |
| Angle view Wide (1/3 in) | 53.4 x 40.1 |
| Angle view Tele (1/3 in) | 5.3 x 4.1 |
| Iris control | manual |
| Focus ctrl | manual |
| Zoom ctrl | manual |

T. CAMERA HOUSINGS AND MOUNTS

- 1. This section pertains to all interior and exterior housings, domes, and applicable wall, ceiling, corner, pole, and rooftop mounts associated with the housing. Housings and mounts shall be specified in accordance to the type of cameras used.
- 2. All cameras and lenses shall be enclosed in a tamper resistant housing. Any additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.

3. The camera and lens contained inside the housing shall be installed on a camera mount. All additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
4. Shall be manufactured in a manner that are capable of supporting a maximum of three (3) cameras with housings and meet environmental requirements for the geographical area the camera support equipment is being installed on or within.
5. Environmentally Sealed
 - a. Shall be designed in manner that it provides a condensation free environment for correct camera operation.
 - b. Shall be operated in a 100 percent condensing humidity atmosphere.
 - c. Shall be constructed in a manner that:
 - 1) Has a fill valve to allow for the introduction of nitrogen into the housing to eliminate existing atmospheric air and pressurize the housing to create moisture free conditions.
 - 2) Has an overpressure valve to prevent damage to the housing in the event of over pressurization.
 - 3) Is equipped with a humidity indicator that is visible to the eye to ensure correct atmospheric conditions at all times.
 - 4) The leak rate of the housing is not to be greater than 13.8kPa or 2 pounds per square inch at sea level within a 90-day period.
 - 5) It shall contain camera mounts or supports as needed to allow for correct positioning of the camera and lens.
 - 6) The housing and sunshield are to be white in color.
6. All electrical and signal cables required for correct operations shall be supplied in a hardened carrier system from the controller to the camera.
7. The mounting bracket shall be adjustable to allow for the housing weight of the camera and the housing unit it is placed in.
8. Accessibility to the camera and mounts shall be taken into consideration for maintenance and service purposes.

V. Indoor Mounts

1. Ceiling Mounts:

- a. This enclosure and mount shall be installed in a finished or suspended ceiling.
 - b. The enclosure and mount shall be fastened to the finished ceiling and shall not depend on the ceiling tile grid for complete support.
 - c. Suspended ceiling mounts shall be low profile and shall be suitable for replacement of 610mm x 610mm (2 foot by 2 foot) ceiling tiles.
2. Wall Mounts:
- a. The enclosure shall be installed in manner that it matches the existing décor and placed at a height that it will be unobtrusive, unable to cause personal harm, and prevents tampering and vandalism.
 - b. The mount shall contain a manual pan/tilt head that will provide 360 degrees of horizontal and vertical positioning from a horizontal position and has a locking bar or screw to maintain its fixed position once it has been adjusted.

W. Interior Domes

1. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
2. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more than 1 f-stop.
3. The housing shall be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide a fully functional pan/tilt dome.
4. The pan/tilt mechanism shall be:
 - a. Constructed of heavy-duty bearings and hardened steel gears.
 - b. Permanently lubricated to ensure smooth and consistent movement of all parts throughout the life of the product.
 - c. Equipped with motors that are thermally or impedance protected against overload damage.
 - d. Pan movements shall be 360 degrees and tilt movement shall not be less than +/- 90 degrees.
 - e. Pan speed shall be a minimum of 10 degrees per second.

X. Exterior Domes

1. The exterior dome shall meet all requirements outlined in the interior dome paragraph above.
2. The housing shall be constructed to be dust and watertight, and fully operational in 100 percent condensing humidity.

2.8 POWER SUPPLIES

- A. Power supplies shall be a low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera, infrared illuminator, and lens manufacturer.
- B. Technical specifications:
 1. Input: 115VAC, 50/60Hz, 2.7 amps
 2. Outputs:
 - a. Number of outputs, [16] <insert number of outputs>
 - b. Fuse/PTC protected, power limited
 - c. Output voltage & power:
 - 1) 24VAC @ 12.5 amps (300VA) or 28VAC @ 10-amp (280VA) supply current
 3. Illuminated power disconnect circuit breaker with manual reset
 4. Surge suppression
 5. Camera synchronization
 6. Rack mount.
 7. Enclosure: NEMA 250, Type 3R.

2.10 NETWORK SERVER

- A. Allow for the transmission of live video, data, and audio over either an existing Ethernet network or a dedicated security system network, requiring an IP address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. The network shall operate in a box-to-box configuration allowing for encoded video to be decoded and displayed on an analog monitor.
- B. If a VASS System network is going to be utilized as the primary means of monitoring, operating, and recording cameras then the following equipment shall be required as part of the system:
 1. System Server
 2. Computer Workstation
 3. Recording Device
 4. Encoder/Decoder

5. Monitor
 6. Hub/Switch
 7. Router
 8. Encryptor
- C. Shall provide overall control, programming, monitoring, and recording of all cameras and associated devices within the VASS System.
- D. All equipment on the network shall be IP addressable.
- E. The VASS System network shall meet or exceed the following design and performance specifications:
1. Two MPEG-4 video streams for a total of 40 images per second will be provided.
 2. PC Software that manages the installation and maintenance of all hardware transmitters and receivers on the network shall be provided.
 3. Video Source that supports any NTSC video source to the computer network shall be addressed.
 4. Receivers that could be used to display the video on a standard analog NTSC or PAL monitor will be addressed.
- F. The system shall support the following network protocols:
1. Internet connections: RTP, Real Time Control Protocol (RTCP), UDP, IP, TCP, ICMP, HTTP, Simple Network Management Protocol (SNMP), IGMP, DHCP, and ARP.
 2. Video Display: MPEG-4, M-JPEG in server push mode only.
 3. Have the ability to adjust bandwidth, image quality and image rate.
 4. Support image sizes of either 704 x 576 pixels or 352 x 288 pixels.
 5. Have an audio coding format of G.711 or G.728.
 6. Provide a video frame rate of at least 30 images per second.
 7. Support LAN Interface Ethernet 10/100BaseT and be auto sensing.
 8. Have a LAN Data Rate of 9.6 Kbps to 5.0 Mbps.
 9. Utilize data interface RS-232/RS-422/RS-485.
- G. All connections within the system shall be via CAT-5 cable and RJ-45 jacks. If analog equipment is used as part of the system, then either an encoder or a decoder will be utilized to convert the analog signal to a digital one.
- H. The VASS network system shall conform to all VA agency wide security standards for administrator and operator use.
- I. Server Technical Characteristics:

| Hardware | Personal Computer |
|---------------------|---|
| CPU | Pentium IV, 3.0 GHz or better |
| Hard Disk Interface | IDE or better |
| RAM | 256 MB |
| OS | Windows XP Home/XP Professional |
| Graphic Card | NVIDIA GeForce 6600 NVIDIA Quadro FX 1400 ATI RADEON X600/X800 or better |
| Ethernet Card | 100 Mb |
| Software | DirectX 9.0c |
| Free Memory | 120 MB |

J. Network Switch Technical Characteristics

| | |
|-----------------------|--|
| Protocol and standard | IEEE802.3 IEEE802.3u IEEE802.3ab |
| Ports | 24 10/100/1000M auto-negotiation RJ-45 ports with auto MDI/MDI-X |
| Network media | Cat 5 UTP for 1,000Mbps Cat 3 UTP for 10Mbps |
| Transmission method | store-and-forward |
| LED | indicator power, act/link, speed |

K. Router Technical Characteristics

| | |
|-------------------|--|
| Network Standards | IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation |
| Protocol | CSMA/CD, TCP, IP, UDP, PPPoE, AND DHCP (client and server) |
| VPN Supported | PPTP, IPSec pass-through |
| Management | Browser |
| Ports | 4 x 10/100Base-T Auto sensing RJ45 ports, and an auto uplink RJ45port(s) 1 x 10Base-T RJ45 port, WAN |
| LEDs | Power, WAN Activity, LAN Link (10/100), LAN Activity |

L. Encryptor Technical Characteristics:

| | |
|--------------|--|
| Cryptography | Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256) |
| Performance | Throughput (end-to-end) @ 100 Mbps line speed: >188 Mbps full duplex |

| | |
|----------------------------|--|
| | (large frames) >200 kfps full duplex (small frames) Latency (end-to-end) @ 100 Mbps |
| Key Management | Automatic KEK/DEK Exchange Using Signed Diffie-Hellman Unit Authentication Using X.509 Certificates |
| Physical Interfaces | 10BaseT or 10/100BaseT Ethernet (Host and Network Ports) 10BaseT Ethernet Management Port Back and Front-Panel Serial Control Port |
| Device Management | THALES Element Manager, Front Panel Viewer, and Certificate Manager 10Base T (RJ-45) or 9-pin Serial Control Port SNMP Network Monitoring |
| Security Features | Tamper Proof Cryptographic Envelope Tamper Evident Chassis Hardware Random Number Generator |
| Management | Channel Encrypted Using Same Algorithm as Data Traffic |
| Security Certifications | FIPS 140-2 Level 3 CAPS Baseline and Enhanced Grades Common Criteria EAL4 and EAL5 (under evaluation) |
| Regulatory | EN60950, FCC, UL, CE, EN 50082-1, and EN 55022 |

2.11 RECORDING DEVICES

- A. All cameras on the VASS System shall be recorded in real time using a Digital Video Recorder (DVR), Network Video Recorder (NVR), or attached storage. The type of recording device utilized should be determined by the size and type of VASS System designed and installed, and to what extent the system is to be utilized.
- B. All recording devices shall be 47.5 cm (19 inch) rack mountable.
- C. All DVR's and NVR's that are viewable over an Intranet or Internet will be routed through an encryptor.
- D. Encryptors shall:
 - 1. Comply with FIPS PUB 140-2.
 - 2. Support TCP/IP.
 - 3. Directly interfaces to low-cost commercial routers.
 - 4. Provide packet-based crypto synchronization.
 - 5. Encrypt source and destination IP addresses.
 - 6. Support web browser-based management requiring no additional software.

7. Have a high data sustained throughput – 1.544 Mbps (T1) full duplex data rate.
8. Provide for both bridging and routing network architecture support.
9. Support Electronic Key Management System (EKMS) compatible.
10. Have remote management ability.
11. Automatically reconfigure when secure network or wide area network changes.

E. Digital Video Recorder (DVR)

1. Shall record video to a hard drive-based digital storage medium in either NTSC or MPEG format.
2. Shall meet the following minimum requirements:
 - a. Record at minimum rate of 30 images per second (IPS).
 - b. Have a minimum of eight (8) to 16 looping inputs.
 - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
 - d. Shall provide instantaneous playback of all recorded images.
 - e. Be IP addressable, if part of a VASS network.
 - f. Have built-in digital motion detection with masking and sensitivity adjustments.
 - g. Provide easy playback and forward/reverse search capabilities.
 - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically, who, what, where and when.
 - i. DVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
 - j. Accessible locally and remotely via the Internet, Intranet, or a personal digital assistant (PDA).
 - k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
 - l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
 - m. Allow for independently adjustable frame rate settings.
 - n. Be compatible with the matrix switcher utilized to operate the cameras. The DVR could be utilized as a matrix switcher only if it meets all of the requirements listed in the matrix switcher section.

3. Technical Characteristics:

| | |
|-----------------------------------|---|
| Compression | MPEG-4 |
| Internal Storage Capacities. | 8 TB. Available USB hard drive up to 2 TB. Optional internal DVD available |
| Digital Recording | Up to 8 video and 4 audio channels |
| Full real-time video recording | Up to 400 IPS@352 x 288: PAL |
| Multiple simultaneous functions | Live viewing, Recording, playback, network transmission, back-up |
| Search functions | Date/time search, event search, bookmark search, smart (pixel) Search |
| PTZ Control | Third party PTZ control |
| User ID security | 3 levels |
| Connectivity to external devices: | Eight 8 input and looping output channels. VGA and dual monitor BNC outputs. Four 4 audio inputs and one [1] audio output. Ethernet 10/100BaseT network connection. Eight [8] to sixteen [16] alarm inputs and four [4] or eight [8] relay outputs. Biphase connection to control Bosch PTZ cameras. Third party PTZ control via RS-422/RS-485 connection. Front and back USB connectors to connect to a PC mouse, or archive video to a USB memory stick or similar device. |
| PC requirements | Windows 2000 or above; DirectX 8.1 or above. Intel Pentium III or above, AMD Athlon with 800 MHz or faster CPU. 512 MB or more RAM. 50 MB hard drive. AGP VGA with 64 MB video RAM or above. 10/100-BaseT network interface. |
| Electrical | Power Input: 100 to 240 VAC; 50/60 Hz Power consumption: [120W] Max. [1.2] A |
| Video | Video standard: PAL or NTSC selectable. |

| | |
|---------------------------|--|
| | Resolution: 704 x 576 PAL, 704 x 480 NTSC Compression: MPEG-4 Inputs: 8 or 16 composite video 0.5-2 Vpp, 75 Ohm automatic termination. Outputs 8 or 16 composite video 1 Vpp, 75 Ohm. |
| Audio | Inputs: 4 or 8 line in, 30 kOhm Output: 1 line, 100 kOhm |
| Monitors | VGA: analog RGB 800x600 MON A: CVBS 1 Vpp@0.1 V, 75 Ohm, BNC Monitor A multi-screen (VGA or CVBS) MON B: CVBS 1 Vpp@0.1 V, 75 Ohm, BNC Monitor B spot/alarm |
| Frame Rate and Resolution | 16-channels PAL: Up to 400 IPS@352x288, up to 200 IPS@704x288, up to 100 IPS@704x576. |
| Alarm inputs | 16 configurable NO/NC, max. input 5 VDC. |
| Alarm outputs | [4] or [8] relay outputs, configurable NO/NC, max. rated 1A, 125 VAC. |
| Connections | Ethernet: RJ45 modular jack 8 pins shielded, 10/100 Base-T. Biphase: Screw terminal connector (5 outputs). Maximum 5 controllable cameras per Biphase output. PTZ control interfaces: RS485/RS422. Serial interface: RS232 output signal, DB9 male connector Keyboard: RJ11 modular jack 6 pins |
| Network: | Transmission speed: up to 120 IPS@352x240 Bandwidth control: Automatic Remote users: Maximum 5 simultaneous connected Control Center users. |

| | |
|----------------------|--|
| Processor | Intel Pentium III 750 MHz |
| Memory | 8 GB RAM |
| Operating System | Windows 98, NT, ME, 2000, XP, and 10 |
| Video Card | 4 MB of RAM capable of 24-bit true color display |
| Free Hard Disk Space | 160 MB for software installation |

| | |
|----------------------|---|
| Network Card | 10Base-T network for LAN operation |
| Archiving | 80 GB, 160 GB, 320 GB and 640 GB Hard Drive; CD-RW |
| Video Input | 1.0 Vpp (signal 714mV, sync 286mV) 75 ohms (BNC unbalanced) |
| Video Output Level | 1.0 Vpp +/-10%, 75 ohms (BNC unbalanced) |
| Impedance | 75 ohms/Hi- impedance x 16 switchable |
| Network Interface | Ethernet (RJ-45, 10/100M) |
| Network Protocol | TCP/IP, DHCP, HTTP, UDP |
| Network Capabilities | Live/Playback/P/T/Z control |
| Recording Rate | 30 ips for 720 x 240 (NTSC) |
| Password Protection | Menu Setup, Remote Access |
| Recording Capacity | 160 (1 or 2 fixed HDD) 1 CD-RW |
| Power Interrupt | Auto recovered to recording mode |

F. Network Video Recorder (NVR)

1. Shall record video to a hard drive-based digital storage medium in MPEG, MPEG4 or H.264 format.
2. Shall meet the following minimum requirements:
 - a. Record at minimum rate of 30 IPS.
 - b. Have a minimum of eight (8) to 16 looping inputs.
 - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
 - d. Shall provide instantaneous playback of all recorded images.
 - e. Be IP addressable, if part of a VASS network.
 - f. Have built-in digital motion detection with masking and sensitivity adjustments.
 - g. Easy playback and forward/reverse search capabilities.
 - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically, who, what, where and when.
 - i. NVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
 - j. Accessible locally and remotely via the internet, intranet, or a personal digital assistant (PDA).

- k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
- l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
- m. Allow for independently adjustable frame rate settings.
- n. Be compatible with the matrix switcher utilized to operate the cameras.

3. Technical Characteristics:

| | |
|-------------------------|--|
| Hardware/CPU | Pentium III Xeon or IV, 1.8 GHz |
| HDD Interface | IDE or better; optional: SCSI II, SCSI Ultra, or Fiber Channel |
| RAM | 1024 MB |
| Operating System | Windows 2000/XP Professional/Server 2003 Standard |
| Graphic | Card VGA |
| Ethernet Card | 100/1000 MB |
| Memory | 20 MB |
| Software Setup | Centralized setup from each authorized PC; access via integrated web server |
| Storage Media | All storage media possible (e.g., HD, RAID), depending on operating system |
| Storage Mode | Linear mode, ring mode (capacity-based) |
| Recording Configuration | Camera name assignment, bandwidth limit, frame rate, video quality |
| Recording Content | Video and/or audio data |
| Search Parameters | Time, date, event |
| Playback | Playback via any IP network (LAN/WAN) simultaneous recording, playback, and backup |
| Network Interface | Ethernet (RJ-45, 10/100M) |
| Network Protocol | TCP/IP, DHCP, HTTP, UDP |
| Network Capabilities | Live/Playback/P/T/Z control |
| Recording Rate | 30 ips for 720 x 240 (NTSC) |
| Password Protection | Menu Setup, Remote Access |
| Recording Capacity | 160 (1 or 2 fixed HDD) 1 CD-RW |
| Power Interrupt | Auto recovered to recording mode |

2.12 WIRES AND CABLES

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
- C. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
- D. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
- E. Conduit fills shall not exceed 50 percent unless otherwise documented.
- F. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
- G. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area
- H. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
- I. For all equipment that is carrying digital data between the Physical Access Control System and Database Management or at a remote monitoring station, shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
- J. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 m. (3 ft.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:

1. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
 2. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
- K. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.
- L. Coaxial Cables
1. All video signal cables for the VASS System, with exception to the PoE cameras, shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.
 2. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
 3. RG-59/U Technical Characteristics

| | |
|--|--------------------------------|
| AWG | 22 |
| Stranding | 7x29 |
| Conductor Diameter | .031 in. |
| Conductor Material | BCC |
| Insulation Material | Gas-injected FHDPE |
| Insulation Diameter | .145 in. |
| Outer Shield Type | Braid/Braid |
| Outer Jacket Material | PVC |
| Overall Nominal Diameter | .242 in. |
| UL Temperature Rating | 75°C |
| Nom. Characteristic Impedance | 75 Ohms |
| Nom. Inductance | 0.094 µH/ft |
| Nom. Capacitance | Conductor to Shield 17.0 pF/ft |
| Nom. Velocity of Propagation | 80 % |
| Nom. Delay | 1.3 ns/ft |
| Nom. Conductor DC Resistance @ 20°C | 12.2 Ohms/1000 ft |
| Nom. Outer Shield DC | 2.4 Ohms/1000 ft |

| | |
|------------------------|--------------|
| Resistance @ 20°C | |
| Max. Operating Voltage | UL 300 V RMS |

4. Signal Cables:

- a. Signal wiring for PoE cameras depends on the distance the camera is being installed from either a hub or the server.
- b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 5 (CAT-V) cable with standard RJ-45 connector at each end. The cable must comply with the Power over Ethernet, IEEE802.3af, Standard.
- c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.
- d. Provide a separate cable for power.
- e. CAT-5 Technical Characteristics:

| | |
|------------------------------|-------------------------|
| Number of Pairs | 4 |
| Total Number of Conductors | 8 |
| AWG | 24 |
| Stranding | Solid |
| Conductor Material | BC - Bare Copper |
| Insulation Material | PO - Polyolefin |
| Overall Nominal Diameter | .230 in. |
| IEC Specification | 11801 Category 5 |
| TIA/EIA Specification | 568-B.2 Category 5e |
| Max. Capacitance Unbalance | (pF/100 m) 150 pF/100 m |
| Nom. Velocity of Propagation | 70 % |
| Max. Delay | (ns/100 m) 538 @ 100MHz |
| Max. Delay Skew | (ns/100m) 45 ns/100 m |
| Max. Conductor DC Resistance | 9.38 Ohms/100 |
| Max. DCR Unbalance@ 20°C | 3 % |
| Max. Operating Voltage | UL 300 V RMS |

5. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.

- b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.
- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- e. Low Voltage Power Cables
 - 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
 - 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

PART 3 - EXECUTION

3.1. GENERAL

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
 - 1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.

- C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- D. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.
- E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.
- F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.2 INSTALLATION

- A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators,

interconnections, services, and adjustments required for a complete and operable system.

- D. The VASS System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a standalone or a complete network.
- E. For integration purposes, the VASS System shall be integrated where appropriate with the following associated security subsystems:
 - 1. PACS:
 - a. Provide 24-hour coverage of all entry points to the perimeter and agency buildings, as well as all emergency exits utilizing a fixed color camera.
 - b. Record cameras on a 24 hours basis.
 - c. Be programmed go into an alarm state when an emergency exit is opened and notify the Physical Access Control System and Database Management of an alarm event.
 - 2. IDS:
 - a. Provide a recorded alarm event via a color camera that is connected to the IDS system by either direct hardwire or a security system computer network.
 - b. Record cameras on a 24 hours basis.
 - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state and notify the PACS.
 - d. For additional VASS System requirements as they relate to the IDS, refer to Section 28 16 00 "INTRUSION DETECTION".
 - 3. Security Access Detection:
 - a. Provide full coverage of all vehicle and lobby entrance screening areas utilizing a fixed color camera.
 - b. Record cameras on a 24 hours basis.
 - c. The VASS System should have facial recognition software to assist in identifying individuals for current and future purposes.
 - 4. EPPS:
 - a. Provide a recorded alarm event via a color camera that is connected to the EPPS system by either direct hardwire or a security system computer network.
 - b. Record cameras on a 24 hours basis.

- c. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated and notify the Physical Access Control System and Database Management of an alarm event.
- F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.
- H. A complete VASS System shall be comprised of, but not limited to, the following components:
 - 1. Cameras
 - 2. Lenses
 - 3. Video Display Equipment
 - 4. Camera Housings and Mounts
 - 5. Controlling Equipment
 - 6. Recording Devices
 - 7. Wiring and Cables
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

- K. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- L. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.
- M. Cameras:
1. Install the cameras with the focal length lens as indicated for each zone.
 2. Connect power and signal lines to the camera.
 3. Aim camera to give field of view as needed to cover the alarm zone.
 4. Aim fixed mounted cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun.
 5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
 6. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
 7. PTZ cameras shall have all preset positions and privacy areas defined and programmed.
- N. Monitors:
1. Install the monitors as shown and specified in design and construction documents.
 2. Connect all signal inputs and outputs as shown and specified.
 3. Terminate video input signals as required.
 4. Connect the monitor to AC power.
- O. Switcher:
1. Install the switcher as shown in the design and construction documents, and according to the OEM.
 2. Connect all subassemblies as specified by the manufacturer and as shown.
 3. Connect video signal inputs and outputs as shown and specified; terminate video inputs as required.

4. Connect alarm signal inputs and outputs as shown and specified;
connect control signal inputs and outputs for ancillary equipment or
secondary control/monitoring sites as specified by the manufacturer
and as shown.
5. Connect the switcher CPU and switcher subassemblies to AC power.
6. Load all software as specified and required for an operational VASS
System configured for the site and building requirements, including
data bases, operational parameters, and system, command, and
application programs.
7. Provide the original and 2 backup copies for all accepted software
upon successful completion of the endurance test.
8. Program the video annotation for each camera.

P. Video Server:

1. Install the video server per design and construction documents, and
as specified by the OEM.
2. Connect video server to AC power (UPS).
3. Connect to VASS network.
4. Install operating system and Video Management Software.
5. Provide Video Management Software programming per VA guidance and
the requirements provided by the Owner. Programming shall include:
 - a. Camera names
 - b. Screen views
 - c. Camera recording schedules (continuous and event) driven
recording. Events include alarms from other systems (sensors),
manual input, and video motion detection.
 - d. Video detection zones for each camera requiring video motion
detection
 - e. Alarm interface
 - f. Alarm outputs
 - g. GUI maps, views, icons and actions
 - h. PTZ controls (presets, time schedules for privacy zones etc.)
 - i. Reports

Q. Video Workstation:

1. Install the video workstation per design and construction documents,
and as specified by the OEM.
2. Connect video workstation to AC power (UPS).
3. Connect to VASS network.

4. Install operating system and application software.
5. Provide application software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
 - a. Screen views
 - b. Graphical User Interface (GUI) maps, views, icons and actions
 - c. Alarm outputs
 - d. Reports

R. Network Switch:

1. Install the network switch per design and construction documents, and as specified by the OEM.
2. Connect network switch to AC power (UPS).
3. Connect network cameras to network switch.
4. Configure the network switch per manufacturer's recommendation and project requirements.

S. Network Recording Equipment

1. Install the NVR or video storage unit as shown in the design and construction documents, and as specified by the OEM.
2. Connect recording device to AC power (UPS).
3. Connect recording device to network switch as shown and specified.
4. Configure network connections
5. Provide recording unit programming per VA guidance and the requirements provided by the Owner. Programming shall include:
 - a. Camera names
 - b. Screen views
 - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
 - d. Video detection zones for each camera requiring video motion detection
 - e. Alarm interface
 - f. Alarm outputs
 - g. GUI maps, views, icons and actions
 - h. PTZ controls (presets, time schedules for privacy zones etc.)
 - i. Reports

T. Video Recording Equipment:

1. Install the video recording equipment as shown in the design and construction documents, and as specified by the OEM.

2. Connect video signal inputs and outputs as shown and specified.
3. Connect alarm signal inputs and outputs as shown and specified.
4. Connect video recording equipment to AC power.
5. Program the video recording equipment;
 - a. Recording schedules
 - b. Camera caption

U. Video Signal Equipment:

1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video or signal inputs and outputs as shown and specified.
3. Terminate video inputs as required.
4. Connect alarm signal inputs and outputs as required.
5. Connect control signal inputs and outputs as required
6. Connect electrically powered equipment to AC power.

V. Camera Housings, Mounts, and Poles:

1. Install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site.
2. Provide a foundation for each camera pole as specified and shown.
3. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as specified in Division 26 of the VA Master Specification and the VA Electrical Manual 730.
4. Provide electrical and signal transmission cabling to the mount location via a hardened carrier system from the Physical Access Control System and Database Management to the device.
5. Connect signal lines and AC power to the housing interfaces.
6. Connect pole wiring harness to camera.

3.3 SYSTEM START-UP

- A. The Contractor shall not apply power to the VASS System until the following items have been completed:
1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
 2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.
 4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
 5. Power supplies to be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.
- B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum of 7 days prior notice.
- C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

- A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.
- B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
- C. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
- D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.6 DEMONSTRATION AND TRAINING

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, "GENERAL REQUIREMENTS".
- B. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications

-----END-----

SECTION 31 05 19
GEOTEXTILE

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|-------------------|---|
| ASTM D4354 | (2012) Sampling of Geosynthetics for Testing |
| ASTM D4355/D4355M | (2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus |
| ASTM D4491/D4491M | (2015) Standard Test Methods for Water Permeability of Geotextiles by Permittivity |
| ASTM D4533/D4533M | (2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles |
| ASTM D4632/D4632M | (2015a) Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4751 | (2016) Standard Test Method for Determining Apparent Opening Size of a Geotextile |
| ASTM D4759 | (2011) Determining the Specification Conformance of Geosynthetics |
| ASTM D4873/D4873M | (2016) Identification, Storage, and Handling of Geosynthetic Rolls and Samples |
| ASTM D6241 | (2014) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe |

1.2 SUBMITTALS

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

SD-03 Product Data

Thread Manufacturing Quality Control Sampling and Testing

SD-04 Samples

Quality Assurance Samples and Tests

SD-07 Certificates

Geotextile

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle geotextile in accordance with ASTM D4873/D4873M.

1.3.1 Delivery

Notify the COR a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 71 degrees C (160 degrees F), or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, either elevate rolls off the ground or place them on a sacrificial sheet of plastic in an area where water will not accumulate.

1.3.3 Handling

Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.1 RAW MATERIALS

A minimum of 7 days prior to scheduled use, submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle-punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

2.1.1 Geotextile

Provide geotextile, as shown on the drawings, that is a nonwoven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

| TABLE 1 MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE | | | |
|--|------------|---------------------------|-------------------|
| PROPERTY | UNITS | ACCEPTABLE VALUES | TEST METHOD |
| GRAB STRENGTH | LBS | 158 | ASTM D4632/D4632M |
| SEAM STRENGTH | Percent | 50 | ASTM D4632/D4632M |
| PUNCTURE | LBS | 320 | ASTM D6241 |
| TRAPEZOID TEAR | LBS | 56 | ASTM D4533/D4533M |
| APPARENT OPENING SIZE | U.S. SIEVE | (No. 30 US sieve) max. | ASTM D4751 |
| PERMITTIVITY | SEC -1 | 0.2 | ASTM D4491/D4491M |
| ULTRAVIOLET DEGRADATION | PERCENT | 50 AT 500 HRS | ASTM D4355/D4355M |

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and

compaction requirements shall be in accordance with Section 31 20 00 Earth Moving.

3.1.2 Placement

Notify the COR a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, lay the geotextile with the machine direction of the fabric parallel to the slope direction.

3.2 SEAMS

3.2.1 Overlap Seams

Continuously overlap geotextile panels a minimum of 6 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, lap the upper panel over the lower panel.

3.3 PROTECTION

Protect the geotextile during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Use adequate ballast (e.g. sand bags) to prevent uplift by wind. The geotextile shall not be left uncovered for more than 15 days after installation.

3.4 REPAIRS

Repair torn or damaged geotextile. Clogged areas of geotextile shall be removed. Perform repairs by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 36 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Remove and replace geotextile rolls which cannot be repaired. Repairs shall be performed at no additional cost to the Government

3.5 COVERING

Do not cover geotextile prior to inspection and approval by the COR. Place cover soil in a manner that prevents soil from entering the

geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the COR. Use equipment with ground pressures less than 7 psi to place the first lift over the geotextile. A minimum of 12 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 20 00, EARTH MOVING. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

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**SECTION 31 11 00
CLEARING AND GRUBBING**

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 within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD) DODI 4150.07 DOD Pest Management Program

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Herbicide Application Plan

SD-03 Product Data

Nonsaleable Materials;

Herbicides;

SD-04 Samples

Tree Wound Paint

SD-07 Certificates

Qualifications;

SD-11 Closeout Submittals

Pest Management Report

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

Comply with DODI 4150.07 for requirements on Contractor's licensing, certification, and record keeping. Maintain daily records using the Pest Management Maintenance Record, DD Form 1532-1, or a computer-generated equivalent. These forms may be obtained from the main web site:
<http://www.dtic.mil/whs/directives/forms/eforms/dd1532-1.pdf>

1.3.2 Qualifications

For the application of herbicides, use the services of an applicator who is commercially certified in the state where the work is to be performed as required by DODI 4150.07. Submit a copy of the pesticide applicator

certificates.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

1.4.1 Storage

Storage of herbicides on the installation will not be permitted unless it is written into the contract.

1.4.2 Handling

Handle herbicides in accordance with the manufacturer's label and Safety Data Sheet (SDS), preventing contamination by dirt, water, and organic material. Protect herbicides from weather elements as recommended by the manufacturer's label and SDS. Spill kits must be maintained on herbicide control vehicles. Mixing of herbicides on the installation will not be permitted unless it is written into the contract.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Tree Wound Paint

Submit samples in cans with manufacturer's label of bituminous based paint of standard manufacture specially formulated for tree wounds.

2.1.2 Herbicides

Provide herbicides currently registered by the EPA or approved for such use by the appropriate agency of the host county and approved by the COR. Select an herbicide that is suitable for the climatic conditions at the project site. Submit manufacturer's label and SDS for herbicides proposed for use.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Herbicide Application Plan

Prior to commencing application of herbicide, submit an herbicide application plan with proposed sequence of treatment work including dates and times of application. Include the herbicide trade name, EPA

registration number, chemical composition, formulation, application rate of active ingredients, method of application, area or volume treated, and amount applied. Include a copy of the pesticide applicator certificates.

3.1.2 Protection

3.1.2.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2.2 Trees, Shrubs, and Existing Facilities

Provide protection in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. Protect trees and vegetation to be left standing from damage incidental to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.2.3 Utility Lines

Protect from damage existing utility lines that are indicated to remain. Notify the COR immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repair of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the COR in ample time to minimize interruption of the service. Refer to Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS for additional utility protection.

3.2 Application

3.2.1 Herbicide Application

Adhere to safety precautions as recommended by the manufacturer concerning handling and application of the herbicide.

3.2.1.1 Clean Up, Disposal, And Protection

Once application has been completed, proceed with clean up and protection of the site without delay. Clean the site of all material associated with the treatment measures, according to label instructions, and as indicated. Remove and dispose of excess and waste material off Government property.

3.2.1.1.1 Disposal of Herbicide

Dispose of residual herbicides and containers off Government property, and

in accordance with the approved disposal plan, label instructions and EPA requirements.

3.3 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm (1-1/2 inches) or more in diameter and shall be trimmed of all branches to the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches.

3.3.1 Tree Removal

All trees and stumps that are located within the construction drawings limits of disturbance shall be removed and designated as clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph 3.3.3 Grubbing. Trees shall be disposed of as specified in paragraph 3.4 DISPOSAL OF MATERIALS.

3.3.2 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 38 mm (1-1/2 inches) or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 32 mm (1-1/4 inches) in diameter with an approved tree wound paint.

3.3.3 Grubbing

Grubbing consists of the removal and disposal of stumps, roots larger than 75 mm (3 inches) in diameter, and matted roots from the designated grubbing areas. Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, to a depth of not less than 455 mm (18 inches) below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be

paved. Fill depressions made by grubbing with suitable material and compact to make the surface conform to the original adjacent surface of the ground.

3.4 DISPOSAL OF MATERIALS

3.4.1 Saleable Timber

All timber on the project site noted for clearing and grubbing shall become the property of the Contractor and shall be removed from the project site and disposed of off station.

3.4.2 Nonsaleable Materials

Written permission to dispose of such products on private property shall be filed with the COR. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Herbicides

Upon completion of this work, submit the Pest Management Report DD Form 1532, or an equivalent computer product, to the Integrated Pest Management Coordinator. This form identifies the type of operation, brand name and manufacturer of herbicide, formulation, concentration or rate of application used.

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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 RELATED REQUIREMENTS

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Finish Grading: Section 32 90 00, PLANTING.

1.3 DEFINITIONS

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 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 described in paragraph 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. If materials differ from design requirements, excavate to acceptable strata subject to owner's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by line located 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 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 COR. 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 COR 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 COR 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.

1.4 CLASSIFICATION OF EXCAVATION

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Rock Excavation (if encountered):
 - 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 42-inch-wide, short-tip-radius rock bucket; rated at minimum 120 hp. flywheel power with bucket-curling force of minimum 25,000 lbf. and stick-crowd force of minimum 18,000 lbf.; measured according to SAE J-1179. Trenches in excess of 10 feet wide and pits in excess of 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 dozer; rated at

minimum 285 hp. flywheel power and equipped with a single-shank hydraulic ripper capable and developing a minimum of 45,000 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 1 cubic yard for open excavation, or 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. Blasting: Removal and disposal of solid, homogeneous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be removed with conventional methods may be performed by blasting as approved by the COR and in accordance with paragraph 3.2.D. of this specification section.
5. 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.

1.5 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
 1. D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 2. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2700 kN m/cu. m.)).
 3. D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- C. Society of Automotive Engineers (SAE):
 1. J732-12 - Specification Definitions - Loaders.
 2. J1179-08 - Hydraulic Excavator and Backhoe Digging Forces.
- D. Utah State Highway and Transportation Department:
 1. Standard Specifications for Highway Construction, Latest Edition.

1.6 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit scale plan daily showing location, limits, and depths of excavated area.
- C. Samples:
 - 1. Soil samples for testing onsite soil and offsite soil if import material is used.
- D. Test Reports: Document that materials comply with the specifications.
 - 1. 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 D1557.
- E. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.
- F. Delegated Design Drawings and Calculations (if applicable): Signed and sealed by responsible design professional.
 - 1. Identify deviations from details shown on drawings.

1.7 QUALITY ASSURANCE

- A. Product Installer Qualifications (if applicable):
 - 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. Retain an approved independent testing laboratory to perform specified tests and submit reports.
 - a. Deliver samples to laboratory in number and quantity required for testing.

1.8 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 be misconstrued as damage caused by earthwork operations.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. General Fill (if applicable): ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SP-SM, and SP-SC, or any combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Plasticity Index: 15 maximum.
 - 2. Liquid Limit: 40 maximum.
- C. Engineered (Classified) Fill: Material meeting the requirements of Section 302 Selected Material of the Utah Standard Specifications for Select Material as summarized below:
 - 1. Contain no muck, frozen material, roots, sod, or other deleterious matter and with a plasticity index not greater than 6 as tested by Utah Test Method (ATM) 204 of ATM 205.
 - 2. Meet the following gradation as tested by ATM 304: 20 to 60 percent passing No. 40 sieve, and 0 to 6 percent passing No. 200 sieve.
- D. 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 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- E. Granular Fill:
 - 1. Bedding for Sanitary and Storm Sewer Pipe: Crushed stone or gravel graded from 1/2 inch to No 4 sieve sizes.

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 1 inch and larger diameter.

2. Leave undisturbed sound stumps, roots up to 3 inches diameter, and nonperishable solid objects minimum 5 feet below subgrade or finished embankment.

3. Do not leave material within burial profile up to 8 feet below finished grade.

C. Trees and Shrubs:

1. Remove trees and shrubs, not shown for removal, within 15 feet of new construction and 7.5 feet of utility lines, when approved in advance by COR.

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 portion of 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 COR.

3. Eliminate foreign materials larger than 1/2 cubic foot in volume, from soil when stockpiled. Retain topsoil on the property.

4. Remove foreign materials larger than 2 inches in any dimension from topsoil used in final grading.
 5. Do not perform 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. Existing Concrete Slabs and Paving (if encountered):
1. Score deeply or saw-cut existing concrete slabs and paving to be removed in neat, straight-cut sections where excavation or trenching occurs.
 2. Extend pavement section a minimum of 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 02, GENERAL REQUIREMENTS (Minor NCA Projects).
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 and proposed elevations indicated on Drawings, except spot elevations, are approximate and were obtained from the site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Notify COR of any differences between existing elevations indicated on Drawings and those encountered on site by Architect/Engineer. Notify COR 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. Remove materials from site and dispose 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 to the angle of repose, banks of excavations or to an angle acceptable by the COR, to protect workmen, banks, adjacent paving, structures, and utilities.

1. Begin construction of excavation system support after review by COR.
2. Extend shoring and bracing minimum 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,

B. Excavation Drainage (if required):

1. Operate pumping equipment and provide other materials, means and equipment to keep excavation free from water and subgrade dry, firm, and undisturbed until permanent work is approved by COR.

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. 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 COR.

D. Blasting: Blasting of materials classified as rock shall be permitted only when authorized by COR. Contractor shall meet all federal, state, and local requirements. All blasting should fall under the classification of "controlled blasting".

1. Blasting shall be done with explosives of quantity and power, and fired in such sequence and locations as to not injure personnel, minimize or eliminate impacts like flying debris, vibrations, sound,

dust and damage due to overbreak, damage or crack rock against which concrete is to be placed, damage property, or damage existing work or other portions of new work. Contractor shall be responsible for damage caused by blasting operations. All blasting should be conducted in a manner to minimize overbreak, thus creating additional excavation. Any additional excavation as a result of overbreak will be at no additional expense to the Government.

2. The Contractor shall submit a Blasting Plan, prepared and sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Blasting mats shall be provided and non-electric blasting caps shall be used. The Contractor shall obtain written approval prior to performing any blasting and shall notify the COR 24 hours prior to blasting. The plan shall contain provisions for storing, handling and transporting explosives as well as for the blasting operations.

3. Submittals:

- a. Blasting Plan: The blasting plan requirements are to be determined by a Contractor experienced in this type of work.

The blasting contractor shall prepare and submit a comprehensive blasting plan that addresses the unique parameters for each phase of the plan including:

1. pre-blast survey
2. Pre-blast meeting
3. Test blast
4. Typical controlled blasts showing perimeter control methods
5. Post-blast survey for each blast or at the end of a day's blasting activities, showing effectiveness of blast(s).
As blasting operations progress, the drilling and blasting procedures shall be determined only by satisfactory results achieved. If a drilling and blasting program result in unacceptable results, devise and employ methods which will improve results.
6. Changes in the approved blasting plan 21 days prior to planned blasting operations
7. All required local, state, and federal approvals should be obtained and forwarded to the engineer for review.

E. Proofrolling and Improvement of Roadway Subgrade:

5. Proofroll exposed subgrade with fully loaded dump truck to check for pockets of soft material.
6. Proofroll subgrade at least two complete passes, one pass in a direction perpendicular to first one. Remove existing material (unsuitable material) in areas that deflect, rut, or pump excessively during proof rolling, or fail to consolidate after successive passes with suitable equipment.
7. Replace removed unsuitable materials with compacted Classified Fill to required depth as determined by the COR. Maintain finished surface of compacted Classified Fill until succeeding operation (such as construction of aggregate base course for pavement) has been accomplished.

F. Trench Earthwork:

8. Utility Trenches (Except Sanitary and Storm Sewer):

- a. Excavate to width required for sheeting and bracing (if required) 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 shall not be greater than authorized by COR.

9. Sanitary and Storm Sewer Trenches:

a. Trench Width:

1) Below a Point 6 inches Above Top of Pipe:

- a) Pipe up to 12-inch diameter: 24 inches maximum
- b) Pipe Larger than 12-inch diameter: Four-thirds pipe diameter plus 8 inches.

2) Trench Width Above 6 inches: Pipe size as required for sheeting and bracing or lay-back of side slopes 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 12 inches above top of pipe.

- 2) Classified Fill: Depth of fill minimum 3 inches plus one-sixth of pipe diameter below pipe to 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 Classified Fill for bed where rock or rocky materials are excavated.

G. Site Earthwork:

- 10. 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 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 COR (as specified in 3.2.E).
 - d. Obtain material samples for soil classification, under the direction of the COR, for testing by an independent testing laboratory to determine suitability.
 - e. Contractor's approved independent testing laboratory shall perform specified soil testing.
 - f. When unsuitable material is encountered, and removed, contract price and time will be adjusted according to Articles, DIFFERING SITE CONDITIONS, (FAR 52.236-2). Adjustments will be based on volume in cut section only.
- 11. Site Grading:
 - a. Provide a smooth transition between adjacent existing grades and new grades as shown on the drawings.
 - 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 1 inch.
- 2) Walks: Plus or minus 1 inch.
- 3) Pavements: Plus or minus 1 inch.

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 COR.
- B. Placing: Place materials in horizontal layers at a maximum of 8 inches in loose depth for material compacted by heavy compaction equipment, and a maximum of 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 tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other equipment (hand or mechanized) as appropriate for soil to be compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without prior approval of COR. 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 D1557 as specified below:
 - 1. Fills, Embankments, and Backfill:
 - a. Under Proposed Structures, Building Slabs, Steps, and Paved Areas: Scarify and recompact top 12 inches of existing suitable subgrade and each layer of backfill or fill material

to at least 95 percent of the material's maximum dry density as determined using ASTM D1557.

- b. Under Sidewalks and Other Non-Structural Concrete Slabs on Grade: Scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material to at least 95 percent of the material's maximum dry density as determined using ASTM D1557.
- c. Landscaped Areas Top 16 inches: No compaction required other than that provided by placement equipment.
- d. Landscaped Areas Below 16 inches of Finished Grade: Compact to at least 90 percent of the material's maximum dry density as determined using ASTM D1557.

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. Finish grade earth floors in pipe basements as indicated on Drawings, to level, uniform slope and leave clean.
- C. Place and compact Classified Fill or native sand and gravel where unsuitable materials are removed for pavement base course subgrade and concrete slabs on grade to total depth determined by the COR. Place in loose lifts not exceeding 12 inches in thickness if a large vibratory compactor is used, or not exceeding 4 inches in thickness if a lightweight or hand operated compactor is used.
- D. Finish subgrade in condition acceptable to COR at least one day in advance of paving and concrete slab construction 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.
- E. Tolerances:
 - 1. Subgrade for Paved Areas and Non-Structural Concrete Slab on Grade:
Plus or minus 0.25 inches of indicated grades.

3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Cemetery property. Stockpile or spread soil as directed by COR.
- B. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of Cemetery property.

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 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Site work concrete - Pedestrian Pavement; Vehicular Concrete; flower/water stations; concrete curb and gutter.

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.

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. M147 - Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
 2. M182 - Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
 3. M213 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- C. ASTM International (ASTM):
1. A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 2. C94/C94M - Standard Specification for Ready-Mixed Concrete.
 3. C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
 4. C171 - Standard Specification for Sheet Materials for Curing Concrete.
 5. C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- D. Utah State Highway and Transportation Department:
1. Standard Specifications for Highway Construction, latest Edition.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site a minimum of 30 days before beginning Work of this section.
 - 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. Inspection and Testing Agency.
 - c. Contractor.
 - d. Installer.
 - e. Manufacturer's field representative.
 - 2. Meeting Agenda: Distribute agenda to participants a minimum of 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. 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.
- C. Certificates: Certify products comply with specifications.
 - 1. Expansion joint filler.
 - 2. Reinforcement.
 - 3. Curing materials.
 - 4. Concrete protective coating.

- D. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.
 - 2. Land surveyor.
- E. Concrete mix design.

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 the State of Oklahoma.
- C. Preconstruction Testing:
 - 1. Engage independent testing laboratory to perform tests and submit reports.
 - a. Deliver samples to laboratory in number and quantity required for testing.
 - 2. Concrete mix design.

1.7 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging legibly. Indicate manufacturer's name or brand, type, and manufacture date.
- C. Deliver steel reinforcement to prevent damage.
- D. Before installation, return or dispose of products with damaged or opened packaging and distorted or damaged steel reinforcement.
- E. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.8 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

- A. Place concrete as specified under paragraph 3.3.C for Cold Weather Placement and paragraph 3.3.B 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: Air-entrained, conforming to the requirements of the Utah Standard Specifications for Portland Cement Concrete Pavement, with properties as summarized in the following paragraphs:
1. Portland Cement: ASTM C150, Type V or equivalent sulfate-resistant cement
 2. Water-Cement Ratio: 0.45
 3. Total Air Content: 4.0% to 7.5%
 4. Coarse Aggregate Gradation: No. 57 or No. 67
 5. Compressive Strength (at 28 days): 4,000 psi
- B. Slump: As indicated in the following table or in accordance with the provisions set forth in the Utah Standard Specifications.

| TYPE | MAXIMUM SLUMP* |
|--|----------------|
| Curb & Gutter | 3 inches |
| Pedestrian Pavement | 3 inches |
| Equipment Pad | 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. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the Specifications.
- B. Welded wire fabric shall conform to ASTM A1064/A1064M.

2.3 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: 1/8 inch maximum variation from straight line in any 10 foot long section, in either a horizontal or vertical direction.
- C. Wood Forms: Minimum 2 inches thick (nominal), free from warp, twist, loose knots, splits, or other defects. Provide approved flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

- A. Concrete Curing Materials: Comply with one of the following:
 - 1. Burlap: AASHTO M182, weighing 7 oz./sq. yd. dry.
 - 2. Impervious Sheeting: ASTM C171.
 - 3. Liquid Membrane Curing Compound: ASTM C1315, Type 1, Class A.

2.5 EXPANSION JOINT FILLERS

- A. Expansion Joint Filler: AASHTO M213 (ASTM D1751).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Prepare, construct, and finish subgrade as specified in Section 31 20 00, EARTH MOVING.
- D. Maintain subgrade in smooth, compacted condition, complying with required section and established grade until succeeding operation has been accomplished.

3.2 SETTING FORMS

- A. Form Substrate:
 - 1. Compact form substrate to uniformly support forms along entire length at grade as shown on drawings.
 - 2. Correct substrate imperfections or variations by cutting or filling and compacting.
- B. Form Setting:
 - 1. Set forms sufficiently in advance of concrete placement to permit performance and approval of operations required with and adjacent to form lines.
 - 2. Set forms to indicated line and grade and use stakes, clamps, spreaders, and braces to prevent movement in any direction.

3. Tolerances: Conform to line and grade with 3 mm (1/8 inch) tolerance when checked with straightedge, with maximum 6 mm (1/4 inch) deviation from true line at any point.
4. Remove forms when removal will not damage concrete and when required for finishing.
5. Clean and oil forms before each use.
- C. Land Surveyor: Establish and control alignment and form grade elevations.
 1. Make necessary corrections to forms immediately before placing concrete.
 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck form before placing concrete.

3.3 PLACING REINFORCEMENT

- A. Keep reinforcement free of dirt, oil, rust, scale or other substances preventing concrete bond.
- B. Install reinforcement as shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.

3.4 PLACING CONCRETE - GENERAL

- A. Preparation:
 1. Obtain COR's approval.
 2. Remove debris and other foreign material from between forms.
 3. Uniformly moisten subgrade without standing water.
- B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.
- C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.
 1. Vibrate concrete against forms and along joints.
 2. Avoid excess vibration and handling causing segregation.
- D. Place concrete continuously between joints without bulkheads.
- E. Install construction joint whenever concrete placement is suspended for more than 30 minutes, and at end of each day's work.
- F. Workmen or construction equipment coated with foreign material will not be permitted to walk or operate in concrete during placement and finishing operations.

**3.5 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENTS, AND
EQUIPMENT PADS**

- A. Place concrete in one layer conforming to cross section shown on drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- C. After concrete has been placed in forms, use a strike-off guided by side forms to bring surface to proper section to be compacted.
- D. Consolidate concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish concrete surface to grade with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.6 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.

3.7 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Flower Water Stations:
 - 1. Finish concrete surfaces to grade and cross section with metal float, troweled smooth and finished with a broom moistened with clear water.
 - 2. Broom surfaces transverse to traffic direction.
 - 3. Carefully finish slab edges, including at formed joints, with edger with radius as shown on drawings.
 - 4. Unless otherwise indicated, edge transverse joints before brooming. Use brooming to eliminate flat surface produced by edger. Produce uniform corrugations, maximum 1/16 inch deep.
 - 5. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.

3.8 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.

3.9 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. Finish joint edges with edging tool having radius as shown on drawings.

C. Score pedestrian pavement with standard grooving tool or jointer.

3.10 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.

3.11 CONSTRUCTION JOINTS

A. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.

B. Provide butt-type joint with dowels in curb and gutter if joint occurs at planned joint location.

3.12 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.

3.13 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 COR.
- 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 a minimum of two layers kept saturated with water during curing period. Overlap mats a minimum of 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 a minimum of 12 inches.
 - c. Securely anchor sheet materials to prevent 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 200 sq. ft./gal., both coats.
 6. Immediately reapply curing compound to surfaces damaged during curing period.

3.14 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

3.15 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.

3.16 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
1. Prohibit traffic on paving for a minimum of seven days after placement, or longer as directed by COR.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
1. When directed by COR, replace concrete containing cracking, fractures, spalling, and other defects within joint boundary, at no additional cost to Government.

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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 Asphalt pavement.

1.2 RELATED REQUIREMENTS

- A. Roadway subgrade preparation: Section 31 20 00, EARTH MOVING.
- B. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
Cedar City Engineering Standard Specifications, latest edition:
 - a. Section 4.3, Roadway Construction.
 - b. Section 2.4, Inspections, Testing and Quality Control

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site a minimum of 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. Inspection and Testing Agency.
 - c. Contractor.
 - d. Installer.
 - e. Manufacturer's field representative.
 2. Meeting Agenda: Distribute agenda to participants a minimum of 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. Test Reports: Results of specified tests indicating that materials and constructed work comply with the specifications.
 1. Aggregate Base Course.
 2. Asphalt Pavement Course.
- C. Certificates: Certify products comply with specifications.
 1. Asphalt prime and tack coat material complying with requirements of Cedar City Engineering Standard Specifications, Section 4.3.
 2. Asphalt cement (binder) complying with requirements of the Cedar City Engineering Standard Specifications, Section 4.3.
 3. Job Mix Design (JMD) documentation indicating that mix equals or exceeds requirements of the Cedar City Engineering Standard Specifications.
- D. Qualifications: Substantiate qualifications comply with specifications.
 1. Manufacturer with project experience list.
 2. Land Surveyor.

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.
- B. COR 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 referenced in the following paragraphs, or as otherwise approved by the COR.
 2. Aggregate Base Course:

- a. Test sources, gradation, liquid limit, plasticity index, percentage of wear, and other properties in accordance with applicable requirements of the Cedar City Standard Specifications.
- 3. ASPHALT Pavement Job Mix Design (JMD):
 - a. Provide a JMD for ASPHALT pavement course in accordance with applicable requirements of Cedar City Engineering Standard Specifications, Section 4.3.

1.7 FIELD CONDITIONS

- A. Environment:
 - 1. Conform to Section 4.3.2 of the Cedar City Engineering Standard Specifications for weather limitations.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 AGGREGATES FOR BASE COURSE AND ASPHALT PAVEMENT

- A. Aggregate for Base Course: Crushed stone or crushed gravel conforming to the requirements of Section 4.3.1 of Cedar City Engineering Standard Specifications.
- B. Aggregates for Asphalt: Conform to the requirements of Section 4.3.1 of Cedar City Engineering Standard Specifications.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: Conform to the requirements of Section 4.3.1 of Cedar City Engineering Standard Specifications.
- B. Asphalt Tack Coat: Conform to the requirements of Section 4.3.1 of Cedar City Engineering Standard Specifications.
- C. Asphalt Prime Coat: Conform to the requirements of Section 4.3.1 of Cedar City Engineering Standard Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Land Surveyor to establish and control pavement (aggregate base course and Asphalt pavement course) alignments, grades, elevations, and cross sections as shown on Drawings.

3.2 MIXING AND DELIVERY OF ASPHALT PAVEMENT MATERIALS

- A. Provide Asphalt pavement materials in accordance with Section 4.3.2 of Cedar City Engineering Standard Specifications, including requirements for JMD, equipment, asphalt mixing plant, preparation of asphalt and aggregates, and mixture.

3.3 SUBGRADE

- A. Prepare subgrade as specified in Section 31 20 00 EARTH MOVING, and in accordance with the following requirements.
- B. Shape to line and grade and compact with self-propelled rollers.
- C. Fill depressions developed under rolling with acceptable material and re-roll area.
- D. Remove soft areas, fill with acceptable materials and re-roll area.
- E. If subgrade becomes rutted or displaced before the placing of subbase, rework subgrade to bring to line and grade.
- F. Proof-roll subgrade with maximum 50-ton gross weight dump truck as directed by COR. If pumping, pushing, or other movement is observed, rework area to provide stable and compacted subgrade.

3.4 AGGREGATE BASE COURSE CONSTRUCTION

- A. Placement of Base Course:
 - 1. Conform to the requirements of Section 4.3.1 of Cedar City Standard Specifications for mixing, placement and compaction. Sampling of aggregate during placement will not be required.
 - 2. Spread and compact to thickness shown on Drawings.
 - 3. Begin rolling sides, continue toward center, and continue until there is no movement ahead of roller.
 - 4. After completion of base rolling, no hauling is permitted over base except top course material delivery.
- B. Compaction: Subgrade compacted to a density of at least 95 percent of the material's maximum dry density (ASTM D1557).
- C. Density testing of compacted aggregate base course will be required in accordance with Sections 4.1.4 of Cedar City Standard Specifications.
- D. Thickness Tolerance: Compacted thicknesses shown on Drawings within minus 1/2 inch to plus 1 inch.
- E. Smoothness Tolerance: Maximum surface deviations of 3/8 inch as measured using a 10-foot straightedge.
- F. Moisture Content: Only amount required to achieve specified compaction in accordance with Section 4.3.2 of the Cedar City Specifications.

- G. Areas of aggregate base course that do not meet the required density, thickness or smoothness, within allowed tolerances, shall be reconstructed as approved by the COR.

3.5 ASPHALT PAVEMENT CONSTRUCTION

- A. Remove all loose materials from compacted aggregate base course.
- B. Apply prime coat, and tack coat where required, in accordance with Section 4.3.2 (as applicable) of the Cedar City Standard Specifications and as approved by the Engineer. Tack coat is only required for coating of contact surfaces of concrete structures within the roadway.
- C. Receipt of Asphaltic Concrete Materials:
 - 1. Unless otherwise provided for in the Standard Specifications, do not accept material unless covered with tarpaulin until unloaded, and unless material is minimum 280 degrees F.
 - 2. Conform to subsection 4.3.2 of the Cedar City Standard Specifications for weather limitations for ASPHALT placement.
- D. Spreading:
 - 1. Conform to subsection 4.3.2, paragraph B, of the Cedar City Standard Specifications.
 - 2. Spread material with minimal handling.
 - 3. ASPHALT pavement course shall be constructed in one or more uniform lifts to the required total compacted thickness indicated on the Drawings. The maximum compacted lift thickness allowed is 3 inches.
- E. Compaction and Surface Requirements
 - 1. During placement of the ASPHALT pavement material, Asphalt should be compacted to minimum of 96% of the Marshall maximum density.
 - 2. Conform to section 4.3.2 for construction of joints.
 - 3. Density testing of compacted ASPHALT pavement will be required in accordance with section 4.3.3. Deficient areas shall be corrected as approved by the COR.
 - 4. Finished paving smoothness and thickness tolerance:
 - a. Conform to subsection 4.3.2, including the following, or as otherwise approved by the COR.
 - b. No depressions which will retain standing water.
 - c. Smoothness Tolerance: Maximum surface deviations of 3/16 inch as measured using a 10-foot straightedge.
 - d. Thickness Tolerance: Maximum of 1/2 inch less than required.

- e. Deviations exceeding specified tolerances for smoothness and thickness are subject to payment reductions or correction as determined by the COR.

3.6 CLEANING

- A. Remove debris, rubbish, and excess material from project site.

3.7 MAINTENANCE AND PROTECTION

- A. The completed ASPHALT pavement surface shall be protected from damage until acceptance of the construction work and substantial completion of the Project.
- B. Damaged areas shall be repaired using methods approved by the COR.

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SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This work consists of all labor, materials, and equipment necessary for furnishing and installing the permanent cemetery chain link fence, gates and accessories in conformance with the lines, grades, and details shown on the Drawings. All fencing and gate materials to be PVC Vinyl Coated 250 to 375 microns (10 to 15 mils) thick thermally fused, ASTM Class-2b, black color, or as approved during the submittal process.

1.2 RELATED REQUIREMENTS

- A. Temporary Construction Fence: Section 01 00 02, GENERAL REQUIREMENTS.
- B. Concrete Footings: Section 32 23 05, CEMENT & CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
 1. A121-13 - Metallic Coated Carbon Steel Barbed Wire.
 2. A392-11a - Zinc-Coated Steel Chain-Link Fence Fabric.
 3. A817-12 - Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire.
 4. F567-14a - Installation of Chain-Link Fence.
 5. F626-14 - Fence Fittings.
 6. F668-11 - Polyvinyl Chloride (PVC) and other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
 7. F900-11 - Industrial and Commercial Swing Gates.
 8. F934-96 (R2013) - Standard Colors for Polymer-Coated Chain Link Fence Materials.
 9. F1083-16 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- C. American Welding Society (AWS):
 1. D1.2/D1.2M-14 - Structural Welding Code - Aluminum.
- D. Federal Specifications (Fed. Spec.):
 1. FF-P-110H - Padlock, Changeable Combination.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
 - 3. Warranty.
- D. Samples:
 - 1. Polymer Coated Product: 5 inch square,
 - 2. Accessories: Full sized, complete assembly.
 - 3. Approved samples may be incorporated into work.
- E. Certificates: Certify each product complies with specifications.
 - 1. Fence alignment.
 - 2. Zinc-coating.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer with project experience list.
 - 2. Installer with project experience list.
- G. Operation and Maintenance Data.
 - 1. Care instructions for each exposed finish product.

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. 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.
- C. Surveyor Qualifications:
 - 1. Trained and experienced to provide services typically provided by a surveyor as defined by state law in the project location.
 - 2. Licensed professional qualified to perform survey services in the project location.

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. Protect products from damage during handling and construction operations.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant against material and manufacturing defects.
 - 1. Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide fences and gates from one manufacturer.

2.2 CHAIN-LINK FENCE

- A. Materials: ASTM F1083 and ASTM A392 ferrous metals, zinc-coated.
 - 1. ASTM A934 PVC coating system.
 - 2. Color: Black
- B. Chain-Link Fabric: ASTM A392 9 gauge wire woven in 1/2 inch mesh. Top selvage twisted and barbed and bottom knuckle selvage. Zinc-coating weight 2.0 ounces per square foot).
- C. Post: ASTM F1083, Grade SK-40A, square, zinc-coated steel. Size and type as indicated on Drawings. Provide post braces and truss rods for each gate, corner, pull or end post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.
- D. Top Rail and Bottom Rail: ASTM F1083, Grade SK-40A, round, zinc-coated steel.

2.3 GATES

- A. Swing Gates: ASTM F900, type as indicated on Drawings. Zinc-coating weight same as fabric.

1. Gates less than 8 feet wide, provide truss rods or intermediate braces.
2. Attach fabric to frame according to manufacturer's instructions, except welding is not be permitted. Arrange latches for padlocking with padlock accessible from both sides regardless of latching arrangement.

2.4 HARDWARE

- A. General: Manufacturer's standard products, installed complete.
- B. Hinges: 180 degree gate hinges per leaf.
- C. Equip gate openings with padlock. Comply with Fed. Spec. FF-P-110H, Type EPC, 2 inch. Securely attached padlock with chain to gate or gate post. Key padlock as directed by Contracting Officer's Representative (COR).

2.5 FINISHES

- A. Aluminum Paint finish:
 1. Powder-Coat Finish: Polyester powder coating, 2 mils minimum thickness. Comply with manufacturer's coating process.
- B. Color: Black.

2.6 ACCESSORIES

- A. General: ASTM F626, caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories.
- B. Primers:
- C. Welding Materials: AWS D1.2/D1.2M, type to suit application.
- D. Galvanizing Repair Paint: MPI No. 18.
- E. Touch-Up Paint: Match shop finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Correct substrate deficiencies.
 1. Fill.
 2. Grind.
 3. Level.

- D. Apply barrier coating to aluminum surfaces in contact with cementitious materials to minimum 30 mils dry film thickness.

3.2 INSTALLATION - CHAIN LINK FENCES AND GATES

- A. General: Comply with ASTM F567. Install products according to manufacturer's instructions and approved submittal drawings.
 - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Registered Professional Land Surveyor or Registered Civil Engineer specified in Section 01 00 02, GENERAL REQUIREMENTS, will stake out and certify fence alignment meeting requirements as indicated on Drawings.
- C. Excavation: Excavate concrete-embedded items of dimensions indicated on Drawings, and provide minimum 2 inches larger diameter than outside diameter of post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the COR.
- D. Post Setting: Install posts plumb and in alignment. Set post in concrete footings of dimensions indicated on Drawings, except in bedrock. Compact concrete free of voids and finish in slope or dome. Cure concrete minimum 72 hours.
- E. Post Caps: Snugly fit exposed ends of post with caps. Install caps to accommodate top rail. Install post caps according to manufacturer's instructions and as indicated on Drawings.
- F. Supporting Arms: Install supporting arms according to manufacturer's instructions and as indicated on Drawings.
- G. Top Rails and Bottom Rails: Install rails before installing chain link fabric. Pass top rails through intermediate post supporting arms or caps as indicated on Drawings. Install expansion couplings (rail sleeves) spaced according to manufacturer's instructions.
- H. Accessories: Install accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, for complete fence installation, with fabric taut and attached to posts, rails, and tension wire.
- I. Touch up damaged factory finishes.
 - 1. Repair galvanized surfaces with galvanized repair paint or PVC coating.

3.3 FABRIC

- A. Pull fabric taut and secure with wire ties or clips to top rail, bottom rail and tension wire close to both sides of each post and at intervals maximum 24 inches on centers. Secure fabric to posts using stretcher bars and ties or clips.

3.4 GATES

- A. Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as indicated on Drawings and according to manufacturer's instructions. Adjust hardware for smooth operation and lubricate when necessary.

3.5 REPAIR OF GALVANIZED OR PVC SURFACES

- A. Use galvanized repair compound, PVC, stick form, or other method, where surfaces need field or shop repair. Repair surfaces according to manufacturer's directions.

3.6 CLEANING

- A. Remove debris, rubbish and excess material from site.

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SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Decorative fence system at location indicated on Drawings.
 - 2. Decorative fence gates at location indicated on Drawings.

1.2 RELATED REQUIREMENTS

- A. Materials product data and samples: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Finish and Color: Section 09 06 00 SCHEDULE FOR FINISHES.
- C. Concrete Footing: Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- D. Footing Excavation: Section 31 20 00, EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Institute of Steel Construction (AISC):
 - 1. ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
 - 1. B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- D. American Welding Society (AWS):
 - 1. D1.2/D1.2M-14 - Structural Welding Code - Aluminum.
- E. Master Painters Institute (MPI):
 - 1. No. 18 - Primer, Zinc Rich, Organic.

1.4 SUBMITTAL

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - a. Point-by-point comparison of proposed "Equal" products.
 - 2. Grommets indicating manufacturer recommendation for each application.
 - 3. Installation instructions.

4. Warranty.

D. Samples:

1. Fence Material: 12 inches long, each type and color.
 - a. Submit quantity required to show full color and texture range.
2. Product: Full sized, complete assembly.
3. Approved samples may be incorporated into work.

E. Certificates: Certify products comply with specifications.

F. 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.

G. 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.

1.5 QUALITY ASSURANCE

A. Manufacturer, Fabricator, Installer Qualifications:

1. Regularly manufactures, fabricates, and installs specified products.
2. Manufactured, Fabricated, and 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. Provide photographs, drawings and other documents showing character and quality of completed installation.

B. Installer Qualifications: Product manufacturer.

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. Provide photographs, drawings and other documents showing character and quality of completed installation.

C. Welders and Welding Procedures Qualifications: AWS D1.3/D1.3M.

D. Delegated Design: Comply with system performance.

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. Protect products from damage during handling and construction operations.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant decorative fences and gates against material and manufacturing defects.
 - 1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Industrial Decorative aluminum fence and gate system with concealed picket attachment.

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 Contracting Officer's Representative (COR) when deviations do not affect design concept and specified performance.
- B. Design framework complying with specified performance:
 - 1. Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings when tested according to ASTM E330/E330M.
 - a. Wind Load: 120 MPH positive, 120 MPH negative, minimum.
- C. Completed panels capable of supporting 300 lb. load (applied at midspan) without permanent deformation, 25 percent inclination change in grade.

2.3 PRODUCTS - GENERAL

- A. Provide decorative fence and gates from one manufacturer and from one production run.
- B. DECORATIVE FENCE SYSTEM.
 - 1. Framework: ASTM B221 extruded aluminum, alloy 6005-T5 for posts and rails (outer channels); alloy 6063-T5 for pickets and rail inner slide channels.
 - 2. Picket Fence: Extruded aluminum, 1 inch square by 0.062" thick.
 - 3. Rails: Extruded aluminum, 1.75 inch square, 0.100 inch thick top, 0.120 inch thick sidewalls, 0.080 inch thick inner side channel, and holes at 4.715 inch o.c. to receive picket; seal with PVC grommets.
 - 4. Retaining Rod: Galvanized steel, 0.125 inch.
 - 5. Posts: Extruded aluminum, minimum 2-1/2 inch square tube, 0.0800 thick, 0.080 inch thick interior reinforcing web.
 - 6. Gates: Extruded aluminum, 1.75 inch sq., 1.75 inch sq. x .250 inch gate ends, and 1 inch sq. x .125 inch pickets.
 - a. Vehicular gates are to be double slide / cantilever gates, similar or approved equal to Ameristar Transport II gates.
 - 1) Gates are to have electric motor operation.
 - 2) Motor operation is to be tied to key card control system on the exterior (entrance) side and automatic road loop detection system on the interior (exit) side.
 - 3) Automatic operation is to be tied to control system in the pump house.
 - 4) System also must have a timer system so that it can open and close on its own at specified times.
 - 5) Gates must be able to be operated manually in case of power outage.
 - b. Pedestrian man gate is to be a swing gate similar or approved equal to Ameristar Exodus Single Egress Gate.
 - 1) Gate to have entrance ADA lever hardware on the exterior (entrance) side and push bar exit device on the interior (exit) side with mortise lock and electric strike tied to key card control and timer system.
 - 2) Key card control and timer system must be tied to control system in the pump house.
 - 3) Provide parallel arm closer on gate.

7. Fasteners: Stainless steel.
 - a. Rail Attachment Bracket: One-way tamperproof security bolts with inverted "T-nuts".
 - b. Post Connections Bracket: Self-drilling hex-head screws.
8. Rings, Post Caps, Finials, and Miscellaneous adornments: Cast aluminum.

2.4 FABRICATION

- A. Pre-cut pickets, rails, and posts in lengths indicated on Drawings. Pre-punch manufacturer's concealed design system rails to accept pickets.
- B. Fully insert rail inner slide into outer channel for internal retaining rod raceway.
- C. Insert pickets through grommets into pre-punched holes in rails; align pre-drilled picket holes with internal raceway.
- D. Insert retaining rods in rail passing through pre-drilled holes in each picket.
- E. Fabricate gates of reinforced concealed design system, picket and rails welded at joint intersections.

2.5 FINISHES

- A. Aluminum Paint finish:
 1. Baked-Enamel or Powder-Coat Finish: Polyester powder coating, 2 mils minimum thickness. Comply with manufacturer's coating process.
 - a. Color: Black.

2.6 ACCESSORIES

- A. Grommets: PVC, High quality.
- B. Primer: Manufacturer's spray cans or paint pens.
- C. Welding Materials: AWS D1.2/D1.2M, type to suit application.
- D. Fasteners: As recommended by manufacturer.
- E. Galvanizing Repair Paint: MPI No. 18.
- F. Touch-Up Paint: Match shop finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Correct substrate deficiencies.
 1. Fill.

2. Grind.
3. Level.

3.2 FENCE INSTALLATION

- A. Layout fence symmetrically, with minimum number of joints.
- B. Installation:
 1. Install fence and gates according to manufacturer's instructions.
 2. Set posts in concrete footers minimum as indicated on Drawings.
 3. Posts setting by other methods as plated posts or grouted core-drilled footers are permissible only when shown in engineering analysis of sufficient in strength for intended application.
- C. Installation Tolerances:
 1. Variation from Indicated Grade: Maximum 6 inches.
 2. Variation from Indicated Line: Maximum 1 inch.
- D. Touch up damaged factory finishes.
 1. Repair galvanized surfaces with galvanized repair paint.
 2. Repair painted surfaces with touch up primer.

3.3 FENCE INSTALLATION MAINTENANCE

- A. Seal exposed surfaces when cutting or drilling rails or posts as follows:
 1. Remove metal shavings from cut area.
 2. Apply custom finish paint to match fence color. Prime and finish exposed surfaces with manufacturer's paint pens.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's instructions.
- B. Set posts plumb, in concrete footings as indicated on Drawings.

3.5 CLEANING

- A. Clean exposed surfaces. Remove contaminants and stains.
- B. Clean site of excess materials, post-hole excavations, and debris removed or scattered uniformly.

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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 receptacles, water spigot, and flower vase container.
3. Ash Urns at locations indicated on Drawings.
4. Benches.
5. Bollards, Chain and Locks.
6. Flag Sleeves.

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 03 50 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.

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: 152 mm (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 Receptacle: 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.
- F. Record Documentation:
1. Flag Sleeve: Annotated Record Drawings using swing tie measurements from prominent features, at approximate 90-degree angles.

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: Product manufacturer.
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.

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."
- B. Manufacturer's Warranty: Warrant benches, trash and flower vase receptacles against material and manufacturing defects.
 1. Warranty Period: Three years.

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 and from one production run.

2.2 FLOWER WATERING STATIONS

- A. General: Materials, finishes and colors as indicated on Drawings.
 1. Housing: Concrete Faucet Posts shall be manufactured in accordance with Section 04 72 10 STONE MASONRY using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, minimum of 300 mm (12 inch) in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. The shop drawings and sample shall include the details space for the pipes, appurtenances, and spigot as well as room for assembly and attachment to produce the fully functional FWS spigot assembly as

specified. An acceptable sample must be obtained prior to manufacturing the units.

- a. Color: 'Pewter' by Davis Color or approved equal.
- 2. Inner Supply: 3/4" threaded brass nipple.
- 3. Inner supply line: 3/4" brass nipple.
- 4. Nozzle: Solid brass casting.
- 5. Outlet: 1/2" threaded brass nipple.
- B. Water spigots as indicated on Drawings, ADA compliant, spigot paddle operated, maximum 2 kg (5 lbs.) force water flow, connected to irrigation main line.
- C. Self-closing valve shall be Haws model #6252 EHLF with brass finish or approved equal.

2.3 GRAVESITE LAYOUT MARKERS

- A. General: Provide both Gravesite Grid Monuments and Gravesite Grid Markers.
 - 1. Gravesite Grid Monuments: Bronze survey marker (monument marker) set into cast-in-place concrete base.
 - a. Materials:
 - 1) Monument Base: Cast-in-place minimum of 24.1 MPa (4,500 psi) @ 28 days, reinforcement and dimensions as indicated on Drawings.
 - 2) Monument Marker: Domed-top, 89 mm (3 1/2 inches) diameter, bronze concrete survey marker with integral locator magnet, and flared anchor post for concrete installation.
 - b. Materials:
 - 1) Grid Marker: Domed-top, 81 mm (3 1/4 inches) diameter, bronze concrete marker.
 - 2) Rebar: Manufacturer's standard rebar, No. 10 soft metric (No. 6); dimension as indicated on Drawings.
 - 3) Insulator: Manufacturer's standard plastic insulator.
 - 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 surveyed location data.

2.4 TRASH RECEPTACLE

- A. Trash Receptacles: Shall be Victor Stanley S42 or approved equal.
 - 1. Steel Body Construction:

- a. Vertical Bar: Solid steel, 9.53 mm x 25.4 mm (3/8 x 1 inch).
 - b. Horizontal Bands: Solid steel, 6.35 mm x 63.5 mm (1/4 x 2-1/2 inches).
 - c. Support Bars: Steel, 9.53 mm x 76.2 mm (3/8 x 3 inches).
 - d. Top Ring: Solid steel, 15.88 mm (5/8 inch).
 - e. Leveling Feet: 9.53 mm (3/8 inch) diameter threaded steel shaft.
 - f. Joints: Fully welded, grind smooth.
2. Capacity: 136 liter (36-gallon).
 3. Inner Liner: High-density plastic inner liner, 2.72 kg (6 lbs.) maximum weight.
 4. Lids: Manufacturer's standard steel, 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 as indicated on Drawings.
 7. Steel Powder Coat Finish: Manufacturer's standard shot blasted, etched, phosphatized, preheated, and electrostatically polyester, powder coatings, 8-10 mils (200-250 microns) dry film thickness.
 - a. Standard Color: Victor Stanley Standard Black.

2.5 FLOWER VASE RECEPTACLE

- A. Materials: Victor Stanley S35 or approved equal. 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, shall be pressure-sensitive vinyl on side of receptacle as indicated on Drawings. Contents and color approved by Contracting Officer's Representative (COR).

2.6 WATER SPIGOT ASSEMBLIES

- A. Water spigots as indicated on Drawings, ADA compliant, spigot paddle operated, maximum 2 kg (5 lbs.) force water flow, connected to irrigation spigot water system isolation valve.

2.7 BENCHES

- A. Description: Benches shall be Victor Stanley RB28 6' bench or approved equal. 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.
- B. Material: Steel.
- C. Locations, sizes and quantities as indicated Drawings.
- D. Finish: Manufacturer's standard shotblasted, etched, phosphatized, preheated, and electrostatically polyester, powder coatings.
 - 1. Color: VS Black approved by COR.
- E. Mounting Hardware: Tamper resistance stainless steel. Exposed bolt ends or flat bolt heads are not acceptable.

2.8 FLAG SLEEVES

- A. Provide flag sleeves at locations and details on Drawings.

2.9 FINISHES

- A. Steel Finish:
 - 1. Powder-Coat Finish: Manufacturer's standard two-coat finish system consisting of the following:
 - a. One coat primer.
 - b. One coat thermosetting topcoat.
 - c. Dry-film Thickness: 0.05 mm (2 mils) minimum.
 - d. Color: Refer to Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Aluminum Anodized Finish: NAAMM AMP 500.
 - 1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
 - 2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.
- C. Aluminum Paint finish:

1. Baked-Enamel or Powder-Coat Finish: Polyester powder coating. Comply with manufacturer's coating process.
2. Fluorocarbon Finish: AAMA 2605; 70 percent fluoropolymer resin, 2-coat system.

2.10 ACCESSORIES

- A. Welding Materials: AWS D1.1/D1.1M, type to suit application.
- B. Fasteners: Tamper resistant Stainless steel, acorn nut.
- C. Anchors: Per manufacturers recommendations.
- D. Galvanizing Repair Paint: MPI No. 18.
- E. Touch-Up Paint: Match shop finish.
- F. Concrete Footing: Comply with SECTION 033000 - CAST-IN-PLACE CONCRETE.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect planned installation materials and locations. Notify COR of any discrepancies in conditions.
 1. Verify materials are damage free and compliant with Drawings. Report non-compliance to COR.

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 COR 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 COR approval before forming concrete pad. Install concrete pad according to SECTION 03 30 53, (SHORT-FORM) 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 pipe, isolation valve, fittings, pressure reducing valve and valve boxes. Install washed stone for splash area.
 2. Benches:
 - a. Install benches as recommended by manufacturer.
- F. Flag Sleeves:
1. Install flag sleeves with flag poles set plumb and top sleeves set at correct elevation, on finish grade, so as not to interfere with mowing operations.
 2. Mark Flag sleeve locations along adjoining roadway, chiseled mark in curb perpendicular to road centerline.

3.4 CLEANING

- A. Clean exposed surfaces. Remove contaminants and stains.
- B. Polish exposed surfaces gloss sheen.
- C. 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 SUMMARY

A. Section Includes:

1. Programmable fully automatic irrigation system with full and complete 100 percent coverage within areas indicated on drawings.
2. Sleeving irrigation pipes and wires as indicated, and beneath hardscape surfaces.

1.2 RELATED REQUIREMENTS

- A. Maintenance of Existing Utilities: Section 01 00 02, GENERAL REQUIREMENTS.
- B. As-Built Drawings: Section 01 00 02, GENERAL REQUIREMENTS.
- C. Availability and Use of Utility Services: Section 01 00 02, GENERAL REQUIREMENTS.
- D. Submittals: Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- E. Concrete: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- F. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- G. Electrical supply and connection to irrigation controller and irrigation pumps: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- H. Spigot: Section 32 33 00, SITE FURNISHINGS.
- I. Plants, Turf, and Grasses: Section 32 90 00, PLANTING.

1.3 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers. Piping is under pressure during flow.
- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 Volts or for remote-control, signaling power-limited circuits.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement

of the irrigation system pipes, or wires will require disturbance of other than landscape materials.

E. RE: Contracting Officer's Representative (COR).

F. COR: Contracting Officer's Technical Representative.

1.4 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standard Institute (ANSI).

1. B40.1-05 - Gauges-Pressure Indicating Dial Type-Elastic Element.

C. American Society of Sanitary Engineers (ASSE).

1. 1013-2005 - Reduced Pressure Principle Backflow Preventers.

D. ASTM International (ASTM).

1. A36/A36M-14 - Carbon Structural Steel.

2. A53/A53M-12 - Pipe, Steel, Black and Hot-Dipped, Zin-Coated, Welded and Seamless.

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

4. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

5. A536-84 (2009) - Ductile Iron Castings.

6. B33-10(2014) - Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

7. B61-08 - Steam or Valve Bronze Castings.

8. B62-09 - Composition Bronze or Ounce Metal Castings.

9. B584-14 - Copper Alloy Sand Casting for General Applications.

10. D1785-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.

11. D1238-04c - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

12. D1784-11 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

13. D1785-06 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120.

14. D2241-15 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

15. D2464-15 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

16. D2466-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

17. D2564-12 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 18. D3139-98 (2005) - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 19. D3261-15 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 20. D3350-10 - PE Pipe & Fittings Materials.
 21. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 22. F656-15 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- E. American Water Works Association (AWWA).
1. C110/A21.10-08 - Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch for Water.
 2. C111/A21.11-06 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 3. C115/A21.15-05 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 4. C151/A21.51-09 - Ductile-Iron Pipe, Centrifugally Cast.
C153/A21.53-00 - Ductile-Iron Compact Fittings for Water Service.
 5. C504-15 - Rubber Seated Butterfly Valves.
 6. C509-09 - Resilient-Seated Gate Valves for Water Supply Service.
 7. C600-10 - Installation of Ductile Iron Water Mains and Their Appurtenances.
 8. C900-07 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting, 100 mm and Through 300mm (4 In. Through 12 inches) for Water Transmission and Distribution.
 9. C901-08 - Polyethylene (PE) Pressure Pipe and Tubing, 13 mm (1/2 inches) through 76 mm (3 inches), for Water Service.
 10. C905-10 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 48 In. (350 Through 1,200 mm) for Water Transmission and Distribution.
- F. Manufacturers Standardization Society (MSS).
1. SP70-2006 - Cast Iron gate Valves, Flanged and Thread Ends.
- G. National Electrical Manufacturers Association (NEMA).
1. 250-2008 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.5 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:

- a. COR (COR).
- b. Landscape Architect.
- c. Contractor.
- d. Installer.
- e. Other installers responsible for adjacent and intersecting work, including landscape planting and flatwork.

2. Meeting Agenda: Distribute agenda to participants a minimum of 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.

1.6 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Shop Drawings: Show size, configuration, and fabrication and installation details.

2. Controller Chart:

- a. Prepare map diagram showing valves, decoders, lateral lines, and communication cables route location. Identify valves size, station, number and irrigation type. Submit approved "As-built" drawings before charts are prepared.
- b. Provide one reduced drawing of actual "as-built" system controller chart, showing area covered by each automatic controller, supplied at maximum size controller door allows.

When controller sequence is not legible when Drawing is reduced to door size, enlarge drawing to readable size and place folded in sealed plastic container, inside controller door.

- c. Print chart with different color used to show area of coverage for each station. Charts must be completed and approved before final inspection of the irrigation system.
- 3. Irrigation point-of-connection showing pipe and valve sizes and lay lengths within specified vaults.
- 4. Irrigation control panel showing all components of control system, location and layout within control cabinet.
- 5. Show sizes of irrigation zones in GPM based on flow rates of actual irrigation outlets submitted and approved. Size valves for actual demand in GPM not exceeding manufacturer's recommendations for valves with pressure-regulating option.
- 6. Flower Water Station Spigot Connection Assembly and Curb Stop Valve.
- 7. Any other detailing through shop drawings indicated in the Drawings.

C. Samples:

- 1. Product: Full sized, complete assembly.
- 2. Approved samples may be incorporated into work.

D. Manufacturer's Literature and Data:

- 1. Description of each product.
- 2. Gear-driven rotor sprinkler heads indicating manufacturer recommendation for each application.
 - a. Provide computer generated distribution uniformity and scheduling coefficient calculations for nozzles used at specified spacing.
- 3. Controllers.
- 4. Valves.
- 5. Installation instructions.
- 6. Warranty.

E. Materials List:

- 1. Pipe and fittings.
- 2. Valves.
- 3. Mainline components.
- 4. Electrical components.
- 5. Control system components.

F. Test Reports: Certify products comply with specifications.

G. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.
2. Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.

B. Installer Qualifications:

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. Project Experience List: Provide contact names and addresses for completed projects.

C. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M

D. Products Criteria:

1. Multiple Units: When two or more units, same type or class of materials or equipment required, provide compatible products from one manufacturer.
2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for final assembled product.
 - a. All components of assembled unit need not be products of same manufacturer but component parts which are alike are product of single manufacturer.
 - b. Components are compatible with each other and with total assembly for intended service.

E. Codes and Regulations:

1. Comply with latest edition of National Electrical Code, Uniform Plumbing Code, and applicable laws and regulations of governing authorities.

1.8 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant irrigation materials against material and manufacturing defects.
 - 1. Warranty Period: One year.

1.9 TEMPORARY IRRIGATION

- A. All areas disturbed due to construction activities shall be restored; for areas requiring seeding, the Contractor shall be responsible for providing temporary irrigation at their own expense until acceptance by the Government.
- B. Water for irrigation shall be provided by the Contractor at their expense.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. System Requirements:
 - 1. Full (head-to-head plus 10-percent) and complete coverage of irrigated areas. Adjust head locations as required to achieve full coverage of irrigated areas.
 - 2. Layout work as shown on the drawings. Drawings are diagrammatic to the extent that swing joints, offsets and fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of Drawings. Lines are to be common trenched wherever possible. Place irrigation heads shown along roadways between 76 mm (3 inches) and 152 mm (6 inches) from edge of pavement, unless otherwise specified.
 - 3. Locations of remote control valves is schematic. Group remote control valves wherever possible and align at set dimension back of curb along roads, at the perimeter of burial sections and/or within landscape beds. Locate remote control valves individually or in groups of no more than four. Where exact location for valves has not been set, or there are conflicts, coordinate location with COR before installation.
 - 4. Run irrigation lines and control wire at boundaries of graves, thru designated utility lanes or beside roadways.

5. Run irrigation lines, control wires and power wires in trenches as indicated on Drawings or as typical for industry standards, when not indicated.
 6. Unless noted otherwise, run irrigation lines, power wires and control wires in sleeves or conduit where installed beneath any site hardscape materials.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application. Run irrigation lines, cables, control wires, and high voltage conduits in separate sleeves.
- C. Completely program irrigation controller according to approved irrigation schedule.
- D. Follow manufacturer's instructions for installation.
- E. Submit manufacturer's written certification that Control System is complete, including related components, and fully operational to COR.

2.2 MATERIALS

- A. Use new materials without flaws or defects.

2.3 PRODUCTS - GENERAL

- A. Provide each product from one manufacturer.

2.4 PIPE AND FITTINGS

- A. Irrigation Main Pipe:
1. Polyvinyl Chloride (PVC) Pressure Pipe: ASTM D1784, Class 200, SDR-21, rated at 1375 kPa (200 psi), gasketing conforming to ASTM F477.
 2. Mainline Pipe Within Sleeves: Provide restrained casing spacers for gasketed joints.
- B. Irrigation Main Fittings:
1. Ductile Iron Pipe Fittings:
 - a. Mechanical Joint Fittings: ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
 - b. Flanged Fittings: ANSI/AWWA C110 and ANSI B16.1 850 kPa (125 lbs.).
 - c. Push-On Joints: -- Slanted, deep bell, gasket style made in accordance with ASTM A-536, Grade 65-45-12 and AWWA C153.
 - 1) Ductile Iron fittings shall be Leemco or approved equal.

- d. Gaskets: High grade EPDM rubber per ANSI/AWWA C111/A21.11, rib-enforced "U-Cup" design to seal and assist in restraining pipe at all pressures.
- e. Joint Restraints: Class 350 Ductile Iron per ASTM A536, Grade 65-45-12, and AWWA C153.
 - 1) Contractor shall provide & install 8 mil thick polyethylene encasement wrap & tape on all ductile iron fittings in direct contact with soil.
 - a) Polyethylene wrap and tape shall be Trumbull or approved equal.

C. Lateral Pipe:

- 1. Pressure Rated PVC Pipe: Size 2-1/2" and larger, ASTM D2241, Class 200, SDR-21, 1375 kPa(200 psi) pressure rating with integral bell end suitable for solvent welding. Size 2" and smaller, ASTM D1785, Schedule 40, PVC, with integral bell end suitable for solvent welding.
- 2. Threaded Pipe: ASTM D1785, PVC 1120, Schedule 80 threaded connections, risers and swing joints.

D. Lateral Fittings:

- 1. Irrigation Laterals: ASTM D2466 PVC, Schedule 40, solvent welded socket type.
- 2. Threaded Pipe: ASTM D2464, PVC, Schedule 80.
- 3. Swing Joints: Manufacturer's standard with elastomeric seal, allows 360 degree rotation, minimum 1375 kPa (200 psig) working pressure.

E. Joining Materials:

- 1. Irrigation Mains: Rubber gaskets, AWWA C111.
- 2. Irrigation Laterals: ASTM D2466 and D1784 PVC Schedule 40, Type 1, solvent weld fittings.
 - a. Primer: ASTM F656.
 - b. Solvent Cement: ASTM D2564.
- 3. Threaded pipes: Teflon-type tape or Teflon based paste pipe joint sealant. Use non-hardening, non-toxic pipe joint sealant for water-carrying pipes on metal threaded connections.

2.5 SLEEVES

- A. Sleeves: ASTM D1784 Rigid, Unplasticized (PVC) 1120, Class 12454-A or 12454-B, with integral bell end.

1. Pipes Larger than 300 mm (12 inch): AWWA C905, DR-18 rated at 1615 kPa (235 psi).
2. Pipes Smaller than 300 mm (12 inch): ASTM D2241, Class 200.
- B. Size: As indicated on Drawings or twice nominal pipe diameter when not shown. Wiring bundle area not exceeding 40 percent of sleeve cross sectional area, according to NEC recommendations.
- C. Restrained Casing Spacers: ASTM A536, Grade 65-45-12 high strength ductile iron.
 1. Restraining Rods: ASTM A242 and ANSI/AWWA C111/A21.11, high strength low alloy material.
 2. Runners: ASTM D-1894, ultra-high molecular weight polymer, 175-350 Joules/cm (600-1200 ft-lbs./in.) tensile impact and coefficient of friction 0.14-0.17.

2.6 RESTRAINTS

1. Joint Restraints: All changes of directions and reductions shall be mechanically restrained. Additional adjacent joints shall also be restrained as per manufacturer's recommendations. Joint restraints shall be ductile iron and made in accordance with ASTM A536, Grade 65-45-12 and AWWA C153.
2. Provide ductile iron fittings on pipe 76 mm (3 inch) and larger, transition fittings between metal and PVC pipe, where thrust block is not allowed, or where extra support is required to retain fitting or joint.
 - a. Mainline Isolation Valve to Pipe Restraint shall be 4" Leemco LGK-400 or approved equal.
 - b. Mainline Fitting to Pipe Restraint shall be 4" Leemco LH-400 or approved equal.
 - c. Mainline Pipe to Pipe Restraint shall be 4" Leemco LB-400 or approved equal.
3. Provide 304 stainless steel bolts, nuts, retaining clamps, all-thread, or other joint restraint hardware in accordance with manufacturer's specifications.

2.7 MAINLINE COMPONENTS

- A. Valves (Except Remote Control Valves):
 1. Underground Shut-Off Valves:
 - a. Gate Valves 50 mm (2 inches) and Larger: AWWA C509, iron body, bronze mounted, double disc with parallel or inclined

seats, non-rising stem turning clockwise to close, 1375 kPa (200 psi) minimum working pressure.

1) Manual Isolation Valve shall be 4" Leemco LMV-44BB or approved equal.

b. Air-Vacuum Relief Valve: Epoxy-coated cast Iron body, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 14 kPa to 1580 kPa (2 psi to 230 psi). Continuous acting combination air and vacuum and air release valve.

1) Air Vacuum Relief Valve shall be Crispin AL-10, size: 1" or approved equal.

2) Valve box shall be 13" x 24" polymer concrete, open bottom, with flared walls, bolt-down lid, and 2 standard mouseholes: Quazite PT1324BB18 with PT1324CA00** bolt-down cover, or approved equal.

2. Bronze Ball Valve with Stainless Steel Handle:

a. Maximum Pressure: 4140 kPa (600 psi) CWP.

b. Federal Specification: WWV35C.

1) Type II.

2) Composition BZ.

3) Style 3.

3. Master Control Valve:

a. 2" Master Control Valve shall be Griswold Controls 2160LE series, or approved equal.

1) Body and Cover: Cast Iron and Bronze with Epoxy Coating.

2) Spring: Stainless steel.

3) Diaphragm: Nylon-reinforced Buna-N.

4) Bolts, Studs, and Nuts: Stainless steel.

5) Tubing and Fitting Control Accessories: brass.

6) Solenoid: 24V AC.

7) Operation: Normally opened with automatic control globe valve with contamination-proof, self-flushing filter screen.

8) Pressure Rating: 13.80 bar (200 psig).

9) Operating Pressure Range: 0.138 to 13.80 bar (2 to 200 psig).

- b. 4" Master Control Valve shall be Griswold Controls 2160P Series, or approved equal.
 - 1) Body and Cover: Brass, epoxy coated.
 - 2) Spring: Stainless steel.
 - 3) Diaphragm: Nylon-reinforced Buna-N.
 - 4) Bolts, Studs, and Nuts: Stainless steel.
 - 5) Tubing and Fitting Control Accessories: brass.
 - 6) Solenoid: 24V AC.
 - 7) Operation: Normally opened with automatic control globe valve with contamination-proof, self-flushing filter screen.
 - 8) Pressure Rating: 13.80 bar (200 psig).
 - 9) Operating Pressure Range: 0.138 to 13.80 bar (2 to 200 psig).

4. Quick Coupling Valve Assembly:

- a. Description: Brass construction, 1 inch nominal size, operating pressure 35-860 kPa (5-125 psi), locking rubber or vinyl cover.
 - 1) Quick Coupler shall be Rain Bird 5LRC or approved equal.
- b. Swing Joints: Pre-fabricated Schedule 80 PVC swing joint.
- c. Quick Coupler Anchor: Bolt on anchor type.
- d. Valve Box: Acrylonitrile Butadiene Styrene (ABS) Plastic, 10 inch round valve box with lid color to match location.
- e. Filter Fabric: Spunbonded polyester 3.5 oz per sq. yard (118.7 grams per sq. m.) landscape fabric.

B. Flower Water Station Spigot Connection Assembly: As indicated on Drawings.

- 1. Flower Watering Station Spigot: As specified in Section 32 33 00, SITE FURNISHINGS.
- 2. Curb Stop Valve: ASTM B62, brass body, 2070 kPa (300 psi) minimum working pressure, female threaded connections, with stop and waste feature.
- 3. Inline pressure regulator: Low lead cast body conforming to ASTM B584, 2750 kPa (400 psi) maximum inlet pressure, with 105 to 515 kPa (15 to 75 psi) adjustable outlet pressure.
 - a. Inline PRV shall be Watts LF223 or approved equal.

4. Copper Pipe: ASTM B88, type "M" soft tubing, wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint.
 - a. Solder: 95-percent tin and 5-percent antimony.
5. Valve box shall be 13" x 24" polymer concrete, open bottom, with flared walls, bolt-down lid, and 2 standard mouseholes: Quazite PT1324BB18 with PT1324CA00** bolt-down cover, or approved equal.
6. Automatic Drain Valve: Automatic Drain Valve shall be Model #: D34 Auto Drain Valve by Waterman Industries or approved equal.

C. Valve Box:

1. Gate Valve:

a. Materials:

- 1) Cast Iron: Tyler Union Model #: 562A with adjustable valve box and lid or approved equal.
- 2) Cover: Mark box cover, differentiate between lawn irrigation system and domestic water supply system, set flush on finished grade.

b. Operations:

- 1) T-Handle Socket Wrench Operation: Underground valves 50 mm (2 inch) nut.
- 2) Handwheels: MSS SP70 Above ground and in pits.

c. Accommodate end valves with type of pipe being installed. Provide mechanical joint ends with self-restrained joints on buried irrigation main valves.

2. Remote Control Valves:

a. Materials:

- 1) HDPE: Structural foam, Type A, Class III.
 - a) Color: as indicated in drawings.
 - b) Size: Minimum 762 mm (30 inches) long by 350 mm (14 inches) deep with -bolt-down lid.

b. After installation, hot brand valve box lid 75 mm (3 inch) high, 1 mm (3/16 inch) deep with permanent white epoxy paint, designating controller and circuit numbers. Place numbers in center of valve cover facing nearest main or service road.

D. Backflow Preventer: ASSE 1013, reduced pressure principle, except pressure drop, in each new connection to existing potable water distribution system.

1. Backflow preventer shall be Febco LF860; Size: 4" or approved equal.

2. Design Flow Rate: Maximum 70 kPa (10 psi).

E. Water Meter Assembly:

1. Water Meter:

a. By Utility Company.

2. Water Meter Pit: In accordance with utility company standards as indicated in the drawings.

F. Polyethylene Encasement Wrap:

- a) Contractor shall provide & install 8 mil thick polyethylene encasement wrap & tape on all ductile iron valves, fittings, restraints, piping and spool pieces in direct contact with soil.
- b) Polyethylene wrap and tape shall be Trumbull or approved equal.

2.8 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

- 1. Remote Control Valve: Globe type, heavy construction, manual shut-off and flow control adjustment for manual operation, minimum 1025 kPa (150 psi) working pressure; higher working pressure for systems that operates with working pressures above 140 psi.
 - a. Install underground, operated by a 24-volt AC electric solenoid Provide unions on both sides of valve. Provide assembly over gravel sump as indicated on Drawings.
 - b. Remote Control Valves shall be Rain Bird PEB-PRS-D series valves or approved equal; size as indicated on drawings.
 - c. Provide valves with pressure regulators, Rain Bird PRS-D module.
 - d. Valves Serviceability: From top without removing valve body from system. Operate valves at maximum 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.
- 2. PVC Union: Schedule 80 threaded union with O-ring seal.
- 3. Bronze Ball Valve with Stainless Steel Handle:
 - a. Maximum Pressure: 4140 kPa (600 psi) CWP.
 - b. Federal Specification: WW-V-35C.
 - 1) Type II.
 - 2) Composition BZ.

- 3) Style 3.
4. Filter Fabric: Spun-bond polyester 3.5 oz. per square yard landscape fabric.
 - a. Mirafi® 135N or approved equal.
5. Wire connectors: Direct burial 600 V maximum voltage. Wire combination size: (2 to 5) 18 AWG to (2) 12 AWG. UL approved. 3M DBY or DBR.
6. Identification Tags: Christy's I.D. tags. Standard Yellow, one sided. Tag Size: 57 mm by 69 mm (2.25 inch by 2.7 inch), hot stamped black letters on yellow background. Hot stamp component number code as indicated.
- B. Pop Up Gear Driven Rotary Sprinkler Assembly: Integral self-closing anti-drain valve, 3.0 m (10 feet) maximum head pressure with removable inlet debris screen.
 1. Full Sprinklers:
 - a. Body: Corrosion resistant, impact resistant, heavy-duty ABS outer case.
 - b. Head Type: Dual or tri-nozzle combination positive gear assembly drive on stainless steel spindles in water lubricated sand proof case.
 - 1) 5" pop-up rotors shall be Rain Bird 8005-SS with integrated SAM check valve and nozzles as indicated on drawings or approved equal.
 - 2) 6" pop-up rotors shall be Rain Bird 5006-+-FC-SAM-R-SS with optional flow shutoff, SAM check valve, and PRS pressure regulation (to 45 psi) and nozzles as indicated on drawings or approved equal.
 2. Part Circle Sprinklers: Same as full sprinklers above, except variable arc type.
- C. Variable-Arc Spray Heads: High impact plastic nozzle with adjusting screw to regulate radius and flow. Heavy-duty stainless steel retracting spring and ratcheting system for pattern alignment. Soft elastomer pressure-activated co-molded wiper seal.
 1. Body: Heavy duty, ultraviolet resistant, pressure-regulating (to 30 psi), plastic sprinkler body, with integral check valve, stem, and nozzle, with non-clogging filter and pressure compensating screens (PCS).

2. Head Type: 6" pop-up spray sprinkler model as follows

3. Rain Bird 1806-SAM-PRS series with HE-VAN series nozzles as indicated on drawings, or approved equal.

Flow Rate: As indicated on Drawings.

D. Pressure Compensating Bubbler Assemblies:

1. Flow rates as shown in the drawings. 1.25 cm (1/2 inch) FPT threaded inlet.

a. Rain Bird 1400 series pressure compensating bubblers or approved equal.

b. Adjustable, in-line spring check valves, capable of holding back 5 to 32 feet of head, constructed from PVC Type 1, ASTM D 1784, cell classification 12454, rated to 200 psi with stainless steel adjustment spring and EPDM seat. Check valves shall be Spears model S1102-05 (1/2" Fipt x Mipt) or approved equal.

E. Decoder-to-Solenoid (DTS) Cables 14 AWG, solid copper; 2 conductor; Use jacketed wire pairs with colors matching jacketed wires on decoders for connecting decoders to control valves.

F. Warning Tape: Polyethylene film warning tape, 0.1 mm (4 mils) thick, 75 mm (3 inches) wide, detectable, imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW", colored as follows:

1. Blue with Black Letters: Potable water.

2. Purple with Black Letters: Reclaimed or untreated well water.

G. Tracer Wires: Plastic-coated copper tracer wire, 1.8 mm (14 gauge), green, Type TW. Install with non-metallic irrigation main lines.

H. Decoders for Two-Wire Operation:

1. Decoder: Solid-state design, housed in a watertight molded plastic housing.

a. Decoder leads: 18 gauge, insulated, stranded copper.

b. Colors as indicated.

c. Wire Leads: Minimum of 305 mm (12 inches) long.

d. Wire Connections: Watertight electrical connections suitable for the wire type being connected.

2. Decoders: Mounted underground in separate 305 mm by 457 mm (12 inch by 18 inch) valve boxes, or with remote control valves. Fastened to inside of valve boxes with stainless steel self-tapping screws. Brand valve boxes containing decoders "SP" in 50 mm

(2 inch) high letters, painted with permanent white epoxy paint.
Place boxes on 457 mm (18 inch) deep bed of pea gravel.

- a. 26VAC input service provided by the two-wire communication path.
 3. Provide factory pre-coded decoders with 1, 2, or 4 addresses, each activating one remote valve solenoid.
 4. Use 4 address decoders to extent practical. Include line surge protection in accordance with manufacturer's specifications.
 5. Provide manufacturer's optional barcode scanner-based decoder programming unit to input decoder addresses. Provide programming unit capable of backing up and restoring programs.
 - a. Field Decoders): Rain Bird FD-101TURF (One station decoder, includes dry splices); FD-202TURF (Two station decoder, includes dry splices); FD-401TURF (Four station decoder, includes dry splices).
 6. Decoder Cable Fuse Device: Paige Electric DCFD 2-way and DCFD3 3-way electrical isolation devices; or approved equal.
 7. Lightning Arrestor: Rain Bird LSP-1 line surge protector, or approved equal.
 8. Grounding Rods: 16 mm by 2.5 meters (5/8 inch diameter by 10-foot long) copper ground rod, copper clamp and #6 bare copper wire; UL-approved; sized per manufacturer's instructions.
- I. Two-Wire Decoder Cable:
1. Two-conductor control cable design consisting of tin coated copper conductors, insulated with PVC and having a high density polyethylene direct burial jacket. Conductors are listed as Type UF by UL or ETL or CSA.
 2. Conductor: Minimum conductor size 14 AWG; soft annealed tin coated solid copper conforming to ASTM B33.
 3. Insulation: Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF rated 60°C.
 4. Cable Assembly: Insulated conductors are laid parallel.
 5. Outer Jacket: Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 1.2 mm (3/64 inch) minimum jacket material to completely fill interstices between the two insulated conductors.
 6. Color Coding: Black, Red.

7. Jacket Color: Blue. (Use a different jacket color for each controller on the project).
- J. Flow Sensor Cable: Direct-burial, polymer-coated aluminum shielded, insulated, 1-pair multi-conductor, with polyethylene outer jacket for connecting flow sensors with satellite controllers.
1. Two 20 AWG foil shield w/drain, black jacket, rated for direct-burial BLK, WHT. Two conductor direct burial shielded cable used with all field sensor connections to satellites such as flow sensors. Cables not to exceed 609 meters (2000 feet) in length.
2. Cables must be certified by Rain Bird Irrigation systems.
- K. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.
- L. Pull Rope for Empty Conduits: 1/4 inch diameter, 12-strand, 544 kg (1,200 lb) tensile strength braided polypropylene rope.
- M. Drainage Backfill: Clean gravel or crushed stone, graded from 6 mm (1/4 inches) minimum to 19 mm (3/4 inch) maximum.
- N. Pipe Bedding and Initial Backfill: Clean sand per Section 31 20 00 EARTH MOVING for trenching and backfilling of utilities.

2.9 CONTROL SYSTEM COMPONENTS

- A. Control System: System consists of Independent controller, and accessories necessary to operate irrigation system. Provide standard package containing the following components:
1. Controller: Rain Bird ESP-LXD Controller, or approved equal.
- a. Two-wire, fully automated, irrigation controller in plastic, UV-resistant, locking, wall mount case with base station capacity of 50 stations and two available expansion slots capable of adding 75 stations each for a total station capacity of 200 stations.
 - b. Controller shall have 4 separate and independent programs, 365 day calendar with permanent day off feature, and seasonal adjustment by program.
 - c. Controller shall be capable of 4 sensor inputs with override switch.
 - d. Controller shall be capable of reading, learning, and managing flow as measured by flow sensor inputs.

- e. Controller shall be capable of controlling up to 5 normally open or normally closed master valves, programmable by station.
- 2. Flow Sensors: Rain Bird FS series brass flow sensors with Rain Bird SD210TURF two-wire decoder, or approved equal.
 - a. 2" flow sensor shall be Rain Bird FS-200-B, brass, tee type sensor with nonmagnetic, spinning impeller, or approved equal.
 - b. 3" Flow sensor shall be Rain Bird FS-350-B, brass, insertion type sensor with nonmagnetic spinning impeller and 2" NPT adapter for installation into any weld-on fitting or pipe saddle.

2.10 BOOSTER PUMP

- A. Booster pump shall be Grundfos BoosterpaQ, model MPC (CUE) 3 CR10-3, or approved equal.

- 1. Booster pump shall be a skid-mounted, variable speed, packaged booster pump system with three (3) vertical, multistage, 3 horsepower, centrifugal pumps each capable of providing up to 50 GPM at 100 psi controlled by a pump logic controller and panel-mounted variable frequency drives (VFD) to maintain constant water delivery pressure.
- 2. The complete packaged booster pump system (including pumps and pump logic controller) shall be a standard product of a single pump manufacturer; designed, built, and tested by the same manufacturer.
- 3. The complete packaged booster pump system shall be certified and listed by UL (Category QCZJ - Packaged Pumping Systems) for conformance to U.S. and Canadian Standards and shall be NSF61 Annex G listed for drinking water and low lead requirements.
- 4. All pumps shall be in-line, vertical, multi-stage design with the following features:
 - a. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
 - b. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
 - c. Pump Construction.

- 1) Suction/discharge base, pump head, motor stool: Cast iron (Class 30)
 - 2) Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
 - 3) Shaft: 316 or 431 Stainless Steel
 - 4) Impeller wear rings: 304 Stainless Steel
 - 5) Shaft journals and chamber bearings: Silicon Carbide
 - 6) O-rings: EPDM
 - d. Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).
 - e. Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.
 - f. The shaft seal shall be a balanced o-ring cartridge type with the following features:
 - 1) Collar, Drivers, Spring: 316 Stainless Steel
 - 2) Shaft Sleeve, Gland Plate: 316 Stainless Steel
 - 3) Stationary Ring: Silicon Carbide (imbedded with graphite)
 - 4) Rotating Ring: Silicon Carbide (imbedded with graphite)
 - 5) O-rings: EPDM
 - g. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one piece component.
5. Booster pump suction and discharge manifolds shall be constructed of 316 stainless steel with male NPT threaded manifold connections.
6. Connections to spool piping at suction and discharge ends shall be made concentric flexible connectors with flanged ends (Proco RC or equal).
7. Pump isolation valves shall be provided on the suction and discharge of each pump. Valves shall be a full lug style butterfly valve with stainless steel valve disc. Valve seat material shall be EPDM and the valve body shall be of cast iron construction, coated internally and externally with fusion-bonded epoxy.

- B. VFD shall be rated for line voltage of 200-240VAC and shall convert incoming fixed frequency single-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.
- C. Fixed Speed Motors are to be provided with the following basic features:
1. Designed for continuous duty operation, NEMA design B with a 1.15 service factor.
 2. Totally Enclosed Fan Cooled or Open Drip Proof with Class F insulation.
 3. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
 4. Motors shall have a NEMA C-Flange for vertical mounting.
 5. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.
- D. Pump system controller:
1. The pump system controller shall be a standard product developed and supported by the pump manufacturer.
 2. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
 3. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
 4. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

5. The controller shall have built in data logging capability. Logged values shall be graphically displayed on the controller and able to be exported to computer via standard connection. A minimum of 3600 samples per logged value with the following parameters available for logging:
 - a. Estimated flow-rate
 - b. Speed of pumps
 - c. Inlet pressure
 - d. Discharge pressure
 - e. Power consumption
 - f. Controlling parameter (process value)
6. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
 - a. Current value of the control parameter, (typically discharge pressure)
 - b. Most recent existing alarm (if any)
 - c. System status with current operating mode
 - d. Status of each pump with current operating mode and rotational speed as a percentage (%)
 - e. Estimated flow-rate, (not requiring flow meter connection)
7. The controller shall have as a minimum the following hardware inputs and outputs:
 - a. Three analog inputs (4-20mA or 0-10VDC)
 - b. Three digital inputs
 - c. Two digital outputs
 - d. Ethernet connection
 - e. Field Service connection to PC for advanced programming and data logging
8. Pump system programming (field adjustable) shall include as a minimum the following:
 - a. Water shortage protection (analog or digital)
 - b. Transducer Settings (Suction and Discharge Analog supply/range)
 - c. PI Controller (Proportional gain and Integral time) settings
 - d. High system pressure indication and shut-down
 - e. Low system pressure indication and shut-down

- f. Low suction pressure/level shutdown (via digital contact)
 - g. Low suction pressure/level warning (via analog signal)
 - h. Low suction pressure/level shutdown (via analog signal)
 - i. Flow meter settings (if used, analog signal)
9. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).
10. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).
11. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).
12. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
13. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.
14. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:
- a. High System Pressure
 - b. Low system pressure
 - c. Low suction pressure (warning and alarm)
 - d. Individual pump failure
 - e. VFD trip/failure

- f. Loss of sensor signal (4-20 mA)
 - g. Loss of remote set-point signal (4-20mA)
 - h. System power loss
15. The pump system controller shall be mounted in a UL Type 12 rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.
16. Control panel options shall include, but not be limited to:
- a. Pump Run Lights
 - b. System Fault Light
 - c. Audible Alarm (80 db[A])
 - d. Surge Arrestor
 - e. Emergency/Normal Operation Switches
 - f. Service Disconnect Switches
 - g. Qty (9) Configurable Digital Outputs available for monitoring
17. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).
18. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).
19. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.
20. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).
21. The controller shall be capable of displaying instantaneous specific energy use (kw/gpm), (optional flow meter must be connected).

22. The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller or be able to input manually into controller based on three points on pump curve of pumps controlled.
 23. The controller shall be capable of displaying an estimated flow-rate on the default status screen.
 24. The controller shall have the ability to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates without the requirement of a flow meter.
 25. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.
 26. The controller shall have a built in Ethernet connection allowing controller to connected to network and access of controller via web browser and internet anywhere around the world where internet communication is available.
 27. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.
- E. External, diaphragm tank shall be provided on the discharge manifold.
1. Diaphragm tank shall be Amtrol model ST-30V, 14 gallon stand tank with $\frac{3}{4}$ " NPT connection, or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.

3.2 INSPECTIONS AND REVIEWS

- A. Site Inspections:
 1. Verify site conditions and note irregularities affecting work.
Report irregularities to COR before beginning work.
- B. Utility Location ("Call Before You Dig"):
 1. Arrange and coordinate underground utility locations with local authorities and cemetery maintenance personnel.

2. Repair underground utilities damaged during construction with no increase in contract price.

C. Irrigation System Layout Review: Stake locations of irrigation system components as defined below for COR's review. Notify the COR one week in advance of review. COR will identify and approve modifications during this review.

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 COR consideration.

B. Perform excavation, trenching, and backfilling for sprinkler system as specified in Section 31 20 00, EARTH MOVING and as indicated on Drawings.

3.4 LAYOUT OF WORK

A. Stake alley and sprinklers locations in existing burial sections using a licensed surveyor. Use alleys as indicated on Drawings.

B. Stake out irrigation system.

C. When staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with COR. To comply with requirements of the following conditions specified herein this specification section to obtain compliance of regulatory regulations.

3.5 SLEEVE AND BORING

A. Provide and install sleeves where pipe and control wires pass under walks, paving, walls, and other similar areas.

B. Extend sleeve minimum 300 mm (12 inches) beyond edge of paved surface, wall, etc. Cover pipe ends and mark edge of pavement.

C. Verify sleeve sizing is adequate before installation. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.

D. Bed sleeves, minimum 100 mm (4 inches) sand backfill above top of sleeve.

3.6 PIPE AND FITTING ASSEMBLY

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur.
2. Cap assembled pipe ends. Remove caps only to continue assembly.
3. Curve trenches to change direction or avoid obstructions within limits of pipe curvature. No deflection allowed at pipe joint.
Minimum radius of curvatures as follows:

| SIZE | RADIUS | OFFSET PER 6 m (20 feet) LENGTH |
|----------------------|-----------------|------------------------------------|
| 38 mm (1 1/2 inches) | 7.5 m (25 feet) | 2.3 m (7 ft-8 inches) |
| 50 mm (2 inches) | 7.5 m (25 feet) | 2.3 m (7 ft-8") |
| 63 mm (2 1/2 inches) | 30 m (100 feet) | 575 mm (1 ft-11 inches) |
| 75 mm (3 inches) | 30 m (100 feet) | 575 mm (1 ft-11") |
| 100 mm (4 inches) | 30 m (100 feet) | 575 mm (1 ft-11") |
| 150 mm (6 inches) | 45 m (150 feet) | 400 mm (1 ft-4 inches) |
| 200 mm (8 inches) | 60 m (200 feet) | 300 mm (1 ft-0 inch) |
| 250 mm (10 inches) | 75 m (250 feet) | 225 mm (9 inches) |
| 300 mm (12 inches) | 90 m (300 feet) | 200 mm (8 inches) |

B. Mainline Pipe and Fittings:

1. Plastic Pipe:

- a. Lay pipe "snake fashion" in trench 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.
- b. Joints:
 - 1) Elastomeric Gasket: ASTM F477, compatible with bell annular groove.
 - a) Thoroughly clean inside of bell or coupling, outside of spigot, and elastomeric gasket immediately before joining two lengths of PVC pipe.
 - b) Lubricate joint and rubber gasket according to pipe manufacturer's instructions.
 - c) Insert elastomeric gasket in the annular groove of bell or coupling according to the manufacturer's instructions. Mark pipe not furnished with depth mark before assembly and insert to full depth of joint.

- d) Align spigot and bell or coupling and push until spigot is fully inserted in bell or coupling. Push with smooth steady motion.
 - 2) Push on Ductile Iron Restrained Fittings: Apply thin film gasket lubricant and place in proper position in bell contour. Insert bevel end of joining pipe and make contact with gasket. Force pipe bevel end to bottom of bell without displacing gasket. Do not caulk. Use lubricant furnished by pipe manufacturer.
 - 3) Mechanical: AWWA C111. Provide bolts, nuts, glands and gaskets on pipe and fittings socket opening.
 - 4) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set minimum 150 mm (6 inches) from walls or floor.
2. Ductile Iron Pipe: AWWA C600.
- a. Joints:
 - 1) Mechanical: AWWA C111. Provide bolts, nuts, glands and gaskets on pipe and fittings socket opening.
 - 2) Push on: Apply thin film gasket lubricant and place in proper position in bell contour. Insert bevel end of joining pipe and make contact with gasket. Force pipe bevel end to bottom of bell without displacing gasket. Do not caulk. Use lubricant furnished by pipe manufacturer.
 - 3) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set minimum 150 mm (6 inches) from walls or floor.
 - 4) Any ductile iron pipe, pipe fittings and spool pieces in direct contact with soil shall be wrapped with polyethylene encasement wrap and taped per manufacturers' recommendations.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe according to manufacturer's instructions and accepted industry practices.
- b. Cure 30 minutes before handling and 24 hours before pressurizing or installing vibratory plow.

- c. Snake pipe from side to side within trench or install with expansion joints.
- d. In irrigation aisles, coordinate location of monuments to avoid conflicts.

2. Fittings: Cross type fittings are not acceptable.

D. Specialized Pipe and Fittings:

- 1. Mechanical Joint Connections: Install fittings, fasteners and gaskets according to manufacturer's instructions and accepted industry practices.
- 2. PVC Threaded Connections:
 - a. Factory-formed threads. Field-cut threads are not acceptable.
 - b. Apply thread sealant according to manufacturer's instructions and accepted industry practices.
 - c. Use plastic components male threads and metal components female threads for plastic-to-metal connection.

E. Joint Restraint Harness:

- 1. Install harness according to manufacturer's instructions and accepted industry practices.
- 2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install self-restraining casing spacers at gasketed pipe bell joints and every 10-feet along gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's instructions.

3.7 INSTALLATION OF MAINLINE COMPONENTS

- A. General: Install as indicated on Drawings.
- B. Valve for Existing Facilities: Match existing of the same type, unless specifically noted otherwise.
- C. All valves meet or exceed specified parameters identified herein, or parameters for existing valves being matched, whichever provide higher quality product.
- D. Valves Setting:
 - 1. Install as indicated on Drawings and according to manufacturer's instructions.
 - 2. Do not set valves under roads, pavement or walks.
 - 3. Clean valve interior before installation.
 - 4. Place valves in same valve box where pressure control valves are installed adjacent to remote control valve.

5. Set valve box cover flush with finished grade.
6. Brand or cast "GV" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.

E. Air/Vacuum Relief Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "AV" in 2 inch high by 3/16 inch deep letters on valve box lid.

F. Quick Coupling Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "QC" in 2 inch high by 3/16 inch deep letters on valve box lid.

G. Flower Watering Station Hydrant Connection Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Sequence of Construction:
 - a. Coordinate exact location with COR.
 - b. Install components before concrete pad. Coordinate installation with Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
3. Location:
 - a. Install stations at locations indicated on Drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. Do not install mainline or lateral pipe under Flower Watering Stations.
4. Paint "FW" in 2 inch high by 3/16 inch deep letters on valve box lid.

3.8 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly: Install as indicated on Drawings and according to manufacturer's instructions.

1. Mainline Flushing:

- a. Flush mainline before installation of Remote Control Valve Assemblies.
- b. Identify remote control valve service tees for mainline flushing. Plug service tees not used for flushing.

- c. Connect 50 mm (2 inch) pipe to flushing service tees, to direct water away from trench and into drainage swale, curb section or storm sewer, away from work area and not disrupt cemetery operations.
 - d. Use water volume 0.9 m/s (3 FPS) velocity in largest pipe flushing.
 - e. Flush multiple points simultaneously.
 - f. Flush minimum 20 minutes. Continue flushing until water is clear of debris.
 - g. COR will review flushing operation and water clarity before stopping flushing operation.
 - h. Disconnect pipe from service tees and install remote control valves.
2. Adjust valve to regulate downstream operating pressure as follows:
- a. Rotor Sprinklers: 480 kPa (70 psi).
 - b. Rotating Stream Nozzles: 310 kPa (45 psi).
 - c. Spray Sprinklers: 240 kPa (35 psi).
3. Connect control wires to solenoid wires with wire connectors and waterproof sealant. Install connectors and sealant according to manufacturer's instructions.
4. Install only one remote control valve to valve box. Locate valve box 1.5m (5-feet) from and align square from adjacent edges of paved areas.
5. Attach ID tag to solenoid with controller station number to control wiring.
6. Brand controller and station number in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
- B. Pop Up Gear-Driven Rotary Sprinkler Assembly:
- 1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
 - 2. Install at locations indicated on drawings.
 - 3. Locate rotary sprinklers 100 mm (4 inches) to 150 mm (6 inches) from adjacent edges of paved areas, walls or fences.
 - 4. Install sprinklers perpendicular to finish grade.
 - 5. Install swing joint as indicated on Drawings.
 - 6. Supply appropriate nozzle or adjust arc coverage of each sprinkler.
 - 7. Adjust each sprinkler throw radius.

8. Install sod 600 mm (2-foot) square around rotary sprinklers in seeded areas.

C. Spray Sprinkler Assembly:

1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
2. Install at locations indicated on drawings.
3. Locate rotary sprinklers 100 mm (4 inches) to 150 mm (6 inches) from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to and flush with finish grade.
5. Install swing joint as indicated on Drawings.
6. Supply appropriate nozzle or adjust each sprinkler arc coverage.
7. Adjust each sprinkler throw radius.

D. Sprinkler Heads and Quick Couplers:

1. Place on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples and install sprinkler heads and quick couplers at flush with ground surface ensuring no dirt or foreign matter enters outlet.
2. Place part-circle rotary sprinkler heads maximum 150 mm (6 inches) from edge, of and flush with top adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
3. Install shrub sprays, sprinklers, and quick couplers on swing joints as detailed on Drawings.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from curb or pavement edges. Place adjacent to walls. Stake heads parallel to riser before backfilling trenches.

3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at locations indicated on Drawings.
2. Install electrical connections according to manufacturer's instructions and as indicated on Drawings.
3. Lightning Protection: Drive full-length grounding rods into soil. Provide and install grounding plates as indicated on Drawings or as required to create grounding connection with field-tested resistance value equal to or lower than specified values identified in this specification. Connect 4 mm diameter (#6 AWG) copper grounding wire to rod and plate using CADWELD style

connections. Brand "GR" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.

4. Attach wire markers to control wire ends inside controller unit housing. Label remote control valve wires with identification number indicated on Drawings, where control wire is connected.
5. Connect control wire to corresponding control unit terminal.
6. Install permanent receiver for hand held radio when not factory installed.
7. Install rain sensor and complete electrical connections control unit according to manufacturer's instructions.

B. Power Wire:

1. Route power wire as indicated on Drawings. Install minimum number field splices. When power wire is spliced, make splice with recommended connector. Place splices in separate 300 mm (12 inch) standard valve box. Coil 600 mm (2 feet) wire in valve box. Brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
2. Lay power wire in trenches. Do not use vibratory plow.
3. Wire: NEC code compliant, green wire as common ground wire from power source to satellites and white for common (neutral) wire.
4. Carefully backfill around power wire, avoid wire insulation or wire connector damage.
5. Unless noted on Drawings, install wire parallel with and below mainline pipe. Install wire minimum 50 mm (2 inches) below bottom of PVC mainline pipe.
6. Encase wire in electrical conduit not installed with PVC mainline pipe, with continuous run of warning tape placed in backfill, 200 to 250mm (8 to 10 inches) below ground surface, directly over wiring.
7. Surface mount wire installed above grade in a professional manner, routing approved by COR.
8. Connect wire to power source.

C. 2-Wire Decoder Cable:

1. Install 2-wire cable in conduit in the same trench as mainline as indicated in the drawings.
2. Provide 900 mm (36 inch) excess wire length in 200mm (8 inch) diameter loop at each 90 degree change in direction. Coil 900mm

- (36 inch) wire length at each splice box and within each remote control valve box.
3. Use wire connectors and waterproof sealant to splice wire according to manufacturer's instructions. Locate splices in valve box containing irrigation valve assembly, or in separate valve box. Use same procedure for valve connection and in-line splices. When separate valve box is used for wire splices, brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
 4. Protect wire not installed with PVC mainline pipe with continuous run of warning tape place in backfill 150 mm (6 inches) above wiring.
 5. Cap exposed wire ends with waterproof wire splices.
 6. Minimize splicing. Provide pull box at each splice. No splice will be allowed between field located controllers and remote control valves.
 7. Do not place irrigation system power wiring in same conduit as control wiring.

3.10 TRACER WIRE INSTALLATION

- A. Install tracer wire on trench bottom, adjacent to vertical pipe projections, continuous throughout pipe length, with spliced connections soldered and wrap with insulation tape.
- B. Install tracer wire following main line pipe and branch lines and terminate in yard box with gate valve controlling main irrigation lines. Provide sufficient wire length to reach finish grade, bend back wire end making loop and attach Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record tracer wire locations and terminations on project record documents.

3.11 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 1. Before punch list review, provide operating keys, servicing tools, spare parts, and other items indicated on Drawings.
- B. Other Materials: Install other materials or equipment indicated on Drawings or installation details that are part of irrigation system.

3.12 FIELD QUALITY CONTROL

- A. Special Inspections and Tests:

1. On-Site Radio Test: Conduct on-site radio test before submitting bid for type of radio control.

B. Field Tests:

1. Test irrigation system per procedures listed in section 1.10.
2. Notify the COR three days in advance of testing.
3. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent -welded PVC joints will be allowed to cure at least 24 hours before testing.
4. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
5. Provide clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
6. Volumetric Leakage Test - Gasketed Mainline Pipe:
 - a. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - b. Purge all air from the pipeline before test.
 - c. Provide all necessary pumps, bypass piping, storage tanks, meters, 75 mm (3 inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous 700 kPa (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
 - d. Allowable deviation in test pressure, 35 kPa (5 psi) during test period; average pressure during test, 700 kPa (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the pressure is 5 psi below the test pressure. Restore test pressure to 700 kPa (100 psi) at end of test. Measure water added to mainline pipe volumetrically to nearest 10 ml (0.025 gallons).

- e. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. Amount of additional water pumped in during test not exceeding the value in table, or the calculated value using the formula below, based on differing number of joints, duration or pressure of the test:
- 1) Leakage Allowable (Gallons per (100 Joints)/Hour).

| PIPE SIZE mm (INCHES) | Test Pressure (PSI) | | | | | | | | |
|-----------------------------|---------------------|------|------|------|------|------|------|------|------|
| | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| 63mm (2 1/2") | 0.26 | 0.28 | 0.30 | 0.32 | 0.34 | 0.35 | 0.37 | 0.39 | 0.40 |
| 75mm (3") | 0.31 | 0.34 | 0.36 | 0.38 | 0.41 | 0.43 | 0.44 | 0.46 | 0.48 |
| 100 mm (4") | 0.42 | 0.45 | 0.48 | 0.51 | 0.54 | 0.57 | 0.59 | 0.62 | 0.64 |
| 150 mm (6") | 0.63 | 0.68 | 0.73 | 0.77 | 0.81 | 0.85 | 0.89 | 0.92 | 0.96 |
| 200 mm (8") | 0.84 | 0.90 | 0.97 | 1.03 | 1.08 | 1.13 | 1.18 | 1.23 | 1.28 |
| 250 mm (10") | 1.05 | 1.13 | 1.21 | 1.28 | 1.35 | 1.42 | 1.48 | 1.54 | 1.60 |
| 300 mm (12") | 1.26 | 1.36 | 1.45 | 1.54 | 1.62 | 1.70 | 1.78 | 1.85 | 1.92 |

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).

- 2) The following are the values for a 2 hour duration test at 100 psi for pipe length containing 100 joints.
- 3.10 L (0.82 gallons) per 100 joints of 75 mm (3 inch) diameter pipe.
 - 4.09 L (1.08 gallons) per 100 joints of 100 mm (4 inch) diameter pipe.
 - 6.13 L (1.62 gallons) per 100 joints of 150 mm (6 inch) diameter pipe.
 - 8.18 L (2.16 gallons) per 100 joints of 200 mm (8 inch) diameter pipe.
 - 10.22 L (2.70 gallons) per 100 joints of 250 mm (10 inch) diameter pipe.

- f) 12.26 L (3.24 gallons) per 100 joints of 300 mm (12 inch) diameter pipe.
- g) Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

- f. Cement or caulking to seal leaks is prohibited.
- g. Contractor may sub-contract testing to pipeline testing company approved by RE/COTR.

7. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

- a. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kPa (80 psi) for 30 minutes.
- b. Cap all sprinkler risers.
- c. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
- d. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
- e. Cement or caulking to seal leaks is prohibited.
- f. After lateral passes test and before operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

8. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:

- a. Activate each remote control valve in sequence from the new controller, manually at the controller, and via any handheld units. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. COR will visually observe operation, water application patterns, and leakage.
- b. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
- c. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.

- d. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
- e. Repeat tests until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
- f. Test backflow prevention device with certified tester before project acceptance.

9. Distribution Uniformity (DU):

- a. Perform DU Test on one zone of burial section rotors and one zone of spray sprinklers per controller.
- b. Select the zones of sprinklers representative of area being irrigated by controller in the presence of the COR.
- c. Perform catch can test using procedures recommended by Irrigation Association.
- d. Where DU test fails, adjust zone or nozzle sizes to meet required Distribution Uniformity.
- e. Calculate and provide written documentation of DU for each zone tested.
- f. Irrigation Association Certified Landscape Irrigation Auditor must perform the test. Provide written evidence of certification before conducting test.

10. Control System Grounding:

- a. Test all new controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, when acceptable by equipment manufacturer without equipment warranty invalidation. Test results meet or exceed control system manufacturer's instructions for acceptance, while maintaining equipment warranty.
- b. Replace defective wire, grounding rod or appurtenances. Repeat test until manufacturer's instructions are met. Add grounding rods as needed, bond all rods together.
- c. When test is acceptable, document results of grounding test on inside of each satellite controller pedestal door and via written report submitted to the COR. Documentation includes

- satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. Mark test results on the inside of each satellite controller pedestal door using a permanent marker.
- d. Submit to the COR, written report of test data listing satellite 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 the local ground for each satellite.
11. Irrigation System Acceptance Test (Burn inches) before Final Inspection:
- a. Upon completion of construction and before Final Inspection, an Acceptance Test (Burn inches) must be passed.
- b. Coordinate start of Test with COR.
- c. During Test, irrigation system must be fully operational from standalone program at the controller. Operate irrigation system, with no faults for 14 consecutive days. When at any time during the 14 day test period, system fault occurs, determine source of the fault and correct, and restart 14 day evaluation period. When system fault occurs, make repairs within 24 hours of notification from COR. Document any faults of test report listing date, fault, cause of fault and corrective action taken.
- d. When system has operated for 14 days without fault, contact the COR to schedule Final Inspection.
- e. When system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; when does not shut down, test starts over.
12. Flushing: After testing, flush system beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
13. Operation Test: Upon completion of the final adjustment of sprinkler heads to permanent level at ground surface, test each sprinkler section by pan test and visual test to indicate uniform distribution within any one sprinkler head area and over the

entire area. Operate entire installation to demonstrate the complete and successful operation of all equipment.

C. Maintenance Services:

1. Maintenance and Operating Instructions: Before final acceptance, provide verbal instructions, minimum 48 hours, to operating personnel. Provide two additional years of software support for one hour each month. Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manuals as follows:
 - a. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - b. 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.
 - c. Manufacturer's Operation and Maintenance manuals.
 - d. Manufacturer's Technical Service Bulletins.
 - e. Manufacturer's Warranty Documentation.
 - f. Software License Information.
 - g. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
 - h. Predictive schedule for component replacement.
 - i. Listing of technical support contacts.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize new irrigation system according to local practices in first fall after completion of construction of irrigation system and start up in spring after completion of construction. Repair any damage caused in improper winterization. Coordinate winterization and start-up with cemetery landscape maintenance personnel.

3.14 CLEANING

- A. Clean exposed product surfaces. Remove contaminants and stains.

3.15 DEMONSTRATION AND TRAINING

- A. Instruct VA personnel in proper irrigation system operation and maintenance.
 - 1. Trainer: Manufacturer approved instructor.
 - 2. Training Time: 30 days minimum.
- B. Submit training plan and trainer qualifications.
- C. Acceptance Condition: After completing work, operate irrigation system 15 consecutive calendar days without breakdown.
- D. Provide training video on DVD or CD to familiarize maintenance personnel with equipment provided. Coordinate final training presentation with Architect/Engineer and COR in outline form before creation, verify format and organization of content is applicable for facility staff utilization.

3.16 PROTECTION

- A. Protect product from traffic and construction operations.
- B. Cover product with reinforced kraft paper, and plywood or hardboard.
- C. Remove protective materials immediately before acceptance.
- D. Repair damage.

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**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 Trees 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.

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 preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. COR (RE).
 - c. Landscape Architect
 - d. Contractor.
 - e. Installer.
 2. Meeting Agenda: Distribute agenda to participants a minimum of 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. Manufacturer's Literature and Data:
 1. Description of each product.
 - a. Seeds.
 - b. Sod.
 - c. Soil amendments.
 - d. Antidesiccant.

- e. Erosion control materials.
 - f. Hydromulch.
 - g. Non-Asphaltic Tackifier.
 - h. Herbicide.
 - i. Weed Control.
 - j. Mulches.
 - k. Edging.
2. Plant list: List of local/regional suppliers for each species to be installed. Include quantities, plant dimension (height x spread) and container/root ball size. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant of the same species shall be supplied by one grower only unless otherwise approved by COR.
- a. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit written evidence that a specified plant cannot be obtained and has been unobtainable since Contract award.
 - b. Substitutions will only be authorized when a plant (or its alternates as specified) is not obtainable and COR, in consultation with District Agronomist, authorizes a change order for use of nearest equivalent obtainable size or variety of plant having same essential characteristics with an equitable adjustment of contract price.
3. Warranty.
- C. 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. |

| | |
|---|--|
| Inert Mulch | 2.3 kg (5 lb.) of each type to be used. |
| All pesticides required such as preemergence 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 |

D. Test reports: Certify products comply with specifications.

1. Imported Topsoil, stockpiled topsoil or on-site native soil to be amended in place: 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 COR. 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) and Cation Exchange Capacity (CEC).

- d. Tests, as specified, for gradation, organics, soil chemistry and pH to be performed by testing laboratory retained by the Contractor 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. Organic 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 sample 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.

- E. Certificates: Certify products comply with specifications.
- F. Before delivery, submit notarized certificates for approval to COR 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. Soil Sulfur.
 - 6. Humates.
 - 7. Mycorrhizae.
 - 8. Peat.
 - 9. Seed: Include guaranteed percentages of purity, weed content and germination of seed, and net weight and date of shipment.
 - 10. Sod.
 - 11. Membranes.
 - 12. M-Binder.
 - 13. Hydro Mulching: Number of kilograms (pounds) of materials to be used per liter (gallon) of water.
- G. 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) or 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 COR:
 - e. Certified Landscape Technician (CLT) - Exterior, with installation specialty areas, designated CLT-Exterior.
 - f. Certified Ornamental Landscape Professional designated COLP.
- B. Licenses: Submit licenses to COR:
- 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 COR of delivery schedule five days in advance, minimum. COR 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. Seasons and Conditions:
 - 1. Perform landscape planting operations within following dates: From February 15 to October 1, but not before irrigation system installed, tested, and approved.
- B. Perform turfgrass installation operations within following dates, but not before irrigation system installed, tested, and approved.
 - 1. Spring Planting: February 15 to April 30.
 - 2. Fall Planting: September 1 to October 1.
- 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 COR stating special conditions and proposal variance.
- D. The Contractor is required to repair all disturbed areas; this may include but is not limited to the following work: regrading for positive drainage, seeding and irrigation until grass or plantings have been established. In areas that do not have permanent irrigation, the contractor shall provide temporary irrigation at their own expense until plantings have been accepted by the Government. The Contractor shall also be responsible for providing water for irrigation at their own expense.

1.10 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Comply with these additional "Warranty" requirements.

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. Compost: The product manufactured throughout the controlled aerobic, biological decomposition of biodegradable materials. The product has undergone mesophilic and thermophilic temperatures which significantly reduces the viability of pathogens and weed seeds (in accordance with EPA 40 CFR 503 standards) and stabilizes the carbon such that it is beneficial to plant growth. Finished compost shall be screened such that ninety-eight percent of material passes 12.7 mm (1/2 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 Compost: Products meeting the US Composting Council's Seal of Testing Assurance (STA) Certification.
2. 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 | 25 to 65 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 |
| Stability | <4 mg CO ² -C per g OM per day |
| Maturity | 80-100% seed emergence and vigor |
| Soluble salts (Electrical Conductivity) | Maximum of 15 dS/m (mmhos/cm) dry weight basis |
| Physical Contaminants | Less than 1 percent by dry weight |
| Moisture Content | 35%-65% (wet weight basis) |
| Heavy Metals | Less than max. limits established by EPA 40 CFR Part 503 |
| | |
| | |
| Pathogen/Weed Seed Destruction | Proof of EPA minimum heating requirements |

- C. 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.
- D. 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 and vine 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 COR'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. Bare-root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after the plants are dug.
- E. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.
- F. 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 25 mm (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 COR 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 ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) 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 PLANTING SOIL MIXTURE

- A. Balled and Burlapped and Container-Grown Plantings: Planting soil mixture shall be composed of uniformly blended mix of 3 parts (by volume) excavated native soil and 1 part (by volume) approved organic soil amendment complying with paragraph 2.2 of this section.
- B. Native Plantings: 100 percent native on-site soil free of clods and subsoil. Do not amend soils intended for native planting.

2.8 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 10 percent nitrogen, phosphoric acid and potash by

weight with minimum 50 percent of nitrogen from controlled release source such as sulfur coated urea (SCU), polymer coated urea (PCU), and sulfur-coated/polymer coated urea (PCSCU).

- 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.

2.9 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 20 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 5 percent available phosphoric acid, and 15 percent potash. Liquid starter fertilizer for hydro mulch slurry, commercial type with 50 percent of nitrogen from controlled release source.

2.10 MEMBRANES

- A. Landscape Fabric: Non-woven needle-punched polypropylene weighing 113 g/sq. m (4.8 oz./sq. yd.) with 950 liter per minute flow rate per sq. m (90 gal. per minute flow rate per sq. ft.) minimum.
1. Landscape Fabric shall be Mirafi 135N or approved equal.

2.11 MULCH

- A. Mulch: Free of deleterious materials and stored to prevent inclusion of foreign material.
- B. Mineral Mulch: Riverbank stone, granite chips, marble chips, volcanic rock or similar and ranging from 25 mm (1 inch) to 65 mm (2-1/2 inches) according to ASTM C 136.
1. 1" Gravel Mulch shall be 'Sunset Gravel 1' as available from Red Cedar Rock Landscape Supply, (435)586-0490 or approved equal.
2. 2"-4" Gravel Mulch shall be 'Sunset Chunky' as available from Red Cedar Rock Landscape Supply, (435)586-0490 or approved equal.
- C. Mineral Mulch (Cobble): Riverbank stone, granite chips, marble chips, volcanic rock or similar and ranging from 100 mm (4 inch) to 2500 mm (10 inches).

1. 4-8" Cobble Mulch shall be 'Caramel Cobble, 4"-10"' as available from Red Cedar Rock Landscape Supply, (435)586-0490 or approved equal.
- D. Organic Mulch: Wood based products such as chips, nuggets or shredded hardwood:
 1. Wood cellulose fiber mulch for hydraulic application (Hydro mulch) with fertilizer: Specially prepared wood cellulose fiber, processed with no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of materials. Do not apply any turfgrass seed in this type mixture. Maximum 12 percent moisture dry weight, plus or minus three percent at time of manufacture. pH range from 3.5 to 5.0. Manufacture wood cellulose fiber for application as follows:
 - a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, fibers will become uniformly suspended to form a homogenous slurry.
 - b. When hydraulically sprayed, material will form blotter-like cover.
 - c. Cover allows absorption of moisture and allow rainfall or applied water to percolate to underlying soil.
- E. Non-Asphaltic Tackifier:
 1. M-Binder: 100 percent organic, non-toxic, biodegradable, free of plant-growth or germination inhibitors; a botanical glue used in hydroseeding, to stabilize soils and for dust control. Derived from the seed of the plantago plant (*Plantago insularis*). Protein content: 1.62; Ash content: 2.70; Fiber: 4.00; ph: 6.8; Settleable solids: 5.00.

2.12 STAKES AND GUYING STRAPS

- A. Tree Support Stakes: Rough sawn wood, free of knots, rot, cross grain, or other defects that impair strength. Minimum 50 mm (2 inches) square by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1-1/4 inches) by 3000 mm (10 feet) with cap, primed with 2 coats flat black exterior enamel.
- B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.
- C. Flags: White surveyor's plastic tape, 150 mm (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 75 mm (3 inch) long openings fitted with screw eyes.
- F. Eye Bolts: Galvanized or cadmium plated steel with 50 mm (1 inch) diameter eye and minimum 40 mm (1-1/2 inches) screw length.
- G. Deadmen: 100 mm by 200 mm (4 inch by 8 inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.
- H. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

2.13 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.

2.14 WATER

- A. Water: Contains no elements toxic to plant life, obtained from local municipal utility as specified in the construction contract.

2.15 ANTIDESICCANT

- A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.16 SEED

- 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 COR. 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 revegetation seed to conform to species and cultivar requirements detailed here. Seed mixtures to be based upon recommendations by district agronomist and listed below.

1. Blend each species component with minimum two regionally adapted cultivars.

| Revegetation Seed Mixtures | Percent by Weight |
|----------------------------|---|
| Primary Mixture | Wolf Creek Sage & Mountain Shrub seed mix as available from Great Basin Seed, 435-283-1411. |
| Seeding Rate | 15 lbs./acre |
| Secondary Mixture | Cereal Rye |
| Seeding Rate | 2 bushels/acre. |

- D. Obtain approval of COR and NCA District Agronomist for deviations from these turfgrass species requirements.

2.17 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.
1. Sod shall be comprised of 90% dwarf tall Fescue blend of 3 locally proven varieties and 10% locally proven variety of Kentucky Bluegrass.

2.18 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 COR's approval before any plant pits or beds are dug. COR 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 COR 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 COR'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 50 mm (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 305 mm (12 inches) deep, pulled by bulldozer 610 mm (24 inches) on center, both directions, then regrade surface.
- C. Place and uniformly spread soil amendment materials humates, mycorrhizae and inorganic soil amendments as recommended by soils report over approved sub-grades. Apply amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling, specified minimum settled depth conforms to lines, grades and elevations indicated on drawings. Incorporate soil amendments by disc harrowing, rototilling or other means in uniform manner. Incorporate approved organic soil amendment 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 100 mm (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 38 mm (1-1/2 inch) diameter from amended soil bed. Amended soil also to be free of smaller stones in excessive quantities as determined by COR.

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 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, COR 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 areas, remove turfgrass 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 300mm (12 inches). Spread approved organic soil amendment uniformly over bed 50 mm (2 inches) deep and thoroughly incorporate into existing soil 200mm (8 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.

3.4 SETTING PLANTS

- A. Move balled and burlapped and container-grown plants only by supporting ball or 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 25 mm (1 inch) above surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.
- B. Backfill balled and burlapped and container-grown plants with planting soil mixture as specified in paragraph 2.7 of this section to approximately half ball depth, then tamp and water. Use additional planting soil mixture to backfill hole. Carefully fold back top half of burlap and remove tying materials. Completely remove all wire caging or similar material. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil. Provide 50 mm (2 inch) high basins for shrubs and 100 mm (4 inch) high basins for trees.
- C. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved preemergence granular ornamental herbicide. Apply herbicide at 90 kg/hectare (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.

3.5 STAKING AND GUYING

- A. Stake and guy plants as indicated on drawings and as specified.
- B. Drive stakes vertically to depth of 800 to 900 mm (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 450 mm (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. Fill trench with mulch.

3.7 MULCHING PLANTS

- A. Apply approved preemergence granular ornamental herbicide and mulch within 48 hours after planting. Apply before both early spring and early fall weed seed germination.
- B. Placing Inert Material: Place landscape fabric with edges lapped 150 to 300 mm (6 to 12 inches) to receive inert mulch material. Spread inert mulch to uniform thickness over membrane as indicated on drawings.
- C. Placing Organic Material: Spread wood-base mulch to uniform 50 to 75 mm (2 to 3 inch) thickness. Rake smooth. Flush mulch with adjacent lawn, curbs and paving. Taper mulch thickness 50mm (2 inches) where planting beds meet adjacent areas.
- D. 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 COR. 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 13 mm

(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 300 mm to 450 mm (4 inch to 8 inch) deep holes 40 to 50 mm (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at maximum 600 mm (2 feet) on center throughout outer half of branch spread zone of each tree. Fertilize to within 100 mm (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 150 mm (6 inches) deep by scarifying, disking, harrowing, or other approved methods. Remove debris and stones on surface larger than 25 mm (1 inch) on surface after tillage. Do not till areas of 3: 1 slope ratio or greater. Scarify these areas to 50 mm (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 150 mm (6 inches) deep. Incorporate topsoil at least 50 to 75 mm (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 AND SOIL AMENDMENTS FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer and adjust soil acidity as recommended by soil test results. Add soil conditioners as specified for suitable topsoil in PART 2.
- B. Spread soil amendments as recommended by soil test results.

- C. Incorporate soil amendments into soil to minimum 100 mm (4 inches) deep in finish grading operation. Lightly mix starter fertilizer with top 13 mm (1/2 inch) of soil. Immediately restore soil an even condition before seeding or sod placement.

3.13 MECHANICAL SEEDING

- A. Drill-seed with approved equipment rate as outlined in "Seed" article above. Plant turfgrass 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 225 kg/m (150 lbs./ft.) of roller width.
- C. Immediately after preparing seeded area, apply hydromulch cap.

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 100 sq. m (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 areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 50 mm (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 plants are well established.
- B. Deep water all trees twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by COR. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

3.17 LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD

- A. Landscape Plant and Turfgrass Establishment Period: Begins immediately after installation, with COR's approval, and continues through growing season sufficiently long for turfgrass and landscape plant materials to become establish and provide satisfactory to District Agronomist and NCA. Conditions and appearance are as follows:
1. Turfgrass 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 and turfgrass during establishment period.
 4. Plants and turfgrass will not be accepted until completion of acceptable establishment period.
 5. During Landscape Plant and Turfgrass Establishment Period complete the following:
 - a. Water plants and turfgrass to maintain moist soil surface until plants and turfgrass are well established. Quantity of applied water required to achieve and maintain these conditions determined on site by District Agronomist in consultation with COR.
 - 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 75 mm (3 inches) high in plant bed and saucers. After all unwanted vegetation has been removed, apply approved preemergent herbicides and re-mulch.
 - e. Spray with approved insecticides and fungicides to control pests and ensure plant survival in healthy growing condition, as directed by COR in coordination with District Agronomist.
 - f. Provide the following during turfgrass establishment:
 - 1) Eradicate weeds. Water, fertilize, overseed, and perform other operation necessary to promote growth of turfgrass.
 - 2) 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 100 mm (4 inches) high. For warm season turfgrasses, mow at

appropriate heights for species and cultivar as directed by COR in consultation with District Agronomist.

- 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 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 1250 sq. mm (2 sq. inches). Reseed unsatisfactory areas within seven days during an active growing season.
- k. Complete remedial measures as directed by COR in consultation with District Agronomist to ensure plant and turfgrass survival.
- l. Repair damage caused while making plant or turfgrass replacements.

3.18 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE

- A. Landscape plant and turfgrass acceptance will occur after completion of LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. Contractor to have completed, located, and installed all plants and turfgrass according to drawings and specifications. All plants and turfgrass 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 and turfgrass. 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 COR have been completed.
- C. Criteria for Acceptance of Turfgrass:
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 1250 sq. mm (2 sq. inches). Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 2. Seed: Living turfgrass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.05 sq. m (0.5 sq. ft.).

3.19 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass areas have been damaged or scarred, restore disturbed areas to original condition.
- C. In areas where planting and turfgrass 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.

3.20 PROTECTION

- A. Protect plants and turfgrass 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.

3.21 ENVIRONMENTAL PROTECTION

- A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

END OF SECTION

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing potable water supply.

B. Definitions:

1. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout the site, as applicable, and in the building areas that provides water from the potable water supply source for the project, including valves, and other appurtenances used to supply water for domestic and irrigation system use..
2. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS. Erosion and Sediment Control.
- E. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- F. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- G. Section 31 20 00, EARTH MOVING: Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing.

1.3 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

A112.6.3-2016Floor and Trench Drains

- B16.1-2010Gray Iron Pipe Flanges and Flanged Fittings,
Classes 25, 125 and 250
- B16.18-2012Cast Copper Alloy Solder Joint Pressure
Fittings
- B16.26-2013Cast Copper Alloy Fittings for Flared Copper
Tubes
- B18.2.2-2015Nuts 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-2014Standard 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-2015aStandard Specification for Steel Castings, High
Strength, for Structural Purposes
- A307-2014Standard Specification for Carbon Steel Bolts,
Studs, and Threaded Rod 60,000 PSI Tensile
Strength
- A536-1984 (R2014)Standard Specification for Ductile Iron
Castings
- A563-2015Standard Specification for Carbon and Alloy
Steel Nuts
- B61-2015Standard Specification for Steam or Valve
Bronze Castings
- B62-2015Standard Specification for Composition Bronze
or Ounce Metal Castings
- B88-2014Standard Specification for Seamless Copper
Water Tube
- B633-2013Standard Specification for Electrodeposited
Coatings of Zinc on Iron and Steel

- C443-2012Standard Specification for Joints for Concrete
Pipe and Manholes, Using Rubber Gaskets
- C857-2014Standard Practice for Minimum Structural Design
Loading for Underground Precast Concrete
Utility Structures
- C858-2010e1Standard Specification for Underground Precast
Concrete Utility Structures
- D1785-2015Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2464-2015Standard Specification for Threaded Poly(Vinyl
Chloride (PVC) Plastic Pipe Fittings, Schedule
80
- D2467-2015Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe Fittings, Schedule 80
- D2672-2014Standard Specification for Joints for IPS PVC
Pipe Using Solvent Cement
- D4101-2014Standard Specification for Polypropylene
Injection and Extrusion Materials
- F437-2015Standard Specification for Threaded Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe
Fittings, Schedule 80
- F439-2013Standard Specification for Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe
Fittings, Schedule 80
- F441/F441M-2015Standard Specification for Chlorinated
Poly(Vinyl Chloride) (CPVC) Plastic Pipe,
Schedules 40 and 80
- F477-2014Standard Specification for Elastomeric Seals
(Gaskets) for Joining Plastic Pipe
- F593-2013aStandard Specification for Stainless Steel
Bolts, Hex Cap Screws, and Studs
- E. American Water Works Association (AWWA):
- B300-2010Hypochlorites
- B301-2010Liquid Chlorine
- C110-2012Ductile-Iron and Gray-Iron Fittings
- C111-2012Rubber-Gasket Joints for Ductile-Iron Pressure
Pipe and Fittings

C115-2011Flanged Ductile-Iron Pipe with Ductile-Iron or
Gray-Iron Threaded Flanges

C150-2014Thickness Design of Ductile-Iron Pipe

C151-2009Ductile-Iron Pipe, Centrifugally Cast

C153-2011Ductile-Iron Compact Fittings

C504-10Rubber-Seated Butterfly Valves

C508-2009Swing-Check Valves for Waterworks Service, 50
mm thru 600 mm (2 inches through 24 inches) NPS

C509-2009Resilient-Seated Gate Valves for Water Supply
Service

C510-2007Double Check Valve Backflow Prevention Assembly

C511-2007Reduced-Pressure Principle Backflow Prevention
Assembly

C512-07Air Release, Air/Vacuum and Combination Air
Valves

C550-2013Protective Interior Coatings for Valves and
Hydrants

C600-2010Installation of Ductile Iron Water Mains and
Their Appurtenances

C605-2013Underground Installation of Polyvinyl Chloride
(PVC) and Molecularly Oriented Polyvinyl
Chloride (PVCO) Pressure Pipe and Fittings

C651-2014Disinfecting Water Mains

C700-2015Cold-Water Meters - Displacement Type, Metal
Alloy Main Case

C701-2015Cold-Water Meters - Turbine Type, for Customer
Service

C702-2015Cold-Water Meters - Compound Type

C706-2010 (Withdrawn) ...Direct-Reading, Remote-Registration Systems for
Cold-Water Meters

C707-2010Encoder-Type Remote-Registration Systems for
Cold-Water Meters

C800-2014Underground Service Line Valves and Fittings

C900-2007Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 100 mm Through 300 mm (4
inches Through 12 inches), for Water
Transmission and Distribution

- C906-15Polyethylene (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-2011Specification for Filler Metals for Brazing and
Braze Welding
- G. Copper Development Association, Inc. (CDA):
A4015Copper Tube Handbook
- H. National Fire Protection Association (NFPA):
24-2016Standard for the Installation of Private Fire
Service Mains and Their Appurtenances
- I. NSF International:
61-2014aDrinking Water System Components-Health Effects
- J. University of Southern California Foundation for Cross Connection
Control and Hydraulic Research (USC FCCCHR):
9th EditionManual of Cross-Connection Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 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 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 (COR).

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 the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.
- C. Comply with all rules and regulations of Federal, State, and Local agencies having jurisdiction over the design, construction, and operation of potable water systems.
- D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations 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.
- E. 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.

F. 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.

G. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading, and welding of piping shall be removed.
2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, 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.

H. 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 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 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 latest Auto-Cad version provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe, direct buried:
 - 1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter with double thickness cement mortar lining interior, interior asphaltic seal coat, and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
 - 2. Below Grade: Supply pipe in lengths not in excess of a nominal 6.1 m (20 feet) with rubber ring type push-on joints, mechanical joint, or approved restrained joint. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
 - 3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation, and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.
- B. 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. Pipe and fittings exposed to view in the finished work are to be painted. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop-primed on the outside with one coat of the pipe manufacturer standard color of rust inhibitive primer or equal. Finished paint color shall be as selected for the location.
6. 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 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. Vacuum and Air Relief Valves: Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Valves shall be rated for the same operating pressure as the pipeline.

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, non-detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

2.8 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.

2.9 VALVE BOX

SPEC WRITER NOTE: Indicate how many "T" handles are to be provided by the Contractor; it is recommended that a minimum of 2 be provided.

- 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.

2.10 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 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).

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2.11 PIPE SLEEVES

- A. Cast gray ductile iron or zinc coated steel.

2.12 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 //or steel; and the follower rings shall be of malleable or ductile iron//.// //For steel piping, the middle ring shall be of steel and the follower rings shall be of steel or malleable 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. //Steel shall have a strength not less than that of the pipe.// 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 // // for // // mm (// // inch) pipe, // // for // // mm (// // inch) pipe, and // // for // // mm (// // 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.

2.13 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. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- C. Backflow preventers shall be approved by the Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR) of the Manual of Cross-Connection Control.
- D. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous, or corrosive.
- E. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- F. 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.

2.14 //WATER METER

2.15 WATER METER

- A. Furnished and set by Water Service Utility and paid for by the contractor.

2.16 CONCRETE VAULTS

- A. Precast, reinforced-concrete vault: ASTM C858, designed for AASHTO HS20-44 load designation.
 - 1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 - 2. Drain: ASME A112.6.3, cast iron floor drain with outlet. Include body anchor flange, light-duty cast iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

SPEC WRITER NOTE: Retain one of the two following paragraphs. Alternate load designations are defined in ASTM C857.

3. //Manhole Frame and Cover: ASTM A48/A48M, Class No. 35A minimum tensile strength, gray cast iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//
4. //Manhole Frame and Cover: ASTM A536, Grade 60-40-18, ductile iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//

SPEC WRITER NOTE: Modify the cover assemblies for large meter and/or backflow preventer assemblies in underground vaults, when applicable, to require suitable hatches for access to the vault rather than manholes, whenever possible.

2.17 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: Manhole steps shall be constructed in accordance with the drawing "Manhole for Sanitary & Storm Sewer" as shown in the standard drawings of Cedar City and shall be similar in construction to the manhole step as manufactured by M.A. Industries, Inc., of Peachtree City, Georgia. The steps shall be constructed of number four (one-half-inch diameter) grade 60 reinforcing steel bars bent and embedded in Copolymer Polypropylene Plastic. The Copolymer Polypropylene Plastic, used to embed the reinforcing bars in, shall conform to the requirements of ASTM 214, Type II grade 43758, and the reinforcing bar shall conform to the requirements of ASTM A 615. Steps are not required in manholes less than 1.2 m (4 feet) deep.

2.18 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.19 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.
- D. 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.
- E. Water Stop Wall Sleeve: Unless otherwise shown or specified, install molded non-metallic high density polyethylene sleeves having an integrally formed hollow water stop. Water stop shall be sized a minimum of 100 mm (4 inches) larger than the outside diameter of the sleeve itself and allowing 1/2 movement between wall forms to resist pour forces. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve itself installed at each end of the sleeve so as to prevent deformation during the initial concrete pour and to facilitate attaching the sleeve to the wall forms. End caps shall remain in place to protect the opening from residual debris and rodent entry prior to pipe insertion. The wall sleeve shall be manufactured by the same company as the modular seal assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 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.
- 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).

N. Trench excavation and compaction of backfill shall comply with the requirements of Section 31 20 00, EARTH MOVING.

3.5 DUCTILE IRON PIPE

- A. Installing Pipe: Lay pipe in accordance with AWWA C600. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by an appropriate industry standard method, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell in order to conform to the manufactured spigot end.
- D. Jointing Ductile-Iron Pipe:
 - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home following industry standard procedures or manufacturer's approved means.
 - 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque. For new construction, all mechanical joints at valves and fittings shall be secured with an approved mechanical joint retainer glands suitable for the pipe.
 - 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.
 - 4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.6 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA 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.

3.7 TRACER SYSTEM INSTALLATION

- A. Install with all buried water main piping.
- B. Begin and terminate system at all connections to existing mains.
- C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 50 mm (2 inch) wide, 0.25 mm (10 mil) thickness polyethylene pressure sensitive tape.
- D. Install splices only as authorized by the COR. Allow the COR 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 COR.
- 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.

3.8 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.

3.9 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.

3.10 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.

3.11 PIPE SEPARATION

A. Horizontal Separation-Water Mains and Sewers:

- 1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary, or sewer service connection.
- 2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
 - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
 - b. The water main invert is at least 457 mm (18 inches) above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
- 3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

- 1. A water main shall be separated from a sewer so that its invert is a minimum of 457 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. The vertical separation shall be maintained for

- that portion of the water main located within 3 m (10 feet) horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in (1) above; or
 - b. The water main passes under a sewer or drain.
 3. A vertical separation of 457 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
 4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.12 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.

3.13 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.

3.14 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 COR office.
 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COR office.

3.15 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 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.

3.16 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 COR.

3.17 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

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SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 42 19, REFERENCE STANDARDS.
D. //Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.//
E. //Section 31 20 00, EARTH MOVING: Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing.
F. Section 32 90 00, PLANTING: Seeding, Topsoil.
G. Section 33 10 00, WATER UTILITIES.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
A48/A48M-2003 (R2012) ..Standard Specification for Gray Iron Castings
A536-1984 (R2014)Standard Specification for Ductile Iron Castings
A615/A615M-2015aStandard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
C76-2015aStandard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

| | |
|--------------------|---|
| C139-2014 |Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes |
| C150/C150M-2015 |Standard Specification for Portland Cement |
| C478-2015 |Standard Specification for Circular Precast Reinforced Concrete Manhole Sections |
| C857-2014 |Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures |
| C990-2009 (R2014) |Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| D698-2012e2 |Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³)) |
| D2321-2014e1 |Standard Practice for Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications |
| D2412-2011 |Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading |
| D3034-2014a |Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| D3212-2007 (R2013) |Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| D3261-2012e1 |Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| D3350-2014 |Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |
| D4101-2014 |Standard Specification for Polypropylene Injection and Extrusion Materials |
| F477-2014 |Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

F679-2015Standard Specification for Poly (Vinyl
Chloride) (PVC) Large-Diameter Plastic Gravity
Sewer Pipe and Fittings

F714-2013Standard 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

C. American Water Works Association (AWWA):

C110-2012Ductile-Iron and Gray-Iron Fittings

C153-2011Ductile-Iron Compact Fittings

C508-2009Swing Check Valves for Waterworks Service, 2
inches Through 24 inches (50 mm Through 600 mm)
NPS

C509-2009Resilient-Seated Gate Valves for Water Supply
Service

C512-2015Air Release, Air/Vacuum, and Combination Air
Valves for Water and Wastewater Service

C515-2009Reduced-Wall, Resilient-Seated Gate Valves For
Water Supply Service

C550-2013Protective Interior Coatings for Valves and
Hydrants

C605-2013Underground Installation of Polyvinyl Chloride
(PVC) and Molecularly Oriented Polyvinyl
Chloride (PVC) Pressure Pipe and Fittings

C900-2007Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 100 mm Through 300 mm (4
inches Through 12 inches) for Water
Transmission and Distribution

C905-2010Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 350 mm through 1,200 mm
(14 Inches through 48 Inches), for Water
Transmission and Distribution

C906-2015Polyethylene (PE) Pressure Pipe and Fittings,
100 mm through 1650 mm (4 Inches through 65
Inches), for Waterworks

D. Uni-Bell PVC Pipe Association:

Uni-B-6-1998Recommended Practice for Low-Pressure Air
Testing of Installed Sewer Pipe

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 30 00, SANITARY SEWERAGE UTILITIES", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
- D. Submit the following as one package:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.
 - 3. Manhole and Structure Material.
 - 4. Frames and Covers.
 - 5. Steps and Ladders.
 - 6. Backflow Preventers
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number

cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection, extension, and modification to Public Sanitary Sewer lines and Public Utility Systems as applicable.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. 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 the latest Auto-CAD version provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 PIPING

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

- a. Pipe and Fittings, 100 mm to 381 mm (4 inches to 15 inches) in diameter, shall conform to ASTM D3034, Type SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints are prohibited.
- b. Pipe and fittings, 450 mm to 900 mm (18 inches to 36 inches) in diameter, shall be solid wall or have a corrugated or ribbed exterior profile and a smooth interior. Pipe shall conform to the following:
 - 1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth innerwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 345 kPa (50 psi) at 5 percent deflection when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.
 - 2) Solid wall pipe and fittings shall conform to ASTM F679, SDR 35 pipe. Fittings shall have gaskets conforming to ASTM F477 and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2.2 JOINTING MATERIAL

A. Gravity Flow Lines:

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212.
Elastomeric gasket, ASTM F477.

2.3 CLEANOUT FRAMES AND COVERS

- #### **A. Frames and covers shall be gray iron casting conforming to ASTM A48/A48M. The frame and cover shall be rated for AASHTO HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting**

slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word "SEWER" shall be cast on the cover.

2.4 WARNING TAPE

- A. Standard, 0.10 mm (4 mils) polyethylene 75 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the COR. Install all temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.3 REGRADING

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean, and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. Comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.5 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow sanitary sewer or sewer service connection.
 - 2. Gravity flow mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
 - a. Local conditions prevent a lateral separation of ten feet; and
 - b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
 - c. The water main is in a separate trench separated by undisturbed earth.
 - 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.
- B. Vertical Separation - Water Mains and Sewers at Crossings:
 - 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1219 mm (48 inches) above the crown of

- pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
 3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
 4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.6 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench, or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt, or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash, and excess jointing materials.

- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe.
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

3.7 CLEANOUTS

- A. 150 mm (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug, or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 mm by 300 mm by 150 mm (12 inches by 12 inches by 6 inches) thick concrete slab set flush with adjacent finished grade.
- B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.8 INSPECTION OF SEWERS

- A. Inspect and obtain the COR's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints, on the inside of gravity sewer lines are not acceptable.

3.9 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.

3.10 TESTING OF SANITARY SEWERS

A. Gravity Sewers and Manholes (Select one of the following):

1. Air Test: PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
 - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.

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SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, dual-wall high density polyethylene piping storm drainage piping, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (MINOR NCA PROJECTS).
B. Section 31 20 00, EARTH MOVING.
C. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
- B. Manufacturers shall have manufacturing and quality control facilities capable of producing and assuring the quality of piping and structures specified.
- C. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit the following documentation to the Owner for review prior to commencement of the work of this Section:
1. Manufacturers' documentation (including product data sheets) for all specified products.
 2. Shop drawings showing fabrication and construction details for drainage structures.

- C. At project completion, submit record (as-built) drawings showing installed system as specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. During loading, transporting and unloading, exercise care to prevent damage to all products furnished.
- B. Pipe shall be marked with manufacturer's identification symbol, size, date of manufacture, class of pipe, and applicable product Specification identification number.
- C. All materials shall be inspected upon delivery to the Site. Damaged or defective materials shall be rejected as determined by the COR.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASTM International (ASTM):
 - A48/A48M.....Standard Specification for Gray Iron Castings
 - A536.....Standard Specification for Ductile Iron Castings
 - A615/A615M.....Standard Specification for Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
 - C76.....Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
 - C150.....Standard Specification for Portland Cement
 - C443.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - C478.....Standard Specification for Precast Reinforced Concrete Manhole Sections
 - C857.....Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - C923.....Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals
 - C990.....Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

| | |
|-------------------|---|
| D1557..... | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2700 kN m/m ³)) |
| D2321..... | Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| D3034..... | Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| D3212..... | Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| F477..... | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| F2306/F2306M..... | Standard Specification (for 12-inch through 60-inch diameter pipe), full circular cross-section with an outer corrugated pipe wall and a smooth inner liner |
| F2648/F2648M..... | Standard Specification for 50 mm to 1500 mm [2 in. to 60 in.] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications. |

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

- C. Utah Department of Transportation Department (UDOT):
Standard specifications for Highway Construction, latest edition.
- D. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe.
- E. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.

PART 2 - PRODUCTS

2.1 PIPING

- A. Gravity Lines (Pipe and Appurtenances):
 - 1. Concrete:

- a. Reinforced pipe, ASTM C76. Class III. Joints shall be watertight flexible joints made with rubber-type gaskets conforming to ASTM C443.
2. Polyvinyl Chloride (PVC):
 - a. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.
3. Dual-Wall Polyethylene Pipe (HDPE):
 - a. Perforated and non-perforated corrugated polyethylene pipe, ADS N-12 WT IB pipe (or approved equal), conforming to AASHTO M294, Type S, or ASTM F2306/F2306M (for 12-inch through 60-inch diameter pipe), full circular cross-section with an outer corrugated pipe wall and a smooth inner liner and AASHTO M252, Type S, or ASTM F2648/F2648M (for 3-inch through 10-inch diameter pipe).
 - b. Pipe perforations shall conform to the above referenced specifications.
 - c.
 - d. Fittings shall conform to the applicable standards referenced in sections 2.02.a.

2.2 JOINTING MATERIAL

- A. Concrete Pipe: Rubber gasket ASTM C443.
- B. Polyvinyl Chloride (PVC) Pipe:
 1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.
- C. Dual-Wall Polyethylene Pipe (HDPE):
 1. Pipe shall be joined using a bell and spigot joint. The joint shall be watertight according to the requirements of ASTM D 3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. Furnish manufacturer-supplied joint lubricant for use on the gasket and bell during assembly.

2.3 MANHOLES, INLETS AND CATCH BASINS

- A. Manholes, inlets and catch basins shall be constructed of precast reinforced concrete rings, precast reinforced Sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with the details shown on the Drawings, and the following OWNER requirements:
1. Precast Reinforced Concrete Rings: Rings or Sections shall have an inside diameter as indicated on the drawings and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the Sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top Section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top Sections shall be eccentric unless otherwise indicated on the Drawings. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Flat top manhole tops shall be reinforced concrete as detailed on the Drawings.
 4. Precast Catch Basins: Concrete for precast Sections shall have a minimum compressive strength of 5,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS-20 loading with 30 percent impact, and conform to ASTM C857.
 5. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast Sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet ASTM C990.
 6. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS-20 loading and shall conform to the details shown on the Drawings. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 7. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478. Steps shall be a minimum of 10 inches wide and project a minimum of 5 inches away from the wall.

The top surface of the step shall have a studded non-slip surface.
Steps shall be placed at 12-inch centers.

- B. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48 or ductile iron conforming to ASTM A536. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the Drawings.

2.4 Concrete

- A. Concrete piping shall have a minimum compressive strength of 4500 psi at 28 days. The cement shall be Type III conforming to ASTM C150.
Concrete shall conform to the provisions of Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.

2.5 Reinforcing Steel

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 60 unless otherwise noted.

2.6 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".

2.7 UNDERGROUND DETENTION FACILITY

- A. The Advance Drainage Systems, Inc. (ADS) Stormtech SC-160LP system shown on the plans is the Basis of Design. Other underground detention systems may be proposed by the contractor, but the contractor will be responsible for submitting and gaining approval from the owner that the contractor proposed system is equal in both quality and function to the Basis of Design.

2.8 WATER QUALITY FILTER

- A. The Advance Drainage Systems, Inc. (ADS) Model 3620WQAXX shown on the plans is the Basis of Design. Other sediment traps may be proposed by the contractor, but the contractor will be responsible for submitting and gaining approval from the owner that the contractor proposed filter is equal in both quality and function to the Basis of Design.

PART 3 - EXECUTION

3.1 Excavation For storm drains and drainage structures

- A. Excavation of trenches and for appurtenances and backfilling for storm drains shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

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 with the lowest one-fourth 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.

3.3 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches over the crown of the pipe.

- I. Install gravity sewer line in accordance with the provisions of these Specifications and the following standards:
 - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations with gasketed joints.
 - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
- J. Warning tape shall be continuously placed 12 inches above storm sewer piping.

3.4 DRAINAGE STRUCTURES

A. General:

1. Circular Structures:

- a. 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.
- b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

B. Rectangular Structures:

- 1. Concrete work for cast-in-place reinforced concrete structures shall be constructed in accordance with Section 03 30 53, (SHORT-FORM) C AST-IN-PLACE CONCRETE, and as specified in Section 609 of the AHTD Standard Specifications.
- 2. Precast concrete base Section of structures shall be set on an 12-inch thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D1557. Set precast concrete Section(s) on base Section (as applicable) true and plumb. Seal all joints with preform flexible gasket material.

C. Do not construct cast-in-place concrete structures when air temperature is 32 degrees F or below.

D. 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:

- 1. Forming directly in concrete base of structure.

2. Building up with brick and mortar.
- E. Floor of structure outside the invert channels shall be smooth and slope toward channels not less than 1:12 (1 inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
- F. The wall that supports access steps shall be 90 degrees vertical from the floor of structure to manhole cover. Install steps per the manufacturer's recommendations. Steps shall not move or flex when used. All loose steps shall be replaced by the Contractor.
- G. Install each drop inlet and catch basin frame and grate on a mortar bed, and flush with the finish pavement. Frames and covers shall be traffic rated and not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall at finish grade. Install an 8-inch thick by 12-inch diameter concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.5 UNDERGROUND DETENTION FACILITY

- A. Install per manufacturer's recommendations in the area shown on the plans.

3.6 WATER QUALITY FILTER

- A. Install per manufacturer's recommendations in the area shown on the plans.

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SECTION 33 46 13
FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies foundation drainage system, including installation, backfill, and cleanout extensions, to place of connection to municipal storm sewer or onsite facilities.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- B. Samples: For each type of filter fabric, pipe, and fitting indicated
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Safety requirements: Section 01 00 02, GENERAL REQUIREMENTS.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 02, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 02, GENERAL REQUIREMENTS, Article 1.12 PHYSICAL DATA.

1.4 ABBREVIATIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. HDPE: High-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.6 COORDINATION

- A. Coordinate connection to storm sewer main, if approved, with the Public Agency responsible for the storm sewer system.

- B. Coordinate exterior utility lines and connections to foundation building drain.

1.7 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.

- B. Comply with the rules and regulations of the Public Agency having jurisdiction over the connection to public storm sewer lines or the requirements for discharge of subsurface drainage.

1.8 APPLICABLE PUBLICATIONS

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

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

HB-17 Division II... Standard Specifications for Highway Bridges
M006-08-ULStandard Specification for Fine Aggregate for Hydraulic Cement Concrete, Single User Digital Publication

M252-08-ULCorrugated Polyethylene Drainage Pipe

M288-06-ULGeotextile Specification for Highway Applications

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

D448-08Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D2321-08Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2751-(2005)Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

- D2729-03Standard Specification for Polyvinyl
Chloride(PVC) Sewer Pipe and Fittings
- D2737-03Standard Specification for Polyethylene (PE)
Plastic Tubing
- D3034-08Standard Specification for Type PSM Polyvinyl
Chloride(PVC) Sewer Pipe and Fittings
- D4216-06Standard Specification for Rigid Polyvinyl
Chloride (PVC) and Related PVC and Chlorinated
Polyvinyl Chloride (CPVC) Building Products
Compounds
- F477-08Standard Specification for Elastomeric Seals
(Gaskets) for Joining Plastic Pipe
- F758-95(2000)e1Standard Specification for Smooth-Wall
Polyvinyl Chloride (PVC)Plastic Underdrain
Systems for Highway, Airport, and Similar
Drainage.
- F949-(2006a)Polyvinyl Chloride (PVC) Corrugated Sewer Pipe
with a Smooth Interior and Fittings

1.9 WARRANTY

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 manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

Pipe for foundation drainage system shall be of the type and size indicated on the drawings. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected.

A. Perforated Drainage Pipe:

1. Perforated, PE pipe and fittings per ASTM D2737, in DN 100 to DN 150 (NPS 4 to NPS 6). Joints shall be coupling type.
2. Perforated, PE pipe and fittings per ASTM D2737, in DN 200 to DN 600 (NPS 8 to NPS 24). Joints shall be coupling type.

3. Perforated, PVC sewer pipe and fittings per ASTM D2729, in DN 100 (NPS 4) only. Joints shall be bell-and-spigot, loose type.
- B. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron. Gravity Sewer pipes shall have a neoprene gasket joints and long sweep elbow fittings. Cleanouts for pre-placed crypt field underdrains shall be as indicated on the drawings and shall be set so as to not interfere with mowing operations. Plastic tops for the crypt field cleanouts shall be provided with concrete anchorage with all features set so as to not cause damage to the mowers.
- C. Drainage Conduit:
1. Pipe, fittings, and couplings shall be perforated and smooth PVC complying with ASTM D4216 and ASTM D2729.
 2. Pipe size shall be 200 mm (8 inches) and have a high minimum flow rate equal to a DN 100 (NPS 4) pipe.
 3. Fittings shall be PVC with DN 100 (NPS 4) outlet connection.
 4. Couplings shall be PVC.
- D. Geotextile to be installed as part of subsurface drainage pipe trenches and beneath riprap shall be a continuous filament polypropylene nonwoven needle-punched fabric, Survivability Class 2 (as defined in AASHTO M 288), meeting or exceeding the following specifications:

| Property | Test Method | Test Value ⁽¹⁾ |
|---|-------------|------------------------------------|
| Grab Tensile Strength | ASTM D 4632 | 158 lb |
| Grab Tensile Elongation | ASTM D 4632 | 50 % |
| Trapezoid Tear Strength | ASTM D 4533 | 56 lb |
| Puncture (CBR) Strength | ASTM D 6241 | 320 lb |
| Permittivity | ASTM D 4491 | 0.2 sec ⁻¹ |
| AOS | ASTM D 4751 | 0.60 mm (No. 30 U.S. Sieve) (max.) |
| Ultraviolet Resistance (% strength retained at 500 hours) | ASTM D 4355 | 50 % |

⁽¹⁾ Minimum Average Roll Value (unless otherwise noted) in weakest principal direction

- E. Geotextile to be installed under aggregate surfacing shall be a continuous filament polypropylene nonwoven needle-punched fabric, Survivability Class 1 (as defined in AASHTO M 288), meeting or exceeding the following specifications:

| Property | Test Method | Test Value ⁽¹⁾ |
|--|-------------|------------------------------------|
| Grab Tensile Strength | ASTM D 4632 | 200 lb |
| Grab Tensile Elongation | ASTM D 4632 | 50 % |
| Trapezoid Tear Strength | ASTM D 4533 | 80 lb |
| Puncture (CBR) Strength | ASTM D 6241 | 435 lb |
| Permittivity | ASTM D 4491 | 0.2 sec ⁻¹ |
| AOS | ASTM D 4751 | 0.60 mm (No. 30 U.S. Sieve) (max.) |
| Ultraviolet Resistance (% strength retained at 500 hours) | ASTM D 4355 | 50 % |

⁽¹⁾ Minimum Average Roll Value (unless otherwise noted) in weakest principal direction

F. Drainage Material:

1. Bedding: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.
2. Fill to 300 mm (1 foot) above pipe: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.

G. Concrete Sand: AASHTO M006.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Trenching and Excavation

Perform required trenching and excavation in accordance with Section 31 20 00 EARTH MOVING. Keep trenches dry during installation of drainage system. Changes in direction of drain lines shall be made with 1/8 bends. Use wye fittings at intersections.

B. Bedding

Place graded bedding, minimum 6 inches in depth, in the bottom of trench for its full width and length compacted as specified prior to laying of foundation drain pipe. Each section shall rest firmly upon

the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall fully support the lower quadrant of the pipe.

C. Pipe Laying

1. Lay drain lines to true grades and alignment with a continuous fall in the direction of flow. Bells of pipe sections shall face upgrade. Clean interior of pipe thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed, and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and re-laid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.
2. Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the COR. Invert elevation of drain pipe shall not be higher than top of lowest floor elevation nor lower than a 45-degree line projected from bottom of any adjacent footing. Lay drain lines and firmly bed in granular material a minimum of 75 mm (3 inches) below invert to top of pipe to true grades and alignment with bells facing upgrade, and to slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed to 300 mm (1 foot) above top of pipe, unless otherwise noted.
3. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standard:
 - a. PE and PVC pipe installation shall be per ASTM D2321 and ASTM F758.
 - b. PE joint construction shall be per ASTM D2737 and AASHTO HB-17, Division II, Section 26.4.2.4, "Joint Properties."
 - c. PVC joint construction shall be per ASTM D3034 with elastomeric seals gaskets per ASTM D2321.
 - d. Perforated PVC joint construction shall be per ASTM D2729, with loose bell and spigot joints.

4. Lay perforated pipe with perforations down. Lay plain end pipe with closed joints held in place with two No. 9 spring steel wire clips at each joint or by standard clay collars.
5. For foundation subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 900 mm (3 feet), unless otherwise indicated.
6. For underslab subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
7. Install cleanout extensions where shown on the Contract Documents.
8. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.

D. Jointing

Perforated and porous types of drain pipes shall be laid with closed joints.

- E. Backfilling: Place a minimum of 300 mm (12 inches) of granular material, hand tamped, extending in width a minimum of 600 mm (2 feet) from building wall. Then place a minimum of 150 mm (6 inches) of concrete sand, well tamped. Continue backfill with concrete sand to within 900 mm (3 feet) of finished grade in planting areas. Remainder of backfill shall be comparable to existing adjacent soils. In bituminous and concrete paving areas, backfill to the bottom of the base course with pervious material. Where foundation drain is within 600 mm (2 feet) of finished grade, one-half of fill shall be made with crushed stone.
1. Filter fabric may be substituted for sand layer.
 2. Vertical drainage mat in conjunction with geotextile may be substituted for sand and drainage material.
 3. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed, and their location marked with wooden stakes.

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