



U.S. Department
of Veterans Affairs

DAYTON NATIONAL CEMETERY

DAYTON, OHIO

IRRIGATE ENTIRE CEMETERY

PROJECT 810CM3026

PROJECT MANUAL

BID SET

JUNE 8, 2015

PREPARED BY:

LEAD DESIGN CONSULTANT/ LANDSCAPE ARCHITECT:

MTR LANDSCAPE ARCHITECTS, LLC

101 BELLEVUE RD., PITTSBURGH, PA 15229

IRRIGATION DESIGNER:

AQUA ENGINEERING, INC.

375 EAST HORSETOOTH ROAD BUILDING 2202, FORT COLLINS, CO 80525-3196

ENGINEER:

KCI TECHNOLOGIES

936 RIDGEBROOK RD., SPARKS, MD 21152

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**DEPARTMENT OF VETERANS AFFAIRS
NCA MASTER SPECIFICATIONS**

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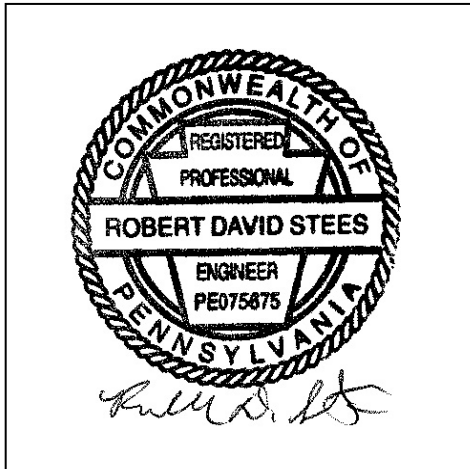
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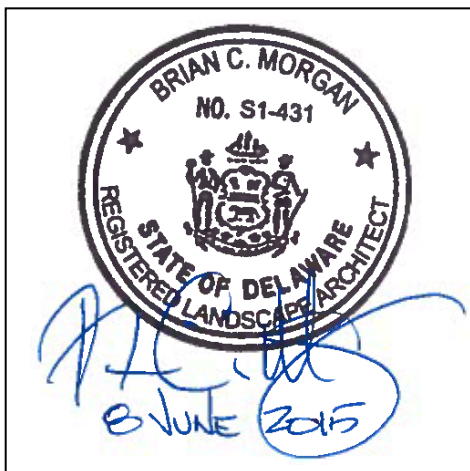
Lead Consultant/ Landscape Architect:
MTR Landscape Architects, LLC

Sections covered by this seal include:
00 01 15, 01 00 02, 01 32 17, 01 33 23,
01 42 19, 01 45 29, 01 56 39, 01 57 19,
02 41 10, 03 30 53, 07 92 00, 31 20 11,
32 05 23, 32 30 00, 32 90 00



Electrical Engineer:
KCI Technologies

Sections covered by this seal include:
26 05 11, 26 05 21, 26 05 26, 26 05 33,
26 05 41, 26 24 16, 26 27 13



Landscape Architect:
KCI Technologies

Sections covered by this seal include:
33 10 00

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Irrigation Designer:
Aqua Engineering, Inc.

Sections prepared by Aqua Engineering
include:
32 82 00, 32 84 00, 32 84 01

SECTION 00 01 15
LIST OF DRAWING SHEETS

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

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SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

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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 the Irrigate Entire Cemetery project at Dayton National Cemetery as required by drawings and specifications.
- B. Visits to the site by Bidders may be made by appointment with the Cemetery Director. It is highly recommended that Bidders visit the Cemetery to familiarize themselves with existing conditions prior to submitting a bid.
- C. Offices of MTR Landscape Architects, as Architect-Engineers (A/E), may render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by the Contracting Officer's Representative (COR) or his duly authorized representative.
- D. All employees of general contractor and subcontractors shall comply with security requirements as established by the COR and 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 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. Contractor's Superintendent shall have the 30-hour OSHA certified Construction Safety course.
 - 2. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course.
 - 3. Submit OSHA training records of all employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. ITEM I, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to:

Tree protection, tree removal, demolition, irrigation, site utilities,
site furnishings, planting and all related work.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, .pdf format electronic files of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from digital files furnished by the Issuing Office.

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 so that appropriate arrangements can be provided for the Cemetery employees. This notice is separate from any notices required for utility shutdown described later in this section.
 - 3. No photography of VA premises is allowed without written permission of the 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. 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 tool boxes and parked machines, and to take any necessary emergency action.

1.5 FIRE SAFETY

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

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

E84-2009a Surface Burning Characteristics of Building
Materials

2. National Fire Protection Association (NFPA):

10-2010 Standard for Portable Fire Extinguishers

30-2008 Flammable and Combustible Liquids Code

51B-2009 Standard for Fire Prevention During Welding,
Cutting and Other Hot Work

70-2008 National Electrical Code

241-2009 Standard for Safeguarding Construction,
Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926 Safety and Health Regulations for Construction

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to 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. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR.
- G. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- H. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- I. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- L. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily and site weekly.
- N. 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 designated and agreed to by the COR in agreement with 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.
 - 2. Provide unobstructed access to the Cemetery areas required to remain in operation.
 - 3. All such actions shall be coordinated with the Utility Company involved:
 - a. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Contractor.
- G. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, eight feet) minimum height, around the construction staging area indicated on the drawings. Construction fence shall be temporary, free-standing type, 2" mesh opening with ("feet") driven into the ground or in paved areas, with panel stands secured by sandbags. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15

inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.

H. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the COR, and Cemetery Director's prior knowledge and written approval.
2. The Contractor shall submit a request to interrupt any such services to both COR and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. The Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Cemetery. Interruption time approved by the Cemetery and COR may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Contractor and not the Government.

- J. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- K. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- L. 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.
- M. **Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the COR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas.** The Contractor must coordinate his schedule with the Cemetery schedule of services and operations on a daily basis. Construction noise during the committal services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period.
1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.
 2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of areas in which alterations occur and areas which are anticipated routes of access, and furnish a signed report, to the Contracting Officer. This report:
 - 1. Shall note any discrepancies between drawings and existing conditions at site.
 - 2. Shall designate areas for working space, materials storage and routes of access to areas where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications which will be furnished by the Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas involved. They shall furnish a report on conditions then existing as compared with conditions of same as noted in first condition survey report.
 - 1. Re-survey report shall also list any damage caused by the Contractor, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
 - 1. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.

1.8 ENVIRONMENTAL CONTROLS

- B. Final Cleanup:
 - 1. Upon completion of the project, or as work progresses, remove all construction debris from the site.

1.9 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
 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 structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed. 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 employ at no additional expense to the Government a certified arborist to trim those limbs or branches with a clean cut and treat the affected area as recommended by the arborist and approved 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 Articles, "Alterations", "Restoration", and

"Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, water/irrigation or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (mechanical and electrical work, trees and landscape, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services, fire protection systems, communications systems (including telephone), irrigation system control and power, which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown or noted 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 KCI Technologies.

(FAR 52.236-4)

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

1.14 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the 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)

1.15 AS-BUILT DRAWINGS

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

- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. 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.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.16 USE OF ROADWAYS

- A. For hauling, use only established public roads and designated permanent roads on Cemetery property and, when indicated or authorized by the COR, such existing or Contractor constructed and/or modified temporary roads which are necessary in the performance of contract work. 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.

1.17 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.

1.18 AVAILABILITY AND USE OF UTILITY SERVICES

- A. No utilities will be provided to the Contractor, except as noted.
- 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. 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:

- D. Electricity (for Construction and Testing): Furnish all temporary electric services.
1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.
- F. Water (for Construction and Testing): Furnish temporary water service.
1. Obtain water by connecting to the Cemetery irrigation distribution system at the new tap-in location. Backflow preventer may not be required at connections to the irrigation system. Water is available at no cost to the Contractor.
 2. The contractor may not connect to the Cemetery potable water distribution system or to the existing irrigation system without approval from the COR.
 3. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from the Cemetery's system.
 4. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.
- G. Fuel: Natural and LP gas required for burner cleaning, normal initial burner-burner setup and adjusting, and for performing the specified burner tests will be furnished by the Government. Fuel required for prolonged burner setup, adjustments, or modifications due to improper design or operation of burner, or control devices shall be furnished by the Contractor at Contractor's expense.

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

1.20 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 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.

1.21 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 will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.22 RELOCATED ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as water, drain, gas, air, and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

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

1.23 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. Signface shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50mm x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is provided in the Contract Drawings.

1.24 CONSTRUCTION DIGITAL IMAGES

- A. During construction period through completion, furnish Department of Veterans Affairs weekly color digital photographs of construction progress (8 to 10 images per week) Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.
- B. Photographs are to be taken with a high-resolution digital camera with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color and no reduction in actual picture size.
1. Compressed size of the file shall be no less than 80% or the original with no loss of information.
 2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example:
101CM3202_10-01-2013_0001. Use underscore, not spaces in digital file names.

3. When images are e-mailed a digital copy shall be made and compressed to 300-500 kilobytes size.
- 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/Project Manager via email to NAME@va.gov within 2 days of when the photo was taken. Identify the content of each picture by a caption incorporated in the photo.
 2. The digital photo files shall also be submitted on CD-ROM to the COR/Project Manager at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.25 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.

1.26 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

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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 Contracting Officer's Representative.
- 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 project 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 a minimum of 50 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 Conditions 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.
4. Exterior Label Information: Provide the following information on an external label attached to each diskette(s):
- a. VA project number and project location.
 - b. Name and telephone number of a point of contact, preferably the person who created the CD
 - c. The CD number and total number of CDs in the set
 - d. The project data status date.

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

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

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

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

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

- E. Approved samples will be kept on file by the 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.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
 - 1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 - 2. Reproducible shall be full size.
 - 3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 - 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 - 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 - 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 - 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

Dayton National Cemetery
Irrigate Entire Cemetery

Project 810CM3026
Bid Set - June 8, 2015

MTR Landscape Architects

101 Bellevue Rd., Ste 200

Pittsburgh, PA 15229

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.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

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

AADM	American Association of Automatic Door Manufacturers http://www.aaadm.com
AATC	American Association of Textile Chemists and Colorist http://www.aatcc.org
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.transportation.org/Pages/default.aspx
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgi.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADA	American with Disabilities Act http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag
ADC	Air Diffusion Council http://flexibleduct.org
AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AHA	American Hardboard Association http://www.domensino.com/AHA/
AIHA	American National Standards Institute/American Industrial Hygiene Association http://www.aiha.org/Pages/default.aspx
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org

AITC	American Institute of Timber Construction http://www.aitc-glulam.org
ALI	Automotive Lift Institute http://www.autolift.org/
AMCA	Air Movement and Control Association http://www.amca.org/
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	Architectural Precast Association http://www.archprecast.org/
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.lightindustries.com/ARI/
ARMA	Asphalt Roofing Manufacturers Association http://www.asphaltroofing.org/
ASAE	American Society of Agricultural Engineers http://www.asabe.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWPA	American Wood Protection Association http://www.awpa.com

AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	The Brick Industry Association http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CARB	California Environmental Protection Agency Air Resources Board http://arb.ca.gov/hompage.html/
CFR	Code of Federal Regulations http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCo de=CFR
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CID	Commercial Item Description http://www.gsa.gov/portal/content/100847
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CPA	Composite Panel Association http://www.compositepanel.org/
CRA	California Redwood Association http://www.calredwood.org
CRI	Carpet and Rug Institute http://www.carpet-rug.com
CRRC	Cool Roof Rating System http://coolroofs.org/
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
CSI	Cast Stone Institute http://www.caststone.org
DASMA	Door and Access Systems Manufacturers Association http://www.dasma.com/

DHI	Door and Hardware Institute http://www.dhi.org
DOE	U.S. Department of Energy http://www.energy.gov/
EEI	Edison Electric Institute http://www.eei.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EIMA	Exterior Insulation Manufacturers Association http://www.eima.com/
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.envirotestinglabs.com/
FCC	Federal Communications Commission http://www.fcc.gov
FHA	Federal Highway Administration http://www.fhwa.dot.gov/
FM	FM Global http://www.fmglobal.com
FPS	The Forest Products Society http://www.forestprod.org
FSC	Forest Stewardship Council http://www.fscus.org
GA	Gypsum Association http://www.gypsum.org
GANA	Glass Association of North America http://www.glasswebsite.com
GBI	Green Building Initiative http://www.thegbi.org/
GS	Green Seal http://www.greenseal.org
GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org

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

NIH	National Institute of Health http://www.nih.gov
NIOSH	The National Institute for Occupational Safety and Health http://www.cdc.gov/niosh/
NIST	National Institute of Standards and Technology http://www.nist.gov
NLMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org
NPA	National Particleboard Association 18928 Premiere Court Gaithersburg, MD 20879 (301) 670-0604
NPCA	National Precast Concrete Association http://www.precast.org
NRCA	National Roofing Contractors Association http://www.nrca.net
NSF	National Sanitation Foundation http://www.nsf.org
NSF	NSF International http://www.nsf.org/
NTMA	National Terrazzo and Mosaic Association http://ntma.com/
NWWDA	Window and Door Manufacturers Association http://www.nwwda.org
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.cement.org/
PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PEI	Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com
PTI	Post-Tensioning Institute http://www.post-tensioning.org

RCSC	Research Council of Structural Connections http://www.boltcouncil.org/
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCAQMD	South Coast Air Quality Management District http://www.aqmd.gov
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Deck Institute http://www.sdi.org
SDI	Steel Door Institute http://www.steeldoor.org
SEI	Structural Engineering Institute http://www.asce.org/SEI/
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SPRI	Single Ply Roofing Industry http://www.spri.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
SWRI	Sealant Waterproofing and Restoration Institute http://www.swrionline.org/
TCNA	Tile Council of North America, Inc. http://www.tileusa.com
TPI	Truss Plate Institute, Inc. http://www.tpinst.org/

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

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

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

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

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

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

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

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

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

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T27-06.....Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-01 (R2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02(R2006).....Density of Soil In-Place by the Sand-Cone Method
- C. American Society for Testing and Materials (ASTM):
- A325-09.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-09.....Definitions for Mechanical Testing of Steel Products
 - A490-08.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-08.....Making and Curing Concrete Test Specimens in the Field
 - C33-08.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete
Specimens

C109/C109M-08.....Compressive Strength of Hydraulic Cement
Mortars

C138-08.....Unit Weight, Yield, and Air Content
(Gravimetric) of Concrete

C140-08.....Sampling and Testing Concrete Masonry Units and
Related Units

C143/C143M-08.....Slump of Hydraulic Cement Concrete

C172-08.....Sampling Freshly Mixed Concrete

C173-08.....Air Content of freshly Mixed Concrete by the
Volumetric Method

C330-05.....Lightweight Aggregates for Structural Concrete

C567-05.....Density Structural Lightweight Concrete

C780-08.....Pre-construction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry

C1019-09.....Sampling and Testing Grout

C1064/C1064M-08.....Freshly Mixed Portland Cement Concrete

C1077-08.....Laboratories Testing Concrete and Concrete
Aggregates for Use in Construction and Criteria
for Laboratory Evaluation

C1314-07.....Compressive Strength of Masonry Prisms

D698-07.....Laboratory Compaction Characteristics of Soil
Using Standard Effort

D1143-07.....Piles 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

D1557-07.....Laboratory Compaction Characteristics of Soil
Using Modified Effort

D2166-06.....Unconfined Compressive Strength of Cohesive
Soil

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

D2216-05.....Laboratory Determination of Water (Moisture)
Content of Soil and Rock by Mass
D2922-05.....Density of soil and Soil-Aggregate in Place by
Nuclear Methods (Shallow Depth)
D2974-07.....Moisture, Ash, and Organic Matter of Peat and
Other Organic Soils
D3666-07.....Minimum Requirements for Agencies Testing and
Inspection Bituminous Paving Materials
D3740-08.....Minimum Requirements for Agencies Engaged in
the Testing and Inspecting Road and Paving
Material
E94-04.....Radiographic Testing
E164-08.....Ultrasonic Contact Examination of Weldments
E329-08.....Agencies Engaged in Construction Inspection
and/or Testing
E543-08.....Agencies Performing Non-Destructive Testing
E709-08.....Guide for Magnetic Particle Examination
E1155-96(R2008).....Determining FF Floor Flatness and FL Floor
Levelness Numbers

E. American Welding Society (AWS):

D1.1-07.....Structural Welding Code-Steel

1.3 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 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 shall meet the requirements of ASTM E329.

2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall 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) shall meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, and Local Building Authority 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 shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or

- unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide 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 D698 and/or ASTM D1557.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556, AASHTO T191, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
 - a. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - b. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
 - c. 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. Topsoil: Provide one soil test for each 200 CY of topsoil from either stockpile source or borrow source.
 - 1. Sample: Prepare as required by testing lab.
 - 2. Testing reports shall include the following at minimum:
 - 1) pH
 - 2) Organic matter
 - 3) USDA soil texture classification
 - 4) Soluble salts
 - 5) Percentage of foreign materials such as rock, roots, and vegetation.
 - 6) Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Magnesium, and Calcium.
 - 7) Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful plant and turfgrass growth. Amendment / fertilization recommendations should be provided separately for landscape plants, turf seeding, and turf sodding. Recommendations for turf shall be for the highest quality installation.
 - 3. The topsoil shall be improved with soil amendments as recommended by the soil testing lab and approved by the CO/COR. Topsoil shall be amended to meet the requirements of 32 90 00 PLANTING for parameters including but not limited to pH and organic matter content. Test amended soil a second time to verify that it meets the specified requirements.
 - 4. Costs of soil amendment and testing will be by Contractor, including follow up tests if needed.
 - 5. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.

6. Submit laboratory test report of topsoil to Architect-Engineer and COR.

B. Organic Soil Amendment (compost): Provide one test for each source. Tests shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists.

1. Sample: Prepare as required by testing lab.

2. Testing Parameters: Refer to 32 90 00 Planting.

3. Submit laboratory test report of organic amendment to Architect-Engineer and COR.

B. Submit laboratory test report of topsoil to CO/COR.

3.3 SITE WORK CONCRETE

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

3.4 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 insure compliance with specifications.

4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least four cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least four cylinders for 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 two cylinders at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows:
Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 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).
 - 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.

----- END -----

SECTION 01 56 39
TEMPORARY TREE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the protection, and preservation of existing trees and gravesite monuments that are affected by execution of the Work, whether temporary or permanent construction.
- B. ALL trees on Cemetery property that are not indicated to be removed are to be protected according to the standards of this section.

1.2 REFERENCES

- A. Publications listed herein are part of this specification to extent referenced.
 - 1. Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance, ANSI A300, December, 1994.
 - 2. ANSI Z133.1 - 1994, Tree Care Operations - Safety Requirements Standards.
 - 3. International Society of Arboriculture (ISA) "Guide for Establishing Values of Trees and Other Plants," prepared by the Council of Tree and Landscape Appraisers (CTLA).
- B. STANDARDS: The applicable provisions of the following standard publication shall apply throughout this section.
 - 1. Evaluation of Hazard Trees in Urban Areas, - published by the International Society of Arboriculture, 1994.
 - 2. American National Standard for Tree Care Operations - Tree, shrub and other woody plant maintenance - standard practices, - ANSI 300-2000, published by American National Standards Institute, 2000.
 - 3. American National Standard for Tree Care Operations - Pruning, trimming, repairing, maintaining, and removing trees, and cutting brush - safety requirements ANSI Z133.1 - 2000, - published by American National Standards Institute, 2000.

1.4 DEFINITIONS

- A. Arborist: licensed arborist certified by ISA certified Arborist with five (5) years minimum experience in the field of urban forestry and remediation of construction damage.
- B. Caliper: Diameter of the trunk at 6" above the soil for trees up to 6" in caliper and diameter at 12" above the soil for trees up to 12" caliper.
- C. Diameter: Diameter at breast height (dbh), which is the average tree diameter at 4.5 feet from the ground on the uphill side of the tree.
- D. Damage to trees:
 - 1. Soil compaction.
 - 2. Broken root tissue.
 - 3. Broken overstory tissue.
 - 4. Actions and/or inactions by Contractor's forces resulting in signs of stress including, but not limited to, defoliation and chlorosis.
- E. Supersonic Air Tool (Airspeed): High speed specialized tool that loosens and removes soil by means of highly compressed air without damaging roots.
- F. Significant Damage: Damage that might reasonably be expected to endanger the long term health and/or form of the tree, as determined by the Landscape Architect, CO/COR or Arborist.
- G. Wheel Saw: 3 inch wide mechanical trencher, Bobcat model WS24 or equal as approved by Landscape Architect.
- H. Protection Zone:
 - 1. The area defined by the drip line of the outer extent of the canopy of a tree, or within ten (10) feet of the outside diameter of a tree's trunk, or within tree protection fence area as shown on plans, whichever is larger.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Tree Pruning Schedule: Written schedule from arborist detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction, if applicable.

C. Qualification Data: For tree service firm and arborist.

1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: All pruning, tree removals, root pruning, and fertilization required shall be performed by an ISA certified Arborist of five (5) years minimum experience in the field of urban forestry and remediation of construction damage.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.
- C. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices (Pruning)."
- D. Preinstallation Conference:
 - 1. Before construction begins, meet with CO/COR and Cemetery Director, to review tree and monument protection procedures and responsibilities.

1.7 PENALTIES

- A. The penalty for noncompliance with the requirements of this section shall be \$500 per incident of noncompliance.
- B. If violations occur the COR may require the Contractor to hire a licensed arborist to observe work in Protection Zones and make recommendations at no additional expense to the Government.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construction mat: In general, vehicle traffic is prohibited in Protection Zones. If equipment access is required through Protection Zones, provide the following:
 - 1. Use only turf-tired vehicles, no tracked vehicles allowed.
 - 2. For one-time traffic, provide 1-inch thick plywood construction matting to protect soil from compaction and rutting.
 - 3. If vehicles will drive over an area more than once, provide heavy construction matting consisting of the following: geotextile fabric

with 8-inch thickness of coarsely shredded wood chips on top.

Respread or add mulch as needed to maintain the specified thickness.

4. Completely remove all construction mat materials as soon as possible.
- B. Trunk protection - trees over 12" caliper: Protect the trunk of the tree from accidental mechanical damage when operating equipment within the Protection Zone by attaching scrap lumber to the trunk with nylon webbing straps. Do not affix by means of nails, screws, lag bolts or any other device which penetrate the bark. If such banding is required to remain for a period greater than four months, check the tension of the straps and loosen them if they become tight to prevent damaging the trunk of the tree.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.
1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart. High visibility orange color, nonfading. Fencing shall be 4 feet high with 3 foot wide access gates.
 2. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering. An 8 ½" x 11" sign indicating the area as a tree protection zone shall be prominently displayed on each fence panel.
 3. The Contractor shall be responsible for the installation and maintenance of all tree protection fencing. Protective fencing shall remain undisturbed until all construction activities have been completed. The Contractor shall remove fencing upon completion of construction.
- D. If protective fencing is damaged, the Contractor shall immediately execute the necessary repairs to re-establish the protective fencing to original configurations.
- E. No construction activity, including installation of erosion control devices and delivery and storage of materials, shall start until all tree protection measures and procedures as indicated are completed.

PART 3 - EXECUTION

3.1 GENERAL

A. The following construction activities are prohibited within Protection Zones:

1. Storage of any construction materials, equipment, stockpiling, excavation or fill, soil, gravel, trash, etc. No soil shall be heaped on trees or monuments.
2. Equipment or vehicle parking.
3. Use of vehicles without proper construction matting; use of tracked vehicles at any time.
4. Masonry set up, clean up or washout.
5. Dumping of any chemicals, (i.e. paint thinner from cleaning brushes), wash-out materials from cleaning equipment, concrete or mortar remainder, trash, garbage, or debris of any kind.
6. Burning within or in proximity to protected areas
7. Felling trees into protected areas.
8. Direction of exhaust from vehicles onto trees or monuments.
9. Contractor shall prevent any contamination of the soil within the Protection Zone by construction materials, debris, silt, fuel, oils, concrete, or any other chemical substance. Contractor shall notify the COR of any such spills, compaction, or other disturbance within the Protection Zone and take immediate action using methods approved by the COR.

3.2 PREPARATION

A. Pre-construction Walkthrough

1. Prior to the start of construction and preservation work, conduct pre-construction review of construction extent and protection requirements. Any potential conflicts shall be brought to the COR's and Landscape Architect's attention.
2. Identify all equipment access routes and areas to receive construction mat for COR approval.

- a. Equipment pathways shall avoid protection zones, except as approved by COR. Vehicles circulating within the Protection Zone shall only drive on a prepared construction mat.

3. Identify areas to be trenched or excavated.
4. Identify trees to receive trunk protection.
5. Locate proposed material and soil storage areas. Review locations for demolished materials and new materials.
6. Identify any trees to be pruned to facilitate equipment access, if applicable. Identify direction of fall for any trees to be removed, if applicable.

B. Pre-construction watering

1. All trees in the vicinity of construction activities shall be thoroughly watered two weeks prior to the start of construction.

3.3 TREE PROTECTION

- A. Contractor shall protect all trees and vegetation within the Protection Zone during all construction operations.
- B. Failure to comply with protection zone requirements can result in immediate work stoppage. All delays and costs due to correction of non-compliance and work stoppage shall be at the Contractor's expense.
- C. Construction within the Protection Zone shall be performed in a manner that avoids injury to trees and their roots as much as possible.
 1. Install construction mat where vehicles must travel through Protection Zones.
 2. Secure all over hanging branches to prevent accidental damage when practical. Tree branches that interfere with construction may be trimmed to clear final grade by a maximum of 9 feet over sidewalks and 14 feet over pavement. Trimming of branches and the cutting of roots shall be in accordance with accepted arboricultural practices and be performed by the Contractor's qualified Arborist.
 3. Tree wounds and cuts shall not be painted with any type of tree paint or other substances.
 4. Install trunk protection for trees over 12 inches in caliper.

3.4 DEMOLITION

A. Special demolition procedures within Protection Zones or adjacent to the designated Protection Zones shall be as follows:

1. Do not pile or load debris adjacent to existing protected trees.
2. If roots are encountered during removal of structures, protect or prune as described in this section.

3.5 EXCAVATION

A. Special Precautions: Protection of existing trees adjacent to excavation involves four areas of operations: careful excavation, selective root relocation and/or removal, protection of tree trunk and branches, and backfill of excavation.

B. Excavation in Protection Zones

1. Hand dig and/or use supersonic air tool to excavate to a depth of 12 inches, below which mechanical methods may be used. Use extreme care when hand digging to leave roots intact.
2. Expose all roots larger than 1" in diameter. Care shall be taken so as not to cause damage to the roots. Notify COR if roots larger than 1" are encountered.
3. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or wrap with wet burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil. If several roots form a tight cluster, leave as much soil attached to the roots as is practical. Do not leave trench open for more than 4 hours. Replace soil and soak with water to pack.
4. Excavated dirt shall be placed away from any adjacent trees or Protection Zones when there is sufficient room. If no room exists, dirt may be placed on plywood to contain the fill and to minimize compaction and mechanical damage to surface roots.
5. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and relocate them without breaking.

6. Do not cut roots larger than 1 inch diameter without approval from CO/COR. Cut smaller roots that cannot be relocated and that interfere with construction with sharp pruning instruments; do not break or chop.

3.6 GRADING

- A. Match existing grades except as noted. Notify COR and obtain approval if unforeseen circumstances require adjustment of finish grades.

3.7 TREE PRUNING

- A. All pruning to be done by a licensed Arborist and only if approved by COR. Prune branches that directly interfere with construction and only with approval from COR.
- B. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and as follows:
 1. Type of Pruning: Cleaning.
 2. Cut branches and roots with sharp, clean pruning instruments; do not break or chop.
 3. Chip removed tree branches and dispose of off-site legally.

3.8 TREE REPAIR

- A. Tree repair recommendations must be provided by a licensed Arborist.
- B. Provide COR reports of damage and recommended remediation on a daily basis if damage occurs.
- C. Promptly provide remedial action to trees damaged by construction operations within 48 hours. Prune or otherwise treat damaged trunks, limbs, and roots according to Arborist's written instructions. Remedial actions shall be at Contractor's expense. Damage that is not addressed within 48 hours may be remediated by the VA at the Contractor's expense.
- D. Remedial maintenance activities which may be required in lieu of or in addition to other penalties shall include, but are not limited to, the following:
 1. Repair: Crown pruning, root pruning, fertilization, mulching, aeration, soil replacement, soil removal, watering, cabling, and bracing.

2. If trees are damaged, penalties still apply and are in addition to remedial measures.

3.9 MAINTENANCE AND RESTORATION

- A. Water trees thoroughly immediately after any excavation or vehicle traffic and every 2 weeks thereafter in dry weather (less than 1 inch of natural rainfall per week), until irrigation system is fully functional.
- B. If the soil within the Protection Zone becomes compacted during construction due to vehicle traffic or materials storage, perform vertical mulching to aerate surface soil.
 - a. Perform vertical mulching wherever construction matting was used.
 - b. Perform vertical mulching within the Protection Zone and no closer than 36 inches (900 mm) to tree trunk.
 - c. Drill 2 inch diameter holes 12 inches deep using a power auger. Start beyond the tree's structural root plate and drill on a 18 x18 inch grid within the critical root zone. If large woody roots are encountered, avoid root damage by slightly moving the drill hole. Backfill the holes with compost or composted mulch.
- C. Repair damaged turf with new sod to match existing turf.

3.10 DISPOSAL OF WASTE MATERIALS

- A. Burning is prohibited at all times.
- B. Disposal: Remove cuttings from Government's property and dispose of legally.

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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, NPDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): <http://www.epa.gov/owow/>
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response:
<http://www.epa.gov/epaoswer/osw/laws-reg.htm>
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website:
<http://www.epa.gov/superfund/index.htm>
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage: <http://www.epa.gov/pcb/>
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
<http://www.epa.gov/ebtpages/airmobilesources.html>
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website:
<http://www.epa.gov/fedsite/cd/asbestos.html>
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities

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

11. National Historic Preservation Act

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

1. Ohio Environmental Protection Agency.
2. Ohio Department of Natural Resources.
3. Montgomery County.
4. City of Dayton.
5. The Construction Industry Compliance Assistance Center:
<http://www.cicacenter.org/index.cfm>
6. 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 Contracting Officer's Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, prepare and submit to the COR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - d. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses,

ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

- e. Procedures to provide environmental protection that complies with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Sediment and Erosion Control Plan including details of proposed temporary sediment and erosion control materials and equipment.
 - j. 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 Sediment and 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 TREE PROTECTION

- A. See Section 01 56 39 Temporary Tree Protection.

1.7 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract and after the project is complete. 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.
3. Tree Protection - see Section 01 56 39 Temporary Tree Protection
4. 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 Erosion and Sedimentation Control Plan and/or as required by Ohio Department of Natural Resources (ODNR).
5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain temporary erosion and sediment control measures such as compost filter sock, inlet protection, berms, dikes, drains, sedimentation basins, grassing, and mulching, straw waddles, fiber rolls, until vegetative cover is established and permanent drainage and erosion control facilities are completed and operative. Comply with requirements of ODNR Rainwater and Land Development Manual.
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.
 2. Monitor water areas, wetlands and wetland buffers affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list protected species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Ohio and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the

Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials at all times, including weekends, holidays, and hours when work is not in progress.
2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

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

1. Perform construction activities involving repetitive, high-level impact noise only between 6:00 a.m. and 9:00 am or 3:00pm and 6:00 p.m unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following 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	Not permitted
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 including full vegetative cover. 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 02 41 10
DEMOLITION AND SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Disconnecting utility services prior to demolition: Section 01 00 02, GENERAL REQUIREMENTS.
- B. Reserved items that are to remain the property of the Government: Section 01 00 02, GENERAL REQUIREMENTS.
- C. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- D. Tree protection: Section 01 56 39: TEMPORARY TREE PROTECTION

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.
- 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.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- E. 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 Contracting Officer's Representative (COR). Coordinate the work of this section with all other work and shall construct and maintain shoring,

bracing, and supports as required. Ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.

- F. 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. **Comply with tree protection requirements.** Remove similar items elsewhere on site or premises as specifically indicated. Removal includes complete removal 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, in compliance with Ohio Department of Natural Resources Rainwater and Land Development Manual, Latest Edition. Install compost filter sock and inlet protection as shown and as per requirements of the Contract Documents, prior to any soil disturbance activities. Provide temporary seeding and permanent sodding as required by the Contract Documents.
- C. Maintain site controls and repair as directed by COR to sustain compliance with requirements of Contract Documents and the ODNR Rainwater and Land Development Manual. Maintain all records and perform inspections as required by the Contract Documents and applicable regulations.

- D. Clearing and Grubbing: Remove only trees indicated on plans as to be removed. Completely grind out and remove stumps and roots or trees indicated to be removed. Do not remove other trees or vegetation unless authorized by the COR.
- E. Tree Protection: See Section 01 57 19: TEMPORARY ENVIRONMENTAL CONTROLS, PARAGRAPH 1.6 TREE PROTECTION.
- F. Topsoil stripping: See Section 31 20 11 - EARTH MOVING (SHORT FORM)
- G. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and 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. Debris, including brick, concrete, stone, metals, removed trees, and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- B. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP

- 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.

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

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies cast-in-place concrete.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 TOLERANCES:

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

1.4 REGULATORY REQUIREMENTS:

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

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- 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 basic designation only.
- B. American Concrete Institute (ACI):
 - 117R-06.....Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete
 - 211.2-98(R2004).....Proportions for Structural Lightweight Concrete
 - 301-05.....Specification for Structural Concrete
 - 305R-06.....Hot Weather Concreting
 - 306R-2002.....Cold Weather Concreting
 - SP-66-04ACI Detailing Manual
 - 318/318R-05.....Building Code Requirements for Reinforced Concrete
 - 347R-04.....Guide to Formwork for Concrete

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

A185-07.....Steel Welded Wire, Fabric, Plain for Concrete
Reinforcement
A615/A615M-08.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
A996/A996M-06.....Standard Specification for Rail-Steel and Axle-
Steel Deformed Bars for Concrete Reinforcement
C31/C31M-08.....Making and Curing Concrete Test Specimens in the
Field
C33-07.....Concrete Aggregates
C39/C39M-05.....Compressive Strength of Cylindrical Concrete
Specimens
C94/C94M-07.....Ready-Mixed Concrete
C143/C143M-05.....Standard Test Method for Slump of Hydraulic
Cement Concrete
C150-07.....Portland Cement
C171-07.....Sheet Material for Curing Concrete
C172-07.....Sampling Freshly Mixed Concrete
C173-07.Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-07.....Making and Curing Concrete Test Specimens in the
Laboratory
C231-08.....Air Content of Freshly Mixed Concrete by the
Pressure Method
C260-06.....Air-Entraining Admixtures for Concrete
C330-05.....Lightweight Aggregates for Structural Concrete
C494/C494M-08.....Chemical Admixtures for Concrete
C618-08.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete
D1751-04.Preformed Expansion Joint Fillers for Concrete Paving and
Structural Construction (Non-extruding and
Resilient Bituminous Types)
D4397-02.....Polyethylene Sheeting for Construction,
Industrial and Agricultural Applications
E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor
Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

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

2.2 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Welded Wire Fabric: ASTM A185. Flat sheets.
- I. Sheet Materials for Curing Concrete: ASTM C171.
- J. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- K. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 3500 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of $f'c$. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of $f'c$.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- * Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

F. Air-entrainment is required for all exterior concrete. Air content shall conform with the following table:

**TABLE I - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in) = #67	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Ready-mixed concrete 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 shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.

B. Treating and Wetting: Treat or wet contact forms as follows:

1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
3. Use sealer on reused plywood forms as specified for new material.

C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:

1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. 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:

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

3.3 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.

- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COR.

3.4 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COR.

3.5 FORM REMOVAL:

Forms shall 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.

3.6 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by COR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.7 PRECAST CONCRETE ITEMS:

Precast concrete items, not specified elsewhere, shall be cast using 5000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

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SECTION 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. Expansion joint filler for site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 QUALITY CONTROL

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 - 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 - 5. Determine sealants will not stain joint substrates according to ASTM C1248.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:
 - 1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
 - 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.

- b. Each type of non-elastomeric sealant and joint substrate indicated.
- 3. Notify RE/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.
- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution:
 - 1. Joints in mockups of assemblies specified in other sections, that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
 - 2. Primers.
 - 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.6 PRE-INSTALLATION CONFERENCE

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

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not proceed with installation of joint sealants under following conditions:
 - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).

- b. When joint substrates are wet.
- c. When dust or airborne particles would adhere to joint sealant.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 DELIVERY, HANDLING, AND STORAGE

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

1.9 DEFINITIONS

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.10 WARRANTY

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be extended to five (5) years.
- B. General Warranty: Special warranty specified in this Article will not deprive Government of other rights Government may have under other provisions of Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.11 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):
 - C612-10 Mineral Fiber Block and Board Thermal Insulation

C717-12b	Standard Terminology of Building Seals and Sealants
C734-06(2012)	Low Temperature Flexibility of Latex Sealants after Artificial Weathering
C834-10	Latex Sealants
C919-12	Use of Sealants in Acoustical Applications
C920-11	Elastomeric Joint Sealants
C1021-08	Laboratories Engaged in Testing of Building Sealants
C1193-13	Use of Joint Sealants
C1248-08(2012)	Staining of Porous Substrate by Joint Sealants
C1330-02(2013)	Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
D217-10	Cone Penetration of Lubricating Grease
D1056-07	Flexible Cellular Materials—Sponge or Expanded Rubber
E84-12c	Surface Burning Characteristics of Building Materials
C. California Air Resources Board (CARB)	
D. South Coast Air Quality Management District (SCAQMD)	
E. Sealant, Waterproofing and Restoration Institute (SWRI): The Professionals' Guide	

PART 2 - PRODUCTS

2.1 SEALANTS

- A. S-1:
 - 1. ASTM C920, polyurethane.
 - 2. Type M or S.
 - 3. Class 25.
 - 4. Grade NS.
 - 5. Shore A hardness of 20-40.
- B. S-2:
 - 1. ASTM C920, polyurethane.
 - 2. Type M.
 - 3. Class 25.
 - 4. Grade P.
 - 5. Shore A hardness of 25-40.
- C. S-3:
 - 1. ASTM C920, polyurethane.
 - 2. Type S.

3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.

D. S-4:

1. ASTM C920 polyurethane.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

E. S-5:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.

G. S-7:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxo cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.

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

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C

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

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

2.5 FILLER

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

2.6 PRIMER

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

2.7 CLEANERS-NON POROUS 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 PREPARATION

- A. Prepare joints in accordance with manufacturer's instructions and as specified only when installers are ready to initiate sealant application as soon as practicable after preparation and before subsequent surface deterioration.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to

- produce a clean, sound substrate capable of developing optimum bond with joint sealants.
2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
1. Apply primer prior to installation of back-up rod or bond breaker tape.
 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.

- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

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

3.5 INSTALLATION

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

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 Joints, Horizontal and Vertical:
 - 1. Metal to Metal: Type S-6, S-7.
 - 2. Metal to Masonry or Stone: Type S-1.
 - 3. Masonry to Masonry or Stone: Type S-1.
 - 4. Stone to Stone: Type S-1.
 - 5. Cast Stone to Cast Stone: Type S-1.
 - 6. Threshold Setting Bed: Type S-1, S-3, S-4.

7. Masonry Expansion and Control Joints: Type S-6.
8. Wood to Masonry: Type S-1.
- B. Metal Reglets and Flashings:
 1. Flashings to Wall: Type S-6.
 2. Metal to Metal: Type S-6.
- C. Sanitary Joints:
 1. Walls to Plumbing Fixtures: Type S-9.
 2. Counter Tops to Walls: Type S-9.
 3. Pipe Penetrations: Type S-9.
- D. Horizontal Traffic Joints:
 1. Concrete Paving, Unit Pavers: Type S-11.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, and other items and arrangements for the specified items are shown on drawings.
- C. Electrical service entrance equipment (arrangements for permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval for sizes and settings of these devices.
- D. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) 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.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed; equipment or device of a kind mentioned which:
 - a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
 - b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
2. Labeled; equipment or device is when:
 - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
 - b. The laboratory makes periodic inspections of the production of such equipment.
 - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified; equipment or product is which:
 - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
 - c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- 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.

1.5 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.6 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with 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.

1.7 EQUIPMENT PROTECTION

- 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 kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits 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. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 3. 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. 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.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 02, GENERAL REQUIREMENTS.

- E. 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 02, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.10 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 panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.11 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. 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.
- 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, pictures, nameplate data and test reports as required.
 3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Manuals: 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. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Lubrication schedule including type, grade, temperature range, and frequency.
 - j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - k. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
 2. Each type of conduit coupling, bushing and termination fitting.
 3. Conduit hangers, clamps and supports.
 4. Duct sealing compound.
 5. Each type of receptacle, toggle switch, outlet box, manual motor starter, device plate, engraved nameplate, wire and cable splicing and terminating material and single pole molded case circuit breaker.
 6. Each type of light fixture is shown on the drawings.

1.12 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.

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SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

- A. Excavation and backfill for cables that are installed in conduit:
Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
 2. Certificates: Two weeks prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed
Installation)
- C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables

83-03.....Thermoplastic-Insulated Wires and Cables

467-01.....Electrical Grounding and Bonding Equipment

486A-01.....Wire Connectors and Soldering Lugs for Use with
Copper Conductors

486C-02.....Splicing Wire Connectors

486D-02.....Insulated Wire Connector Systems for Underground
Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors

493-01.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable

514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.

B. Single Conductor:

1. Shall be annealed copper.

2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.

3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.

2. Direct burial: Type USE Cable with copper conductors shall be in accordance with UL 493.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *

* or white with colored (other than green) tracer.
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2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped wires.
 3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.
- C. Feeder Circuits:
 1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
 2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
 4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.5 WARNING TAPE

- A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene non-detectable type.
- B. The tape shall be red with black letters indicating "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- 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. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. 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.
- H. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR.
 - 4. Pull in multiple cables together in a single conduit.

- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.3 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. 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.

3.4 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.5 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

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

3.6 FEEDER IDENTIFICATION

- A. In each interior pullbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.7 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
 - 3. Do not install direct burial cables under railroad tracks.
- B. Under road and paved surfaces: Install cables in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (two inch) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
- C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.
- D. Cut the trenches neatly and uniformly:
 - 1. Excavating and backfilling is specified in Section 31 20 11, EARTH MOVING (SHORT FORM).
 - 2. Place a 75 mm (3 inch) layer of sand in the trenches before installing the cables.
 - 3. Place a 75 mm (three inch) layer of sand over the installed cables.
 - 4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inch) preservative impregnated wood planking 75 mm (three inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
- F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.
- G. Connections and terminations shall be submersible type designed for the cables being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.8 EXISTING WIRING

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

3.9 FIELD TESTING

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system 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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
 - 1. Certification that the materials and installation is 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

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.

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

B1-2001.....Standard Specification for Hard-Drawn Copper
Wire

B8-2004.....Standard Specification for Concentric-Lay-
Stranded Copper Conductors, Hard, Medium-Hard,
or Soft

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface Potentials
of a Ground System

C. National Fire Protection Association (NFPA):

70-2008.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-2005Thermoset-Insulated Wires and Cables

83-2003Thermoplastic-Insulated Wires and Cables

467-2004Grounding and Bonding Equipment

486A-486B-2003Wire 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.

C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

A. 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

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.6 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.7 SPLICE CASE GROUND ACCESSORIES

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes,

cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 - 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - 3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- E. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- F. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.

2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- G. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- H. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.4 CORROSION INHIBITORS

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

3.5 CONDUCTIVE PIPING

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

3.6 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure 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 less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

3.7 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.

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, 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. Bedding of conduits: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

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

- A. 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.
- B. 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.

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 the basic designation only.
- B. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)
- C. 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-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and
Covers
- 651-05.....Schedule 40 and 80 Rigid PVC Conduit
- 651A-00.....Type EB and A Rigid PVC Conduit and HDPE Conduit
- 797-07.....Electrical Metallic Tubing
- 1242-06.....Intermediate Metal Conduit
- D. 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

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 19 mm
(3/4 inch) unless otherwise shown.
- B. Conduit:
 - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 - 2. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
 - 3. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A,
heavy wall PVC or high density polyethylene (PE).
- C. Conduit Fittings:
 - 1. Rigid steel conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA
FB1.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only
steel or malleable iron materials are acceptable. Integral
retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal
wall of an enclosure.

- d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
3. Direct burial plastic conduit fittings:
- a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.
4. Expansion and deflection couplings:
- a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 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 fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- 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. 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. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COR as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, conduit penetrations, completely seal clearances around the conduit and make watertight.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. 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 and electrically continuous.
6. Independently support conduit at 8'0" 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 (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Do not use aluminum conduits in wet locations.
12. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

C. 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.

D. 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, 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 inches) thick is prohibited.
 - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

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 above 600 volts:
 1. Rigid steel.
- C. Conduit for Conductors 600 volts and below:
 1. Rigid steel. Different type of conduits mixed indiscriminately in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

3.5 DIRECT BURIAL INSTALLATION

- A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
 1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
 2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
 3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
 4. Tops of conduits shall be as follows unless otherwise shown:
 - a. Not less than 600 mm (24 inches) below finished grade.
 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 11, EARTH MOVING (SHORT FORM).
 - a. Cut the trenches neatly and uniformly.
 - b. Do not kink the conduits.
 7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
 8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
 9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.
- B. Exterior routing of branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):

3.6 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

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. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.8 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 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.

3.9 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 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.
- 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.

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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 ducts to form a complete underground raceway system.
- B. "Duct" and "conduit", and "rigid metal conduit" and "rigid steel conduit" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 31 20 11, EARTH MOVING (SHORT FORM): Trenching, backfill and compaction.
- 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 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.
- 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.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 3. If necessary to locate ducts at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the COR for approval prior to construction.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
 - 1. Certification that the materials 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

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.

A. American Concrete Institute (ACI):

Building Code Requirements for Structural Concrete
318/318M-2005.....Building Code Requirements for Structural
Concrete & Commentary
SP-66-04.....ACI Detailing Manual

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

C478/C478M 2009(b).....Standard Specification for Precast Reinforced
Concrete Manhole Sections
C990 REV A 2008Standard Specification for joints concrete
pipe, Manholes and Precast Box using performed
flexible Joint sealants.

C. Institute of Electrical and Electronic Engineers (IEEE):

C2-2002National Electrical Safety Code

D. National Electrical Manufacturers Association (NEMA):

RNI 2005.....Polyvinyl Chloride (PVC) Externally Coated
Galvanized Rigid Steel Conduit and Intermediate
Metal Conduit
TC 2 2003.....Electrical Polyvinyl Chloride (PVC) Tubing And
Conduit
TC 3-2004.....PVC Fittings for Use With Rigid PVC Conduit And
Tubing
TC 6 & 8 2003.....PVC Plastic Utilities Duct For Underground
Installations
TC 9-2004.....Fittings For PVC Plastic Utilities Duct For
Underground Installation

E. National Fire Protection Association (NFPA):

70 2008.....National Electrical Code (NEC)

F. Underwriters Laboratories, Inc. (UL):

6-2007.....Electrical Rigid Metal Conduit-Steel
467-2007.....Standard for Grounding and Bonding Equipment
651-2005.....Standard for Schedule 40 and 80 Rigid PVC
Conduit and Fittings

651A-2000.....Type EB and A Rigid PVC Conduit and HDPE
Conduit, (RTRC)

651B-2007.....Continuous Length HDPE Conduit

G. U.S. General Services Administration (GSA):

SS-S-210A-1981.....Sealing Compound, Preformed Plastic for
Expansion joints And Pipe Joints

PART 2 - PRODUCTS

2.2 DUCTS

A. Number and sizes shall be as shown on drawings.

C. Ducts (direct burial):

1. Plastic duct:

a. NEMA TC2 and TC3

b. UL 651, 651A and 651B, Schedule 40 PVC or HDPE.

c. Duct shall be suitable for use with 75 degree C rated conductors.

2. Rigid metal conduit, PVC-coated: UL6 and NEMA RN1 galvanized rigid steel, threaded type, coated with PVC sheath bonded to the galvanized exterior surface, nominal 1 mm (0.040 inch) thick.

2.3 GROUNDING

A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS and UL 467

B. Ground Wire: Stranded bare copper 16 mm² (4 AWG) minimum.

2.4 WARNING TAPE:

A. Standard 4-mil polyethylene 76 mm (3 inch) wide tape, non-detectable type, red with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW".

2.5 PULL ROPE:

A. Plastic with 890N (200 pound) minimum tensile strength.

PART 3 - EXECUTION

3.2 TRENCHING

A. Refer to Section 31 20 11 EARTH MOVING (SHORT FORM) for trenching back-filling, and compaction.

B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

C. Cut the trenches neatly and uniformly.

D. For Concrete Encased Ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1200 mm (4 foot) intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings wherever possible.
 3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
 4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, with appropriate warning tape attached.
- E. Conduits to be installed under existing paved areas, roads, and railroad tracks that are not to be disturbed shall be jacked into place. Conduits shall be PVC-coated rigid metal.

3.3 DUCT INSTALLATION

A. General Requirements:

1. Ducts shall be in accordance with the NEC and IEEE C2, as shown on the drawings, and as specified.
2. Slope ducts to drain and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) outside of building foundation.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) away from edge of slab.
5. Install insulated grounding bushings on the terminations.
6. Rigid steel conduits shall be coupled to the ducts with suitable adapters, and the whole encased with 75 mm (3 inches) of concrete.
7. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.

C. Direct Burial Duct and Conduits:

1. Install direct burial ducts and conduits only where shown on the drawings. Provide direct burial ducts only for low voltage systems.

2. Join and terminate ducts and conduits with fittings recommended by conduit manufacturer.
 3. Direct burial ducts and conduits are prohibited under railroad tracks.
 4. Tops of ducts and conduits 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.
 5. Do not kink the ducts or conduits.
- D. Duct and Conduit Cleaning:
1. Upon completion of the duct bank installation or installation of direct buried ducts, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 3600 mm (12 inches) long, and shall have a diameter not less than 13 mm (1/2 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.
 2. Mandrel pulls shall be witnessed by the COR.
- D. Duct and Conduit Sealing: Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of panelboards.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams accessories and weights of equipment. Complete nameplate data including manufacturer's name and catalog number.
- C. Certification: Two weeks prior to final inspection, submit four copies of the following to the COR:
 - 1. Certification that the material is in accordance with the drawings and specifications has been properly installed, and that the loads are balanced.

1.4 APPLICABLE PUBLICATIONS

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.

- A. National Electrical Manufacturers Association (NEMA):

PB-1-2006.....Panelboards

AB-1-2002.....Molded Case Circuit Breakers, Molded Case
Switches and Circuit Breaker Enclosures

B. National Fire Protection Association (NFPA):

70-2005National Electrical Code (NEC)

70E-2009.....Standard for Electrical Life Safety in the
Workplace

C. Underwriters Laboratories, Inc. (UL):

50-2007.....Enclosures for Electrical Equipment

67-2009.....Panel boards

489-2009.....Molded Case Circuit Breakers and Circuit
Breaker Enclosures

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.
- B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.
- C. All panelboards shall be hinged "door in door" type with:
 - 1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized ports.
 - 2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.
 - 3. Push inner and outer doors shall open left to right.
- D. All panelboards shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard cover. Panelboards shall have main breaker, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
- E. Panelboards shall conform to NEMA PB-1, NEMA AB-1 and UL 67 and have the following features:
 - 1. Nonreduced size copper bus bars, complete with current ratings as shown on the panel schedules connection straps bolted together and rigidly supported on molded insulators.

2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases; two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two-or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.
3. Mechanical lugs furnished with panelboards shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
4. Neutral bus shall be 100% rated, mounted on insulated supports.
5. Grounding bus bar equipped with screws or lugs for the connection of grounding wires.
6. Buses braced for the available short circuit current.
7. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
8. Protective devices shall be designed so that they can be easily replaced.
9. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.
10. Series rated panelboards are not permitted.

2.2 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panels shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.2 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

- ### **A. Breakers shall be UL 489 listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.**

- B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.
 - 1. Molded case circuit breakers in new panelboards shall have minimum interrupting rating as indicated on the drawings. Molded case circuit breakers installed in existing panelboards shall have minimum interrupting rating to match highest rated circuit breaker in existing panelboard.
 - 2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less.
- C. 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 ON, TRIPPED, and OFF positions.
 - a. Line connections shall be bolted.
 - b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the panelboard.
 - 8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
 - 9. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory in a neat and typewritten manner.

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. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.
- B. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved by the COR. Schedules, after approval,

shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.

- C. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished grade shall not exceed 1980 mm (78 inches).
- D. Directory-card information shall be typewritten to indicate outlets; lights, devices, and equipment controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.
- E. Provide ARC flash identification per NFPA 70E.

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SECTION 26 27 13
ELECTRIC METERING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of an electric metering system installed for electrical equipment such as the irrigation pumps.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage cable.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

- A. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include devices, locations, connections, conduit runs, wiring type, details, and attachments to other work.
 - 3. One line diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components.
- B. Manuals:
 - 1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.

- c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
 - d. Approvals will be based on complete submissions of manuals together with shop drawings.
- 2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the COR.
 - a. The manuals shall be updated to include any information necessitated by shop drawing approval.
 - b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
 - c. Show all terminal identification.
 - d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
 - e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.
- C. Certifications:
 - 1. Two weeks prior to final inspection, submit four copies of the following to the COR:
 - a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.
 - b. Certified copies of all factory design and production tests, and field test data sheets and reports for the assemblies.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - IEEE C2.....(2007; Errata 2007) National Electrical Safety Code
 - IEEE C37.90.1.....(2002; Errata 2003) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
 - IEEE C57.13.....(1993; R 2003) Standard Requirements for Instrument Transformers

IEEE Std 100.....(2000) The Authoritative Dictionary of IEEE
Standards Terms

C. National Electrical Manufacturers Association (NEMA):

NEMA C12.18.....(2006) Protocol Specification for ANSI Type 2
Optical Port

NEMA C12.20.....(2002) Electricity Meter - 0.2 and 0.5 Accuracy
Classes

D. National Fire Protection Association (NFPA):

70-2008.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

- A. Provide meter base for utility company meter. The metering equipment shall meter the new three phase, 480Y/277VAC electrical service used by the equipment shown on the drawings. Meter and meter base shall meet all of Dayton Power and Lighting Utility requirements.

2.2 ELECTRICAL SERVICE UTILITY POLE

- A. Provide utility pole for new electrical service for irrigation pumping system. Coordinate utility pole requirements with the utility company.
- B. Provide all required conduit, wiring, grounding, cross arms, insulators, and fused cutouts as required for new Dayton Power and Lighting electrical service as shown on drawings. Coordinate installation to meet Dayton Power and Lighting service requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Utility Meter shall be mounted on electrical service utility pole at location shown on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Visual and mechanical inspection:
1. Compare equipment nameplate data with specification and approved shop drawings.
 2. Inspect physical and mechanical condition.
 3. Verify grounding of metering enclosure.
 4. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter.
 5. Verify that correct multiplier has been placed on face or meter where applicable.
- B. Electrical tests:

1. Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate electrical information.

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SECTION 31 20 11
EARTH MOVING (SHORT FORM)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including topsoil stripping, excavation, fill, backfill, and grading. .

1.2 DEFINITIONS

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proof rolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to CO/COR's approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trench work throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the following test procedures:

1. For granular engineered fill or backfill: ASTM D 1557.
2. For cohesive (clayey) soils: ASTM D698.

D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements: Section 01 00 02, GENERAL REQUIREMENTS.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 02, GENERAL REQUIREMENTS.

1.4 CLASSIFICATION OF EXCAVATION

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed;

together with any type of materials regardless of character of material and obstructions encountered.

1.5 SUBMITTALS

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

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Nursery and Landscape Association (ANLA):
2004.....American Standard for Nursery Stock
- C. American Association of State Highway and Transportation Officials (AASHTO):
T99-01 (R2004).....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
T180-01 (2004).....Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (18 inch) Drop
- D. American Society for Testing and Materials (ASTM):
D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. Standard Specifications of Michigan Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill:
1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4).
 2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: See Section 02 41 10 DEMOLITION AND SITE CLEARING
- B. Grubbing: See Section 02 41 10 DEMOLITION AND SITE CLEARING

- C. Tree Protection: See Section 01 56 39: TEMPORARY TREE PROTECTION.
- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations will or have compacted or otherwise disturbed the existing grade or turf, for example in the contractor's storage and staging areas.
1. Strip topsoil as defined herein from within the limits of earthwork operations.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines when possible to prevent damage to root system.
 2. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses.
 3. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on Cemetery property. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading.
 4. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.
 5. 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 Erosion and Sedimentation Control drawings, details, and notes. 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 sock) and stabilized if undisturbed in accordance with the Erosion and Sedimentation Control drawings, details, and notes.
 6. Dispose of unsuitable or excess topsoil legally off site.
- E. Concrete Slabs and Paving: Where excavation or trenching occurs, score deeply or saw cut existing concrete slabs or paving to be removed to ensure a neat, straight cut. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Cemetery Property. Restore paving to original condition unless otherwise indicated.

- F. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by CO/COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by CO/COR.
- B. Excavation Drainage: Operate pumping equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from CO/COR. Approval by the CO/COR is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the CO/COR should be contacted to consider the use of flowable fill.
- C. Blasting: Blasting shall not be permitted.
- D. Trench Earthwork:
1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheet piling and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the CO/COR.

2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. The bottom quadrant of the pipe shall be bedded on undisturbed soil or granular fill.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
 - c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.
3. Irrigation system trenches - see 32 84 00 Planting Irrigation.
4. Water utilities - see 33 10 00 Water Utilities.
- E. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the soil testing laboratory as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the CO/COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on meters (yardage) in cut section only.
- F. Finished elevation of subgrade shall be as follows:
 1. Pavement Areas - bottom of the pavement or base course as applicable.
 2. Lawn Areas - 6 inches below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use suitable excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by CO/COR.
- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with engineered fill material compacted to 95% of the maximum dry density.
- C. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the CO/COR. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each layer to not less than 95 percent of the maximum density determined in accordance with the following test methods:
 - 1. For granular engineered fill or backfill: ASTM D 1557.
 - 2. For cohesive (clayey) soils: ASTM D698.

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 1800 mm (6 feet).

- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the CO/COR at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS

- A. General: General: Harrow and till to a depth of 6 inches, new or existing lawn areas to remain, which are disturbed during construction. Remove all temporary road materials and construction debris prior to tilling. Do not till lawn areas within tree drip lines or tree protection zones. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed.
- B. Place topsoil and perform finish grading in accordance with 32 90 00 PLANTING.
- C. Install sod in accordance with 32 90 00 PLANTING.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the CO/COR from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.6 CLEAN-UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of

Dayton National Cemetery
Irrigate Entire Cemetery

Project 810CM3026
Bid Set - June 8, 2015

debris, and suitable for subsequent construction operations. Remove
debris, rubbish, and excess material from the Cemetery Property.

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SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Pedestrian Pavement: flower/water stations, miscellaneous repairs
- C. Equipment Pads

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 11, EARTH MOVING-SHORT FORM.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Joint sealant: 07 92 00 JOINT SEALANTS

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.3 E., for Cold Weather Placement and Article 3.3 D., for Hot Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Joint sealant and backer rod
 - 3. Reinforcement
 - 4. Curing materials
- C. See 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE for additional submittal requirements.

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. Refer to the latest edition of all referenced Standards and codes.

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

M31-07.....Deformed and Plain Billet Steel Bars for
Concrete Reinforcement (ASTM A615/A615M-96A)
M55M/55M-09.....Welded Steel Wire Fabric for Concrete
Reinforcement (ASTM A185)
M147-04.....Materials for Aggregate and Soil-Aggregate
Subbase, Base and Surface Courses (R 1996)
M148-05.....Liquid Membrane-Forming Compounds for Curing
Concrete (ASTM C309A)
M171-05.....Sheet Materials for Curing Concrete (ASTM C171)
M182-05.....Burlap Cloth Made from Jute or Kenaf
M233 Boiled Linseed Oil Mixture for Treatment of
Portland Cement Concrete.

M213-05.....Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction
(Non-extruding and Resilient Bituminous Type)
(ASTM D1751)
T99-09.....Moisture-Density Relations of Soils Using a 2.5
kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
T180-09.....Moisture-Density Relations of Soils Using a 4.54
kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

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

C94/C94M-09.....Ready-Mixed Concrete
C143/C143M-08.....Slump of Hydraulic Cement Concrete
C1116/C1116M-08.....Fiber Reinforced Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be 4,000 psi air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following requirements:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")

Pedestrian Pavement & Mow Strip	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Max slump 4" as determined by ASTM C143. Tolerances as established by ASTM C94.	

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 AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

2.3 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum .

2.5 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

2.6 CONCRETE PROTECTION MATERIAL

Linseed Oil mixture shall conform to AASHTO M233.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 11, EARTH MOVING-SHORT FORM.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SETTING FORMS

- A. Base Support:
 - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 - 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
 - 1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
 - 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
 - 3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
 - 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 - 5. Clean and oil forms each time they are used.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 02, GENERAL REQUIREMENTS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.
 - 1. Make necessary corrections to forms immediately before placing concrete.
 - 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.3 EQUIPMENT

- A. The CO/COR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.4 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the CO/COR shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.5 PLACING CONCRETE - GENERAL

- A. Obtain approval of the CO/COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the CO/COR before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.6 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENTS, AND EQUIPMENT PADS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.

- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.7 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes/areas without approval by the CO/COR.

3.8 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.9 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks and mow strip:
 - 1. Finish the surfaces to grade and cross section with a metal float, troweled smooth and finished with a broom moistened with clear water.
 - 2. Brooming shall be transverse to the line of traffic.
 - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
 - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
 - 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the

- pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.10 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.
- D. Correct irregularities exceeding the above.

3.11 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.12 CONTRACTION/CONTROL JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown. Joints may be sawed after tooling to achieve the proper depth. Sawing shall be performed prior to initial shrinkage of concrete. Ravelling at edges of joints due to sawing is unacceptable.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.13 EXPANSION/ ISOLATION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.

- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 - 2. Using joint filler of the type, thickness, and width as shown.
 - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.14 CONSTRUCTION JOINTS

- A. Place construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- B. Use a butt-type joint with dowels in if the joint occurs at the location of a planned control joint.
- C. Tool edges of construction joint to look the same as control joints.

3.15 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the CO/COR. The finished concrete shall be of a uniform color and texture. Curing method shall not cause mottling or staining in the finished concrete surface.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray

of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.

D. Liquid Membrane Curing:

1. Apply membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.
5. Curing compound shall be compatible with concrete finish and shall not create mottled or uneven color or texture in the finished work.

3.17 CLEANING

A. After completion of the curing period:

1. Remove the curing material (other than liquid membrane).
2. Sweep the concrete clean.
3. After removal of all foreign matter from the joints, seal joints as herein specified.
4. Protective Coating - apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against the items constructed under this section to protect the concrete against the action of deicing materials.
5. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the CO/COR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the CO/COR.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

Dayton National Cemetery
Irrigate Entire Cemetery

Project 810CM3026
Bid Set - June 8, 2015

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SECTION 32 30 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Furnish and install the Flower-watering stations, including trash receptacles, water spigot, and flower vase container and complete any required work necessary to make the water supply equipment operate using the water supply source indicated.

2. Flag Sleeves

1.3 RELATED WORK

A. The following items are not included in this Section and will be performed under the designated Sections:

1. Section 033053: CAST-IN-PLACE-CONCRETE (SHORT FORM)

1.4 SUBMITTALS

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

1. General: For each item specified in description of work or Part 2 - Products, provide information 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. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.

2. Provide templates and rough-in measurements as required.

3. Provide samples of full range of colors and finishes available for review and approval, prior to ordering.

1.5 REFERENCE STANDARDS

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.

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

B221-08Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes

B. American Welding Society (AWS):

D1.2-97..... Structural Welding Code Aluminum

C. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.2 FLOWER WATERING STATIONS: GENERAL

- A. Flower watering station materials, finishes and colors shall match existing and fully comply with the specifications and Contract Drawings or be deemed as approved equal.

2.3 TRASH RECEPTACLE

- A. Trash receptacles shall match existing and completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the existing product is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the existing product, they must be identified in the submittal. If the differences result in a product that is deemed less than the existing, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted with a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

B. MATERIALS

1. Main body construction shall be 9.53mm x 25.4mm (3/8" x 1") vertical solid steel bar; 6.35mm x 63.5mm (1/4" x 2-1/2") horizontal solid steel bands; 9.53mm x 76.2mm (3/8" x 3") steel support bars; 15.88mm (5/8") solid steel top ring; leveling feet with a 9.53mm (3/8") diameter threaded steel shaft. All trash receptacles shall be signed to read "TRASH" as indicated on the details in the Contract Drawings. Sign material, finish, color, font and font size shall be as shown on the Contract Drawings. Mounting of signs shall be as shown on approved Shop Drawings. All joints of steel components shall be fully welded and ground smooth throughout.
2. Unit shall contain one 136 liter (36-gallon) capacity high density plastic inner liner with its weight not to exceed 2.72 kg (6 lbs.). The unit manufacturer shall provide the black plastic inner liners

which shall be molded on tooling designed for and owned by the unit manufacturer. The inner liner shall offer maximum capacity and strength with lightweight construction using critical molded ribs, integral handholds, and high strength materials. This style of inner liner shall minimize handling difficulty and facilitate easy emptying and storage while affording long service life.

C. REQUIRED OPTIONS

1. Lids: Units shall be shipped with manufacturer's standard tapered formed lid with formed dome and with self-closing door. The lids shall be made of the manufacturer's standard high strength plastic material designed to match the selected manufacturer's standard color. Each lid shall be provided with a stainless steel aircraft cable and attachments to secure the lid to the unit.
2. Color shall match existing Victor Stanley Standard Bronze (verify).
3. Mounting plate: Standard (1) anchor bolt hole.

D. FINISHES

1. All fabricated metal components are steel shotblasted, etched, phosphatized, preheated, and electrostatically powder-coated with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are then fully cured to coating manufacturer's specifications.
The thickness of the resulting finish averages 8-10 mils (200-250 microns).

2.4 FLOWER VASE RECEPTACLE

- A. Flower vase receptacles shall match existing and completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the existing product is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the existing product, they must be identified in the submittal. If the differences result in a product that is deemed less than the existing, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted for consideration as part of a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

B. MATERIALS:

1. Flower vase receptacles shall match existing. Flower vase receptacles shall be of the size indicated on the Contract Drawings, and shall be of the same construction, finish and indicated Victor Stanley color as the trash receptacles, with the following exceptions:
2. All flower vase receptacles shall be signed to read "FLOWER VASES" as indicated on the details in the Contract Drawings.
3. The "Floral Regulations" decal shall be as indicated on the Contract Drawings and be factory applied to the top of the receptacle lid. Decal shall be pressure sensitive vinyl designed for outdoor use. The content of the decal, lettering color and background color of decal shall be as approved during the shop drawing process. The materials for the decal shall be regularly used by the manufacturer for flower vase receptacles at VA National Cemeteries.

2.5 WATER SPIGOT ASSEMBLIES

- A. Water spigots shall match existing with the approved Victor Stanley color coating, or be approved equal. Water spigot fountain shall be from a manufacturer with at least 5 years of experience producing similar products. The water spigot fountain assembly shall operate with an inlet water pressure of 275 kPa (40 psi) and shall include a pressure regulator installed on the supply line to the spigot prior to the connection to the spigot as well as an isolation valve, both of which shall be installed in a valve box as indicated on the drawings. The spigot shall be of cast aluminum with a long lasting paint coating system, applied to a sand blasted aluminum, with a primer coat and finish coat that matches the Victor Stanley Bronze paint system color. The water spigot shall operate with a handle, be self-closing, and operate with 2 Kg (5 lbs). of force or less when the water pressure to the spigot is provided at 275 kPa (40 psi) or less. The spigot shall be designed as an anti-freezing jug filler. The outlet for the spigot shall be plain end, with no threads (preferred configuration) or shall include a vacuum breaker on the outlet if the end is threaded. The spigot shall have a top access that allows replacement of the anti-freezing mechanism from the top of the cast aluminum body following removal of the access cover. The final approved configuration, including the mounting method, shall be as approved during the submittal process.

2.8 FLAG SLEEVES

- A. For existing facilities, furnish flag sleeves at the locations and following the details in the Contract Drawings, which are modified from the existing flag sleeves.
- B. Flag sleeves shall be furnished and installed as indicated and shall support the flag pole style selected for this facility as determined by the Operations staff.
- C. Flag sleeve locations shall be marked along the adjoining roadway, by painting a dot on the edge of the pavement perpendicular to the road centerline at the flag sleeve location. The flag sleeve locations shall be also be located on the "Record Drawings" for the project and shall be annotated using swing tie measurements from prominent features, at approximate 90 degree angles.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. 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.

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by COR. Verify that all elements in this section "fit" within location provided.
- B. Install items rigid, plumb and true to lines and levels shown.
- C. Assemble (if required) and install items as per manufacturer's printed instructions, or approved shop drawings, unless otherwise specified or shown.

3.3 INSTALLATION

- B. Flower Watering Stations:
 - 1. Stake location of flower watering stations and obtain approval from Owner's Representative prior to forming concrete pad. Install concrete pad in accordance with 033053 - CAST-IN-PLACE CONCRETE (Short Form) and 32 05 23 Cement and Concrete for Exterior Improvements.

2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions. Following installation of water spigot, install washed stone for splash area.
3. Install water spigot assemblies according to manufacturer's recommendations, including pipe, isolation valve, fittings, pressure reducing valve, and valve boxes. All anchoring hardware shall be stainless steel. Coordinate all work with other trades.

C. Flag Sleeves:

1. Install flag sleeves as indicated on the Contract Drawings at the locations indicated. Install the flag sleeves so the flag poles set in them are plumb and insure that the top of the sleeves are set at the correct elevation, based upon finished grade, so as to not interfere with the mowing operations.

3.4 CLEAN UP

- A. Clean up area of excess material and debris. Clean above ground portions of all receptacles and other site improvements.

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SECTION 32 82 00
IRRIGATION PUMP STATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is to provide a complete and working booster pumping station. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete manufacturing and installation of the pump station, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

1. Procurement of all applicable licenses, permits, and fees as required by local utilities and regulations.
2. Coordination of Utility Locates ("Call Before You Dig").
3. Services of a factory field service person to supervise the assembly, installation, and start-up of the pumping system, and the training of maintenance staff.
4. Furnishing and installing a prefabricated skid mounted VFD controlled booster pump station including electrical controls and all other items as specified.
5. Furnishing and installing a vault to house the pump system including lid, hatch, ventilation fan and all other items as specified.
6. Maintenance period.

1.2 RELATED WORK

- A. Division 26 Electrical
- B. Section 32 84 00 PLANTING IRRIGATION

1.3 BIDDER QUALIFICATIONS

- A. Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) pre-fabricated pumping systems having similar or larger flows.

- 1.4** Equipment manufacturer must regularly and presently manufacture the item as one of their principal products. **DISCREPANCIES:** It is the intent of these plans and specification that the irrigation pump station be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Contracting Officer Representative for clarification.

1.5 SUBMITTALS

- A. Make submittal and provide number of copies per Specification Section 013323. Unless otherwise noted, provide four (4) copies of pumping system information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for bidder qualifications, pipe, valves, fittings, pump and motor, control system components, vault, hatch, ventilation fan, ladder, sump pump, float switch shop drawings, and all other equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Confirm component meets Made in America criteria for VA projects. Submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review
- B. Materials List: Include pipe, valve, fittings, pump and motor, control system components, and electrical equipment. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, performance curves for pump, specifications, and operating instructions for equipment shown on the materials list. Submit complete instructions for installation, operation, and recommended maintenance of the pump station. Installation instructions must include pump station manufacturer's recommended mounting and anchoring details.
- D. Maintenance Manual: Submit Bound maintenance manual that includes all manufacturers' data listed above and recommended operating procedures and preventive maintenance procedures. Include guide for troubleshooting operation problems with the pump station and complete documentation for programming, recommended settings and adjustments.
- E. Shop Drawings:
1. Submit shop drawings of proposed pump station. Show products required for proper installation, their relative locations, and

critical dimensions. Submit technical data sheets, electrical schematics, sequence of operation, and UL listing authorization form. Note modifications to the installation drawings.

2. The construction documents show the representative layout, elevation view, and critical dimensions for the pump station and enclosure. Pump station manufacturer is responsible for layout and design of the pump station supplied, and any special coordination issues that affect the critical dimensions, layout, or orientation of the pump station. Installation shop drawing must include pump station manufacturer's recommended mounting and anchoring details.
3. Provide shop drawings for the vault. Submit shop drawing as required in the specifications. Show products required for proper installation, their relative locations and critical dimensions. Submit technical sheets, electrical schematics, and UL listing authorization form. Note modifications to the installation detail.

F. Factory Testing:

1. Pump station must be completely wired, piped, hydraulically, electrically and flow tested to full station capacity at factory prior to shipment to job site.
2. Submit a proof of testing report including name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. Document all tests were passed.
3. Testing report must be verified by Contracting Officer Representative prior to pump control panel shipment.

G. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.

H. Record Drawings: Submit information listed in Part 3 of these specifications.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
 1. B16.5: Pipe Flanges and Flanged Fittings
 2. B58.1: Turbine Pump
- C. American Society for Testing and Materials (ASTM):
 1. A48: Standard Specification for Gray Iron Castings

2. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A105: Standard Specification for Carbon Steel Forging for Pipe Applications
4. A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
5. A234: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- C. International Organization for Standardization (ISO):
 1. 9001: Requirements for a Quality Management System
- D. National Electrical Manufacturers Association (NEMA):
 1. NEMA 4: Indoor or Outdoor Enclosures with Protection Against Wind Blown Dust and Rain, Splashing Water, Hose Directed Water, and Undamaged by the Formation of Ice on the Enclosure.
 2. MG-1-12: Motors and Generators
- E. Underwriters Laboratories Inc. (UL):
 1. File #E142155: Industrial Control Panels
- F. National Electric Code: (latest edition 2011)
- G. Uniform Plumbing Code: (latest edition)

1.7 RULES AND REGULATIONS

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. All electrical control panels with controls shall be built in accordance to N.E.C., U.L. and E.T.L. standards. The electrical components and enclosure shall be labeled as a complete U.L. listed assembly with manufacturer's U.L. label applied to the door. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.
- D. Provide single source responsibility for the manufacture, warranty, service, operation, and installation of the fully automatic variable speed pumping system as described in contract documents. Pumping system must conform to the following specifications in all respects. This

specification covers the minimum requirements; however, it should not be construed as all inclusive.

1.8 TESTING

- A. Notify the Contracting Officer Representative five working days in advance of on-site testing.
- B. Bump manual motor starter controls to prove correct rotation and secure local inspection/approval.
- C. On completion of assembly of the pumping station, pump shall be hydrostatically tested at maximum pump shutoff head and at design flow rate.
- D. Test, verify, and demonstrate to the Contracting Officer Representative the proper operation of all control and safety shut off devices.
- E. Verify flow and discharge pressure from the pump station and demonstrate, to the Contracting Officer Representative, system performance based on the specified values.
- F. Central Computer Test: Verify flow sensor is reporting to the irrigation central control computer.
- G. Acceptance Test Prior to Final Inspection:
 - 1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
 - 2. Coordinate start of Acceptance Test with Contracting Officer Representative.
 - 3. During the Acceptance Test, the pumping system must be fully operational. The pumping system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 72 hours of notification from Contracting Officer Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
 - 4. When the system has operated for 14 days without fault, contact the Contracting Officer Representative to schedule Final Inspection.

1.9 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer Representative is to observe the Contractor's interpretation of the construction documents and to address questions with regards to the pump installation.

1. Scheduled reviews such as those for testing should be scheduled with the Contracting Officer Representative as required by these specifications.
2. Impromptu reviews may occur at any time during the project.
3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.10 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives materials of prime quality, installed and maintained in a thorough and careful manner.
- B. The manufacturer shall warrant the pumping system to be free of defects and product malfunctions for a period of five years from date of Final Inspection including the 14 day test period by Contracting Officer Representative.
- C. The programmable controller shall be unconditionally warranted for 5 years from the date of shipment. The pumping system manufacturer shall be responsible for all warranties. Pass through warranties are not acceptable.
- D. Failures caused by lightning strikes, power surges, vandalism, flooding, operator abuse, or acts of God are excluded from warranty coverage.
- E. Repair damage to the premises caused by a defective item. Make repairs within 72 hours of notification from the Contracting Officer Representative.
- F. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- G. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.11 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate installation of pumping system with Contracting Officer Representative and Cemetery Staff. See pumping system installation details for required coordination efforts.
- B. All training to be documented and coordinated with cemetery staff. Contractor to provide service provider contact information to cemetery staff for pump station and control system.
- C. Control of Excavations: See Section 3.2 for safety and access directions. Construction cannot proceed until the layout of the pumping system is reviewed and accepted by the Contracting Officer Representative.

PART 2 - MATERIALS

2.1 QUALITY

- A. Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

2.2 SUBSTITUTIONS

- A. Make complete submittals of all manufacturers' data showing compliance with the Contract Documents.
- B. In making a request for a substitution to the Contracting Officer Representative, the Contractor represents that he:
 - 1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Contracting Officer Representative.
 - 2. Will coordinate the installation and make all modifications to the work, which are required for the complete installation and operation of the system.
- C. The Contracting Officer Representative will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.
- D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

2.3 GENERAL REQUIREMENTS

- A. Provide a prefabricated skid-mounted booster pumping system with VFD controls with the capacity and discharge pressure downstream of all pump station components as shown in the construction documents. Provide variable frequency drive (VFD) motor controls with regenerative type drive.

- B. Pump station must be completely piped, wired, hydraulically and electrically tested before shipment to the job site.
- C. Construction must include skid assembly to support all components during shipping and to serve as the installed mounting base. Base must be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of pump and motor. Skip welding is not acceptable during fabrication of the skid.
- D. All components of the pump controls shall be designed to function in an outdoor environment exposed to all of the elements.
- E. Furnish protective and insulated enclosure as required.
- F. Construction shall include all necessary field fabrication of pipe, fittings, and supports.
- G. Pump station must meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner, and shall be delivered within the negotiated schedule.
- H. Provide a factory-trained technician to supervise the installation of the pump station control panel and filtration assembly.
- I. All pump station control components shall be supplied by and be the responsibility of one manufacturer, even though others manufactured some components.
- J. Control panel must interface with irrigation central control system as described in the drawings.
- K. Provide all necessary hardware, wiring, panels, interfaces, and software for complete and fully operational system.
- L. Acceptable Manufacturers are:
 - 1. RAIN BIRD CORPORATION (520.741.6185)
 - 2. FLOWTRONEX (800-786-7480)
 - 3. MOTOR CONTROLS INC. (972-247-4440)
 - 4. WATERTRONICS (800.356.6686, 262.367.5000)
 - 5. PRECISION PUMPING SYSTEMS (208.323.5300)
 - 6. Or approved equal.

2.4 PUMP

- A. Use an electric motor driven pump; either close coupled horizontal centrifugal or vertical multi-stage with mechanical shaft seal, volute case and impeller. The shaft shall be a self adjusting mechanical type.
- B. The pump and motor are to be constructed so that the motor and entire rotating element can be removed from the casing without disturbing the piping.

- C. All pump flanging shall have 150 psi rating. The pump casing shall be constructed from cast or ductile iron and engineered to modern hydraulic standards. The impeller shall be an enclosed, single piece bronze casting, completely machined on all outside surfaces, and dynamically balanced at time of pump assembly. The impeller shall be keyed to the shaft and securely fastened.
- D. Bearings shall be of the roller or ball type of sufficient size to withstand the radial and axial thrust loads incurred during service.
- E. Shaft shall be stress-proof steel accurately machined and polished and of sufficient size to transmit full driver output. Complete documentation of shaft deflection and B-10 bearing life analysis shall be included by the pump manufacture with submittals. Shafts shall be protected by a renewable shaft sleeve. The coupling shall be designed to transmit full horsepower and torque load, with an OSHA approved coupling guard.

2.5 MOTOR

- A. Pump motor shall be squirrel cage induction horizontal solid shaft type. Pump impeller must be direct mounted and keyed to the motor shaft with a stainless steel protective sleeve. The temperature rise of the motor shall be to NEMA Standard MG-1-12.42 for class B or Class F insulation.
- B. Furnish premium efficiency motor designed and rated for continuous variable speed inverter duty.
- C. Radial and thrust bearings of ample capacity to accommodate the hydraulic thrust of the pump shall be incorporated into the motor. The motor shall be of proper size to drive the pump at any point on its operation curve without exceeding motor horsepower nameplate rating.
- D. Motor must be compatible with VFD controls.
- E. Motor must be manufactured by U.S. Motor or approved equal.

2.6 PIPING

- A. Fabricated Piping: All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. Piping 16" and smaller shall be Schedule 40. All welding flanges shall be forged steel with slip-on or welding neck type. All welding fittings shall be seamless, conforming to ASTM Specification A234, with pressure rating not less than 150 PSI. All pressurized tube fittings shall be copper or brass.

- B. Intake and Discharge Piping: Furnish intake and discharge piping for booster pump station constructed and fabricated from Schedule 40 carbon steel pipe and equipped with isolation valves. Piping must be painted per manufacturer's specific color or as specified by the Contracting Officer Representative.

2.7 VALVES

- A. Drain Valves: Drains are to be provided from any possible low point in the system and are to consist of 1/4" brass angle valves unless otherwise noted. Drain piping is to be furnished so that no drain water runs out on top of the deck plate. They include, but are not limited to, the following:
 - 1. Drain in pump discharge manifold between pump check valves and control valve.
 - 2. Drain in the bottom of each pump volute.
 - 3. A washdown 3/4" brass hose bib shall be provided downstream of the control valve, upstream of the main station isolation valve.
- B. Check Valves: Use center pivot dual disc non-slam type, cast iron bodied with bronze and stainless steel trim. Sealing surfaces shall utilize resilient Buna N rubber.
- C. Isolation Valves: Use butterfly type with the position lever or gear hand wheels and rated at 200 psi WOG working pressure. Trim shall include stainless steel stem, bronze streamlined disc, and full faced resilient seat. Install on each pump inlet and outlet.

2.8 SENSORS

- A. Pressure Gauge: Provide 3½-inch diameter, all welded construction, constructed of stainless steel, glycerin filled, with ANSI Class B accuracy gauges. Range to be at least 30% higher than highest pressure attainable from the pumps at shutoff head conditions. Install ball valves to provide total isolation of all pressure gauges.
- B. Pressure Transducer: Use for all pressure signals for the control logic. Provide solid-state bonded strain gage type with an accuracy of plus/minus 0.25%, constructed of 316L stainless steel, rated for pressures greater than station discharge pressure and which will provide gage pressure output rather than absolute pressure.

- C. Magnetic Flowmeter: Provide magnetic type flow sensor with microprocessor based signal converter capable of multiple pulse outputs.

2.9 ELECTRICAL

- A. Electrical Supply: Power supply to the station is three phase, 480 volt, 60 hertz.
- B. General: Electrical panels are to be mounted above grade separate from the pump station. Provide UL Listed control panel that provides all the necessary control to efficiently control the pumping system. Required components include but are not limited to main disconnect, surge protection, lightning arrestor, phase monitor, fuses/blocks, variable speed drive, fuse protection, dual mechanically and electrically interlocked contactors, solid state overloads, door devices, individual pump lighted HOA switches, display/touch screen and programmable logic controller.
- C. Enclosures:
1. Use NEMA 4 with powder coat finish.
 2. Assemble all electrical starter and control panels from components that are U.L. listed and each completed panel must be U.L. listed as an Industrial Control Panel.
 3. Furnish heat exchanger for closed loop cooling of the enclosure.
 4. Provide corrosion inhibiting modules.
- D. Variable Speed Drive:
1. Provide complete instrumentation and controls to automatically start, stop and modulate pump speed(s) to smoothly, efficiently and reliably pump variable flow rates at a constant discharge pressure. Provide full alarms and safety features needed to protect the equipment and irrigation piping system.
 2. Provide a digital, pulse width modulation (PWM) variable frequency drive (VFD) using current IGBT inverter technology.
 3. Supply a VFD for each pump motor.
 4. Provide a regenerative type drive capable of converting the single phase power source to three phase.
 5. Display the following operating information: KWH, elapsed time, Output frequency (Hz), motor speed (RPM), motor current (amps), and voltage.
 6. Acceptable manufacturers are ABB, Eaton, Fuji or approved equal.

E. Programmable Logic Controls:

1. Provide an industrial grade programmable logic controller (PLC) to handle all system controls. PLC must have built-in Ethernet and USB port(s). Acceptable manufacturers are Honeywell, Mitsubishi, Siemens or approved equal.
2. PLC must be capable of providing output to communication cable path to Central Computer for monitoring software.
3. PLC must be capable of providing the following control, alarms and/or shutdowns:
 - a. Automatic alternation of main motors to equalize run time
 - b. Automatic pressure ramp-up capability
 - c. Electrical overload shutdown safety
 - d. VFD fault shutdown
 - e. Automatic system diagnostic utility
 - f. High pressure and low pressure discharge safeties
 - g. PLC or VFD emergency bypass - manual mode
 - h. Main power line phase/volt monitoring
 - i. Individual motor overload/thermal protection safeties
 - j. Single phase and three phase surge protection safeties
 - k. Remote control and monitoring software

F. Display:

- a. Provide color touch screen display mounted on the control panel door. Device must allow operator to view and selectively modify PLC. Minimum size 8.4-inches. Display to be alphanumeric backlite keypad with ethernet port and be capable of ethernet communication.

G. Skid Wiring:

1. Install all wiring from control panels to motor in liquid-tight conduit with copper conductors rated not less than 600 volts AC and of proper size to carry the full load amperage of the motor without exceeding 70% capacity of the conductor. A grounding cable shall be included in the liquid-tight conduit. There shall be no splices between the motor starters and the motor connection boxes.
2. Wiring to flow sensors and pressure transducer shall be multi-conductor shielded cable suitable for Class 11 low voltage controls.

H. Grounding:

1. Furnish grounding equipment required by pump station manufacturer to adequately protect the pump station control panel and pump and motor.
2. Coordinate grounding of pump station control panel with electrical plans.

I. Standards:

1. All wiring shall conform to the National Electrical Code. Flexible conduit sections shall be less than 5 feet in length. All conduit to devices shall be attached securely to avoid trip hazards.
2. Manufacturer shall provide a wiring schematic. The schematic shall show all devices, connections and wire numbers.
3. All controls and electrical equipment shall be thoroughly inspected and tested before shipment.

2.10 REMOTE MONITORING AND CONTROL SOFTWARE

- A. Furnish pump station manufacturer's system monitoring software. Install on a central computer as designated by the Contracting Officers Technical Representative.
- B. Pump station monitoring software must be capable of displaying the same information available on the control panel display.
- C. Communication between the pump station control panel and the central computer with the monitoring software shall be via hardwire.

2.11 PAINTING

- A. Painting of the pumping system shall consist of a multi-step coating system which includes metal preparation, rust inhibitive prime coat, and a two part polyurethane finish having a total dry film thickness of not less than 4 mils or approved equal powder coating process
- B. Pump station components shall be painted the manufacturer's standard color. All electrical enclosures and accessory panels shall be painted to a minimum thickness of 3 mils.
- C. Provide a 1-quart can of the finish paint with the system for job site touch up use.

2.12 VAULT

A. Pre-Cast Concrete Vault:

1. Provide shop drawings showing complete information for the fabrication and installation of a pre-cast concrete vault. Include special reinforcement and lifting devices for handling and installation.

2. Provide layout dimensions including blockouts, joints, accessories and openings.
 3. Manufacturer is responsible for design of reinforcement and its placement. Fabricate units with concrete having minimum compressive strength of 4,000 PSI at 28 days using Type I-II cement. Furnish test reports of concrete indicating compressive strength. Certify that the concrete vault will support the required design load.
 4. Fabricate vault in conformance with ASTM C-478 for manufacturing, testing, and quality control.
 5. Furnish vault with concrete finish equal to smooth steel formed as-cast concrete. Small surface holes caused by air bubbles, normal form joint marks, minor cracking, chips and spalls and normal color variations will be permitted.
 6. Furnish shop drawings with Registered Professional Engineers seal.
 7. Provide electrical schematic showing wiring to all components that require power.
- B. Hatch: Furnish hatch as shown on the drawings or installation details to be part of the vault. Minimum size of hatch is as shown on drawings. Approved manufacturer is Bilco or approved equal.
- C. Ladder: Furnish access ladder as shown on the drawings or installation details. Approved manufacturer is Bilco or approved equal.
- D. Ventilation Fan: Furnish fan and vent piping as shown on the drawings or installation details. Approved manufacturer is Dayton or approved equal.
- E. Sump Pump: Furnish sump pump and piping as shown on the drawings or installation details.
- F. Float Switch: Furnish float switch and relay to disconnect power to all components in the vault except the sump pump. Furnish float switch as shown on the drawings and installation details.
- G. Penetration Seal: Use a modular seal to permanently seal all penetrations into the vault. Use Link Seal or approved equal.

2.13 OTHER COMPONENTS

- A. Other Materials: Provide other materials or equipment shown on the drawings or installation details to be part of the pumping system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

3.2 EXCAVATION AND BACKFILLING

- A. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer Representative.

3.3 SHIPPING AND OFF-LOADING

- A. Contractor must furnish and coordinate shipping and off-loading of pump station. Location and mounting detail shall be furnished to the Contractor by the pump station manufacturer.

3.4 PUMP STATION INSTALLATION

- A. Align pump station piping with inlet and discharge pipe prior to finalizing fabrication.
- B. Anchor filter assembly to concrete mounting pad and complete all piping connections prior to technical start-up, testing and operation.
- C. Electrical control panels are to be mounted above grade, separate from the pumping system. Electrical connection to pumping system control panel shall consist of a single conduit from 3 phase 460 volt disconnect to the pump station main disconnect. Electrical connections from control panel(s) to electrical components in vault shall be individual electrical connections.

3.5 TECHNICAL START-UP

- A. Pump station manufacturer must conduct technical start-up of the pump station. Procedures should include:
1. Station start-up and pressurization.
 2. Pressure, flow, automatic shut-down and programming adjustments
 3. Monitoring each day for 14 days during the 14 day test. Keep a log of all records/faults and turn over to COR after final completion of the 14 day test.

3.6 VAULT

- A. Coordinate exact location of vault with COR prior to installation.
- B. Coordinate exact location of other components in the vault.
- C. Lift, place and secure vault in accordance with manufacturer's instructions and approved shop drawing.
- D. Other Components: Install all other components in vault in accordance with manufacturer's instructions and approved shop drawing.

3.7 INSTALLATION OF OTHER COMPONENTS

- A. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pumping system, even though such items may not have been referenced in these specifications.

3.8 MAINTENANCE AND OPERATION INSTRUCTIONS

- A. Pumping System Maintenance:
 - 1. Prior to Final Inspection, coordinate and provide two 4-hour training sessions to operating personnel on proper operation and maintenance of the pumping system. Training sessions must be for a period of not less than 4-hours each, scheduled on two different days and cover aspects of winterizing, maintaining, operating, trouble shooting and repairing the pumping system.
 - 2. Submit per Section 1.5. Include table of contents and index sheet. Provide sections that are indexed and labeled for the following information:
 - a. Catalog cut sheets for pumping system.
 - b. Manufacturer's Operation and Maintenance manuals including complete documentation for programming and recommended settings and adjustments.
 - c. Manufacturer's Technical Service Bulletins.
 - d. Manufacturer's Warranty Documentation.
 - e. Manufacturer's guide for troubleshooting operational problems.
 - f. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections, recommended method for recording the findings of the inspections and winterization.
 - g. Predictive schedule for component replacement.
 - h. Listing of technical support contacts.
 - 3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.

3.9 PROJECT RECORD DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record pumping system alterations. Record work, which is installed differently than shown on the construction drawings. Record accurate reference dimensions.
- C. Prior to project completion label each sheet of the project drawings (redlines) as "Record Drawing" and turn over to Contracting Officer Representative for delivery to Engineer. Completion of the Record Drawings is a prerequisite for Final Inspection.

3.10 MAINTENANCE

- A. Operate and maintain pumping system for a duration of 30 calendar days from Final Acceptance. Make periodic examinations and adjustments to pumping system components as necessary so as to achieve the most desirable operation.

3.11 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Clean all surfaces and touch up scratches on pumping system or piping with factory paint to match original.

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SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:
1. Procurement of all applicable licenses, permits, and payment of required fees.
 2. Coordination of Utility Locates public and private ("Call Before You Dig").
 3. Maintenance period.
 4. Sleeving for irrigation pipe and wire.
 5. Booster pump station.

1.2 RELATED WORK

- A. Section 01 56 39 TEMPORARY TREE PROTECTION
B. Section 26 ELECTRICAL
C. Section 32 82 00 IRRIGATION PUMP STATION
D. Section 32 90 00 PLANTING

1.3 QUALITY ASSURANCE

- A. Contractor:
1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed PVC pipe (3-inch and larger); centralized control systems; electrically operated remote control valves; large radius rotary sprinklers (minimum 1-inch inlet with swing joint) and pre-fabricated booster pump stations.
 2. Contractor and project superintendent must be certified by control system manufacturer as a certified contractor for installation of control system wiring and grounding systems. Provide documentation from control system manufacturer regarding certification.

3. Key personnel employed by the contractor must provide proof of Irrigation Association Certified Irrigation Contractor.
4. Provide documentation of contractor qualifications with equipment submittals.

B. Equipment Manufacturer:

1. Manufacturer regularly and presently manufactures the item as one of their principal products.

C. System Requirements:

1. Full and complete coverage is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

- A. Make submittal and provide number of copies per Specification Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, and control system components and control system communication including radio test if radio is the communication option used. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Equipment submitted must conform to the Buy American Act. Provide manufacturing location of items submitted.
- E. Construction Equipment: Submit a complete list of the equipment to be used for construction. Submit manufacturers' catalog cuts and/or

specifications for trenchers and vibratory plows to demonstrate that the equipment will fit in the aisles where the piping is being installed.

- F. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.
- G. Testing:
1. Document the occurrence of all tests on the Daily Report. Indicate which test was conducted and whether or not it was successful.
 2. Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- H. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- I. Colored Irrigation Controller Charts: Submit information listed in Part 3 of these specifications.
- J. Record Drawings: Submit information listed in Part 3 of these specifications.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole
- C. American National Standard Institute (ANSI):
- B40.1-91.....Gauges-Pressure Indicating Dial Type Elastic Element
- D. American Society of Agricultural Engineers (ASAE):
- S398Sprinkler Testing and Performance Reporting.
- E. American Society for Testing and Materials (ASTM):
- B61-93.....Steam or Valve Bronze Castings
- B62-93.....Composition Bronze or Ounce Metal Castings
- D1785-91.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

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- D2241-89.....Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
- D2287-81.....Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- D2464-91.....Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2466-90.....Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2564-94.....Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings
- D2855-96.....Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D3350.....Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- F714.....Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F477-90.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F2164.....Field Leak Testing of Polyethylene Pressure Piping Systems
- B209-96.....Aluminum and Aluminum-Alloy Sheet and Plate
- F. American Water Works Association (AWWA):
- C110-93.....Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids
- C111-90.....Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
- C115-94.....Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges
- C151-93.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
- C153-94.....Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.
- C500-93.....Gate Valves for Water and Sewerage Systems
- C504-87.....Rubber Sealed Butterfly Valves

C600-93.....Installation for Ductile-Iron water Mains and Their Appurtenances

C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service

G. Irrigation Association (IA): Technical Resources, Irrigation Best Practices & Standards

H. Manufacturers Standardization Society (MSS):

SP70-90.....Cast Iron gate Valves, Flanged and Thread Ends

I. National Electrical Manufacturers Association (NEMA):

250-85 Enclosures for Electrical Equipment (1000 Volts Maximum);
Revision 1, May 1986

J. National Electric Code: (latest edition 2011)

K. Uniform Plumbing Code: (latest edition)

1.6 RULES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.7 DEMOLITION

- A. Remove/salvage existing irrigation components as indicated on the drawings. Remove items in a manner that minimizes damage to components. Deliver only salvageable components to Cemetery. Properly dispose of other removed items.
- B. Abandon existing irrigation pipe in place. If existing pipe is encountered during installation of new irrigation pipe, cut and remove two (2) feet of existing irrigation pipe on either side of the new irrigation pipe. Properly dispose of removed pipe.
- C. Reuse existing control wiring as indicated on drawings. Cut existing control wiring at remote control valves and permanently label end of

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wire with existing station number. Protect existing control wiring during construction of new irrigation system.

1.8 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies. After the contractor has installed the new point of connection, water will be available for flushing and testing of the new irrigation system. The contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer Representative, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.9 TESTING

- A. Notify the Contracting Officer Representative five working days in advance of testing.
- B. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Contracting Officer Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test - Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.
 - 3. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
 - 4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
 - 5. Testing pump must provide a continuous 140-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.

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6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
 7. Subject mainline pipe to the anticipated operating pressure of 100 PSI for two hours. Maintain constant pressure. The amount of additional water pumped in during the test will not exceed:
 - a. 0.41 gallons per 100 joints of 3-inch diameter pipe
 - b. 0.54 gallons per 100 joints of 4-inch diameter pipe
 - c. 0.81 gallons per 100 joints of 6-inch diameter pipe
 - d. 1.08 gallons per 100 joints of 8-inch diameter pipe
 - e. 1.35 gallons per 100 joints of 10-inch diameter pipe
 8. Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$
Where: L = Allowable Leakage (gph)
 N = Number of Joints
 D = Nominal Diameter of Pipe (inches)
 P = Average Test Pressure (psi)
 9. Replace defective pipe, fitting, joint, valve, or appurtenance.
Repeat the test until the pipe passes test.
 10. Cement or caulking to seal leaks is prohibited.
 11. Contractor may sub-contract testing to pipeline testing company approved by Contracting Officer Representative .
- F. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:
1. Subject pipe to a hydrostatic pressure equal to the anticipated operating pressure of 90 PSI for 30 minutes.
 2. Cap all sprinkler risers.
 3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 5. As an alternative to the visual inspection described in Item 4. above, the Contracting Officer Representative may request that a pressure drop test be performed:
 - a. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.
 - b. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.

- c. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
 6. Cement or caulking to seal leaks is prohibited.
 7. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
- G. Booster Pump:
1. On completion of installation of the pumping station, all discharge pipe and valves shall be hydrostatically tested at maximum pump shutoff head.
- H. Operational Test -Remote Control Valves, Lateral Piping and Sprinklers:
1. Activate each remote control valve in sequence from each controller using the remote control valve. Manual operation of the valves is not an acceptable method of activation. The Contracting Officer Representative will visually observe operation, water application patterns, and leakage.
 2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
 3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
 4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
 5. Repeat test(s) until each lateral pass all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Contracting Officer Representative .
- I. Distribution Uniformity (DU):
1. Irrigation Audits
 - a Performed by an Irrigation Association Certified Landscape Irrigation Auditor.
 - b Complete an irrigation audit, to include 10 "representative" irrigation zones/test areas.
 - c Identify the 10 areas to be tested based on cemetery site conditions in consultation with the cemetery foreman and/or irrigation personnel, irrigation auditor, NCA National Irrigation Specialist and COR.

- d Test Area Selection Criteria:
 - (1) Proximity to water source
 - a) Minimum one audit close to the source
 - b) Minimum one audit near farthest point of irrigation system from source.
 - (2) Elevation
 - a) Minimum one audit near the highest point on the site.
 - b) Minimum one audit near the lowest point on the site.
- 2. Sprinkler Characteristics
 - a. Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site;
 - b. Minimum of one audit in an area with good sprinkler coverage based on the quality of turf;
 - c. Minimum of one audit in an area with poor sprinkler coverage based on the quality of turf.
- 4. Final determination of the areas to be tested will be based on the recommendation of the Contractor and their understanding of the purpose and goals of performing these irrigation audits with final approval by the NCA National Irrigation Specialist. Submit a map indicating the locations of the zones to be tested.
- 5. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.
 - a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.
 - 1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.
 - 2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
 - 3) If a site is being audited that consistently has winds above 10 mph, then the Contractor and National Irrigation Specialist will determine the best course of action to proceed as to the effect of the wind on the audits.

6. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.
 - a. Supply all data in a digital (MS Excel format) as well as paper report format to NCA via VA COR.
 - b. Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
 - c. Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.
7. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the irrigation system is to be audited in its current condition. However, pressure is to be checked at the pressure regulating device on each valve tested by using a Schrader valve compatible connection and liquid filled pressure gauge. If there is no pressure regulating valve, the closest sprinkler to the RCV will be checked using a pitot tube and liquid filled pressure gauge.
8. Based on the area being audited, the Contractor shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
9. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
 - a. Number of catch cans used
 - b. Size of the area tested
 - c. Number of sprinklers tested
 - d. Site conditions
 - 1) Spacing shall be consistent and in a square pattern throughout each testing area.
10. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
11. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.

12. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
 - a. Rotor type sprinklers - a minimum of 10 minute run time and a maximum of a 30 minute run time;
 - b. Spray type sprinklers (pop ups) - a minimum of 5 minute run times and a maximum of 10 minute run times;
 - c. Rotary/stream type sprinklers - a minimum of 20 minute run time and a maximum of 60 minute run time.
13. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
14. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
 - a. Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
 - b. No flow meter information provided
 - c. Reason - no flow meter present on site
 - d. Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
15. On a copy of the irrigation plan accurately (within 1-foot) show the following:
 - a. All sprinklers and associated valves for each test area;
 - 1) Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
 - 2) All catch cans (numbered per the worksheets) and associated data collected.
16. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location audited along with associated worksheets filled out as specified above.
17. If any conclusions can be drawn based on the area tested, distribution uniformity or precipitation rate, they should be

explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.

18. Submit Entire audit report to COR within 10 working days of the completed field work.

J. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each controller pedestal door and via a written report. Documentation should include satellite name or number, date of test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the Contracting Officer Representative.

K. Acceptance Test Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
2. Coordinate start of Acceptance Test with Contracting Officer Representative.
3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from Contracting Officer Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.

4. If the fault is found to be due to factors outside of the contractor's control (for example, mainline pipe break in area not being renovated) the evaluation period will continue. The time required to make the repair shall not be included in the evaluation period.
5. When the system has operated for 14 days without fault, contact the Contracting Officer Representative to schedule Final Inspection. Substantial completion consideration is only given after the 14 day test has been accepted.

1.10 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
 1. Schedule reviews for irrigation system layout or testing with the Contracting Officer Representative as required by these specifications.
 2. Impromptu reviews may occur at any time during the project.
 3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
 4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.11 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
- B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from the date of acceptance by Contracting Officer Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the

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premises caused by construction or a defective item. Make repairs within 24 hours of notification from Contracting Officer Representative.

- C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Contracting Officer Representative. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.
- B. Install irrigation components in landscaped areas only.
- C. Construction cannot proceed unless staking of irrigation mainline, isolation gate valve locations, quick coupling valve locations, remote control valve locations, sprinkler, and controller locations are reviewed and accepted by the Contracting Officer Representative.
- D. Protection of Existing Monumentation and Gravesites:
 - 1. Contractor is responsible for staking location of piping in burial sections. Contractor and Contracting Officer Representative to document condition of existing monumentation prior to construction in each burial section.
 - 2. Protect existing monumentation using plywood or tarps erected between the trench and monumentation during construction. Use ½" plywood set vertically between monuments and construction equipment to protect upright monuments. Use ¾" plywood laid flat on the ground over flat monumentation. Install protection prior to demolition or construction and remove immediately after construction. Maintain access to the public at all times except as approved by the Contracting Officer Representative.
 - 3. Damage to monuments or other cemetery property is defined as:
 - a. Broken, chipped, cracked, scraped, scratched, stained or any other physical damage.
 - b. Monument moved out of its original location or position, tilted or displaced.
 - 4. Upon completion of construction in each burial section, Contractor and Contracting Officer Representative to verify condition of monumentation.

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5. If existing monumentation has been disturbed or damaged during construction, Contractor must correct, repair or pay for the replacement of monumentation before finishing construction in the affected burial section.

PART 2 - PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Contracting Officer Representative must approve equipment prior to construction. The Contractor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes and pressure ratings referenced in the construction documents are a minimum and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeve beneath hardscape for irrigation pipe and wiring. Provide separate sleeve beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.
- D. Size sleeves are as shown on the drawings. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

- A. Mainline Pipe and Fittings:
 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
 2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.

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3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer. Acceptable manufacturer for ductile iron fittings is Harco or approved equal.
4. Provide joint restraint harness at valves, changes of direction and as recommended by the manufacturer. For joint restraints on PVC pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536-80 and ASTM F1674-96.
5. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length. Acceptable manufacturer for casing spacers is Ford Meter Box Company or approved equal.
6. HDPE Mainline:
 - a. Use HDPE pipe where directional boring is required to install mainline pipe.
 - b. Use high density, extra high molecular weight polyethylene pipe (HDPE), extruded from material meeting the specifications of cell classification of PE 345434C, ASTM standard D 3350, SDR 9, rated at 200 PSI conforming to the dimensions and tolerances established by ASTM F 714 for mainline pipe.
 - c. Join pipe lengths using butt-fusion technique as recommended by pipe manufacturer.
 - d. Use flanged fittings to connect HDPE to PVC pipe.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters not manufactured in Class 160.

3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
2. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 MAINLINE COMPONENTS

A. Backflow Preventer/Booster Pump Assembly:

1. General:
 - a. As presented in the installation details.
 - b. Provide a prefabricated system complete with backflow preventer, booster pump, piping, valves, electrical controls and all components shown in the installation detail.
 - c. Construction must include skid assembly to support all components during shipping and to serve as the installed mounting base.
 - d. Assembly must be designed, fabricated and installed in a workmanlike manner.
 - e. All components of the assembly must be designed to function in an outdoor environment exposed to all of the elements.
 - f. Provide a factory-trained technician to supervise the installation of assembly.
 - g. Assembly must be supplied by and be the responsibility of one manufacturer, even though others manufactured some components.
 - h. Assembly must be completely piped, wired, hydraulically and electrically tested on structural steel skid before shipment to the job site.
2. Backflow Preventer: Use a reduced pressure principal backflow prevention device, ductile iron valve body with fusion epoxy coating, bronze relief valve and trim, stainless steel springs, OS&Y and NRS shut-offs and rated for maximum 175 PSI working

pressure. Valve setter to be compatible with backflow preventer. Acceptable manufacturer and model is Febco LF-880V or approved equal.

3. Booster Pump:

- a. Provide a prefabricated skid-mounted pumping station as described in Section 32 82 00 that automatically maintains a constant discharge pressure regardless of varying flow demands within the station rating. Pumping station must have the capacity and station discharge pressure downstream of all pump system components using the number of equally sized main pumps as shown on the drawings. Provide variable frequency drive (VFD) motor controls.

B. Winterization Assembly:

1. As presented in the installation details.
2. Ball Valve: Use threaded carbon steel ball valve.
3. Valve Box: Use plastic (ABS) jumbo valve box with black lid and extension. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Master Valve Assembly:

1. As presented in the installation details.
2. Single chamber ductile iron valve with one-piece disc and diaphragm assembly. Valve should have only one moving part allowing it to open, close as commanded by the solenoid valve. Use 152 ANSI flanged valve rated to 250 PSI. 316 Stainless steel trim. Buna-N diaphragm. Stainless steel stem, nut and spring. Solenoid valve must be capable of closing the master valve if and when a high flow condition is identified by the central control system. Acceptable manufacturers are Watts, Wilkins or approved equal.
3. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.

D. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI

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minimum working pressure and mechanical joint ends meeting AWWA Standard C509. Acceptable manufacturers are NIBCO, Clow, Kennedy, Mueller or approved equal.

3. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

E. Air-Vacuum Relief Valve Assembly:

1. As presented in the installation details.
2. Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 2 PSI to 230 PSI. Use a continuous acting combination air and vacuum and air release valve. Acceptable manufacturer is Bermad, Crispin, Fresno, Waterman or approved equal.
3. Bronze Ball Valve: Use a valve rated to 235 PSI. Acceptable manufacturer is Nibco or approved equal.
4. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
5. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

F. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking vinyl cover. Acceptable manufacturer and model is Hunter HQ-5LRC, Rain Bird 5-LRC, Toro 474-44 or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco or approved equal.
4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor or swing joint integrated anchor. Acceptable manufacturers are Harco, Lasco, Spears, or approved equal.
5. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.

6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

G. Pressure Regulating Valve Assembly:

1. As presented in the installation details.
2. Single chamber ductile iron valve with one-piece disc and diaphragm assembly. Valve should have only one moving part allowing it to open, close and modulate as commanded by the pilot control system. Use 152 ANSI flanged valve rated to 250 PSI. 316 Stainless steel trim. Buna-N diaphragm. Stainless steel stem, nut and spring. Pilot control system must be capable of modulating to a constant pressure regardless of varying flow rates. Acceptable manufacturers are Watts, Wilkins or approved equal.
3. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.

H. Flower Water Hydrant:

1. As presented in the installation details.
2. Hydrant: Use Murdock M-175VA to match and be compatible with the existing equipment. Use an ADA compliant, self draining hydrant.
3. Curb Stop Valve: Brass body, 300 PSI minimum working pressure. ASTM B-62, female threaded connections with stop and waste feature. Acceptable manufacturers are Ford, Mueller, A.Y. McDonald or approved equal.
4. Pressure Regulator: Use an adjustable, bronze body pressure regulator with integral stainless steel strainer. Spring range 10-125 PSI, 1-inch inlet and outlet. Acceptable manufacturers and models are Apollo Series 36, Watts Model 223, Wilkins Model 600 or approved equal.
5. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.
6. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
7. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. As presented in the installation details.
2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm will be of nylon reinforced nitrile rubber. The valve will have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed will prevent flooding of the valve box. The valve will house a fully encapsulated, one-piece solenoid. The solenoid will have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. Use 24 VAC 50/60 Hz solenoid that is compatible with a low voltage control wire control system. Valve must have a flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve must open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve will have a self-cleaning stainless steel screen designed for use in dirty water applications. Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. Valve must have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture and model is Rain Bird PESB to match and be compatible with existing.
3. Shut-off Valve: Use an angle valve AWWA C135 rated, ductile iron epoxy coated with stainless steel valve mechanism and restraint system. Acceptable manufacturers are Leemco LV212/218 and Harco swivel 90 lateral isolation valve.
4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
5. Valve Box: Use plastic (ABS) large valve box with black lid or combination of standard and round valve boxes with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.

6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
7. Install assembly over gravel sump as presented in the installation details.
8. Wire connectors: Use 3M DBR/Y-6.
9. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

B. Pop-Up Rotor Sprinkler Assembly:

1. As presented in the installation details.
2. Rotary Sprinkler: Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish part circle sprinklers with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Nozzle must be tested per ASAE S398.1 and be verified to deliver Distribution Uniformity of 80% or more and a Scheduling Coefficient of 1.2 or less at the specified offset spacing. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10 feet of elevation. Minimum pop-up height is 3 ½-inches. Acceptable manufacturer and model is Rain Bird 8005 to match and be compatible with existing.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Rain Bird, Spears, Lasco or approved equal.

C. Pop-Up Spray Sprinkler Assembly:

1. As presented in the installation details.
2. Spray Sprinkler: Use a spray sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish sprinkler with pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Rain Bird 1800-SAM-PRS to match and be compatible with existing.
3. Swing Joint: Use pre-manufactured triple swing joint with ½-inch inlet. Acceptable manufacturer is Rain Bird, Spears, Lasco or approved equal.

2.7 CONTROL SYSTEM COMPONENTS

A. Central Control System:

1. Description: Irrigation control system consisting of central control computer and field satellite controllers. Provide, install and test control system complete with desk top computer, software, printer, peripherals, interface components, power conditioner communication hardware and software. Provide 1 year of phone and troubleshooting support. Acceptable manufacturers and models are Rain Bird IQ, Rain Master Oasis, Toro Sentinel or approved equal.
2. Software: Provide to the Contracting Officer Representative a software license-to-use document specifying terms and conditions of the license-to-use including the training, support, and update provisions noted herein. Provide latest version of available at time of construction, along with a 5-year technical support and software upgrade plan.
3. Basic Capabilities: Minimum capabilities to include:
 - a. Ability to display drawings and maps
 - b. Remotely perform all satellite controller keystroke operations from the central computer
 - c. Hard wire communication between the central controller and field satellite controllers. Radio communication will be allowed as an option provided the contractor can prove the radio communication will not add cost after the bid has been accepted. Flow management to include hydraulic model of irrigation system with definitions of water source and pipe network and a flow analysis and optimization to show flow during operation and modeled operation.
 - d. Capable of sensing flow and activating the master valve when a high flow condition has been identified.
 - e. Global percent scaling or water budgeting of all stations.
 - f. Ability to repeat water application cycles with a soak time between each application.
 - g. Automatic chronological event log.
 - h. Weather station compatible to report evapotranspiration data from an on-site weather station

- i. Compatible with the provided handheld radio system that allows remote operation of the system through the central control system.
 - j. Does not require a FCC license for communication
 - k. Compatible with and capable of receiving sensor feedback from the booster pump station including flow.
 - l. Future software updates at no cost for a minimum of five years.
 - m. On-site service and repair for two years.
- 4. Handheld radio system: Provide three (3) handheld remote radios each with a charging unit compatible with the Central Control System. System must allow for wireless communication to control the irrigation system via a radio. Use radios that do not require a FCC license to operate.
 - 5. Training: Provide four training sessions, for up to three user personnel, conducted by the control system manufacturer's training personnel, on-site using the project's central control system, including handheld radio, at a place and time to be determined. Each training session should be for a period of not less than 4-hour each and scheduled on different days. The Contractor must help schedule and coordinate the training session. Training must include an overview of system operations and functions, troubleshooting techniques, user maintenance as well as detailed one-on-one training for selected individuals.
 - 6. Technical Manuals: Provide three (3) copies of all user technical manuals.
 - 7. Support: The control system manufacturer is to provide phone-in support to the Contracting Officer Representative at no cost for a period of 1 year within the initial purchase price of the system.

B. Satellite Control Units:

- 1. Description: Field control units, pedestal mounted, communicating with specified central control system and controlling remote control valves. Acceptable manufacturer and model are Rain Bird ESP, Rain Master Evolution, Toro Sentinel or approved equal.
- 2. Basic Capabilities:
 - a. 100% solid state electrical components with heavy duty, additional, surge protection for input and output circuits.

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- b. Large capacity terminal block.
 - c. 24 VAC transformer capable of operating nine solenoids simultaneously.
 - d. Surge protection backed by 3-year lightning warranty.
 - e. Battery backup of at least 14 days.
 - f. Remote activation of each station from hand held radio.
 - g. Minimum number of stations as shown on the drawings.
 - h. AG 2401 surge/lightning protection on power side
 - i. Maximum surge protection by manufacturer on station side
 - j. Stainless steel enclosure
 - k. Compatible with a master valve and flow sensor
- 3. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
 - 4. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
 - 5. Lightning protection: Provide one 12"x36"x0.0625" ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, two 6-inch plastic round valve boxes, and one CADWELD connector at each satellite or satellite controller group.

C. Power Wire:

- 1. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type TC Round Jacketed multi conductor cable with ground, direct burial, UL listed, rated at 600 volts. Power wires shall be black, white, and green in color. Contractor is responsible for ensuring the power wire sizes are compatible and adequate for the control system being used.
- 2. Splices: Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for wye splices.
- 3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried

installations. Use rigid metallic conduit with sweep elbows for above grade installations.

4. Warning tape to be installed above all power wire and communication cable, use non-detectable marking tape 4.0 mil thickness, linear low-density polyethylene, specifically formulated for extended use underground. The legend shall continually repeat a minimum of every three feet. The tape tensile strength shall be in accordance with ASTM D882 and not be less than 4100 MD and 3650 TD. Elongation properties shall be in accordance with ASTM D882 and be greater than 550% at break point. Tape flexibility shall be in accordance with ASTM D671 and shall remain pliable. Tape composition shall be of virgin LLDPE/LDPE. The tape color shall be red. The legend shall read "Caution Electric Line Buried Below". The tape width shall be 3-inch. Manufacturer T. Christy Enterprises, or approved equal.

D. Controller Wire:

1. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
2. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of active control wire. Wire color shall be continuous over its entire length.
3. Splices: Use 3M DBR/Y-6 splices as recommended by control system manufacturer.
4. Valve Box: Use plastic (ABS) standard rectangular valve with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
5. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

E. Instrumentation:

1. Weather Station:

- a. Use a station that is compatible with specified control system and which can be used for daily irrigation scheduling adjustments.
- b. Weather station is to be automatically interrogated at interval set by Contracting Officer Representative , and reports of local reference evapotranspiration (ET_o) rates and rainfall are to be determined and reported. ET_o rate calculation is based on ASCE standardized equation.
- c. Ability to terminate irrigation events at user preset wind velocity thresholds,
- d. Ability to terminate irrigation events when temperature drops below user preset threshold.
- e. Ability to terminate irrigation events during or immediately after rainfall events
- f. System interrogation is to occur from the same microcomputer used for centralized irrigation control system. Communication to weather station is to be per manufacturer's requirements or approved alternative.
- g. Lightning protection: Provide one 12"x36"x0.0625" ground plate, earth contact enhancement material, one 5/8"x10 foot copper clad UL listed grounding rod, approximately 20 feet of #6 AWG bare copper grounding wire, 6-inch plastic round valve boxes and CADWELD connectors at weather station.

2.8 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

B. Utility Locates ("Call Before You Dig"):

1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Contracting Officer Representative one week in advance of review. The Contracting Officer Representative will identify modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of sprinklers in existing burial sections. Use alleys as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer Representative.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Existing Survey Markers:
 1. Protect markers during construction.
 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.

- C. Existing Monumentation and Gravesites: At no time shall soil be allowed to pile on or around the existing gravesites and monumentation. Use a tarp when excavation trenches in burial sections. Trenches in burial sections may not be open longer than 24 hours. Backfill material spoils must be removed immediately and not allowed to remain in burial sections after backfill is complete. Sod to be installed over all trenches within 4 days of trench backfill.
- D. Excavation Equipment - All equipment used for trenching, pipe pulling and directional boring must be equipped with turf tires.
- E. Installation Methodology:
1. Mainline:
 - a. Open trench to install PVC mainline pipe.
 - b. Direct bore to install HDPE mainline pipe.
 - c. Mainline pipe has been routed to avoid conflicts with existing trees. Do not install mainline pipe within drip line of any existing tree. Immediately contact Contracting Officer Representative if a conflict between mainline pipe routing and an existing field condition is identified.
 2. Lateral Pipe in Existing Burial Sections:
 - a. Install lateral pipe between existing monumentation as presented in the installation details.
 - b. Use a vibratory plow device specifically manufactured for pipe pulling to install lateral pipe. Maintain minimum burial depth. Roll trench after pulling pipe.
 - c. Use directional boring techniques to install lateral pipe at selected locations indicated on the drawings. Maintain minimum burial depth.
 - d. Pothole prior to installation to identify potential conflicts with burial vaults. Complete four (4) potholes per lateral at locations where there are no sprinklers. Pothole at each end of the lateral and at two (2) locations equidistant from each end of the lateral.
 - e. Do not install mainline pipe within drip line of any existing tree. Immediately contact Contracting Officer Representative if a conflict between mainline pipe routing and an existing field condition is identified.

3. Lateral Pipe in Non Burial Areas:

- a. Use a vibratory plow to install lateral pipe. Maintain minimum burial depth. Roll trench after pulling pipe.
- b. Use directional boring techniques at selected locations indicated on the drawings.

F. Minimum cover:

1. 36-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
2. 12-inches over irrigation lateral pipe to sprinklers in existing burial sections.
3. 18-inches over irrigation lateral pipe to sprinklers in non burial areas. (distance from top of pipe to finish grade)
4. 24-inches over low voltage control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
5. 6-inches vertical separation between mainline pipe and lateral pipe installed in a common trench.
6. 4-inch minimum horizontal separation between pipes and wiring in a common trench.
7. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.

G. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer Representative.

H. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.

I. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the Contracting Officer Representative.

J. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

K. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:

1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- L. Backfill mainline, lateral pipe and wiring in turf areas in the following manner:
 1. Backfill the trench and directional boring excavations by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.
- M. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves where it is not installed using horizontal boring techniques.
- N. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer Representative.
- O. Resod all trenches and areas disturbed by construction of the irrigation system. See installation details installation procedure description.
- P. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer Representative for trench depth adjustments.

3.4 SLEEVING AND BORING

- A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe are a minimum of twice the diameter of the pipe.
- D. Directional boring slurry to be disposed of legally off site by the contractor.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral

pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"
6"	150'	1'-4"
8"	200'	1'-0"
10"	250'	9"

B. Mainline Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:

- a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Ductile iron fittings will not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.

2. HDPE Pipe:

- a. Join pipe lengths using butt-fusion technique as recommended by pipe manufacturer.

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- b. Join HDPE pipe to PVC pipe using HDPE (butt-fusion) x adapter with ductile iron back-up ring. Provide transition fitting as required for connection to PVC pipe or mainline valving.

3. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.

2. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.

2. PVC Threaded Connections:

- a. Use only factory-formed threads. Field-cut threads are not permitted.
- b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
- c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

E. Joint Restraint Harness:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Backflow Preventer/Booster Pump Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Connect to irrigation mainline piping.

B. Winterization Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "WA" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Master Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "MV" in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Isolation Gate Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "GV" in 2-inch high by 3/16-inch deep letters on valve box lid.

E. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

F. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

G. Pressure Regulation Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "PRV" in 2-inch high by 3/16-inch deep letters on valve box lid.

H. Flower Water Station:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Mainline Pipe Flushing:

1. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
2. Identify service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
3. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations or erode site.
4. Use a volume of water such that the velocity in the largest pipe flushing to this point is a minimum of 3 FPS.
5. Multiple points may be flushed simultaneously.
6. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
7. Contracting Officer Representative will review the flushing operation and clarity of water before stopping the flushing operation.
8. Disconnect pipe from service tee(s) and install remote control valve(s) or valve-in-head sprinkler(s).

B. Remote Control Valve Assembly:

1. Install per manufacturer's recommendations where indicated on the drawings.
2. Adjust valve to regulate the downstream operating pressure to 70PSI for pop-up rotary sprinklers and 35 PSI for spray sprinklers.

3. Wire connectors and waterproof sealant will be used to connect low voltage control wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
4. Install only one remote control valve to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas. Group valve boxes together where possible equidistant from the adjacent valve boxes.
5. Attach ID tag with controller station number to control wiring at solenoid.
6. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Pop-Up Rotor Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install rotary sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 2-foot square piece of sod around all rotary sprinklers in areas to be seeded.

D. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install spray sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.

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5. Install swing pipe and fittings per manufacturer's recommendations.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Central Control System:

1. The location of the central control computer and weather station as depicted or described on the drawings is approximate; the Contracting Officer Representative will determine the exact location during sprinkler layout review.
2. Install and test central control components including microcomputer, printer, computer peripherals, interface components, communication cabling, electrical connections, and other communication hardware per manufacturer's recommendations and the Acceptance Test.
3. Electrical connections to the central control system are to be completed by control system manufacturer's trained representative.

B. Satellite Control Unit:

1. Install satellite control unit(s) at location(s) shown in the construction documents.
2. Install electrical connections per control system manufacturer's recommendations. Electrical connections are to be completed by control system manufacturer's trained representative.
3. Lightning protection: Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections.
4. Attach wire markers to the ends of low voltage control wire cable inside controller. Label cable with the identification number per irrigation plan.
5. Install permanent receiver for hand held radio if not factory installed.
6. Create and program each new control unit with a "grow-in" and a peak season irrigation program.
7. Provide 8 hours of training for cemetery staff with manufacturer's qualified representative.

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C. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box. Brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 2-inches below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer Representative.
8. Connect wire to power source.

D. Control Wire:

1. Route low voltage control cable in mainline trench.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box or valve-in-head sprinkler.
3. If a cable must be spliced, make splice with waterproof connectors and sealant installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
4. Unless noted on plans, install wire parallel with and below mainline pipe.

5. Protect wire not installed with pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

E. Instrumentation:

1. Install per manufacturer's recommendations at location indicated on drawings.
2. Provide electrical connections between central control system hardware and weather station under direction and observation of central control system manufacturer's personnel.

3.9 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide two 8-hour training sessions to operating personnel on proper operation and maintenance of the irrigation and pump system. Training sessions must be for a period of not less than 8-hours each, scheduled on different days and cover aspects of maintaining, operating and repairing the new irrigation system components. Maintenance training session cannot be concurrent with central control system training sessions. Provide an additional 8-hours of prepaid training for the next two years as part of the software support.
2. Submit per Section 1.4. Include table of contents and index sheet. Provide sections that are indexed and labeled for the following information:
 - a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - b. Manufacturer's Operation and Maintenance manuals.
 - c. Manufacturer's Technical Service Bulletins.
 - d. Manufacturer's Warranty Documentation.

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- e. Recommended routine maintenance inspections for weekly, monthly and annual inspections, recommended actions for the inspections, recommended method for recording the findings of the inspections and proper winterization techniques.
 - f. Predictive schedule for component replacement.
 - g. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.

B. Control System Programming:

- 1. Create and program controller with a grow-in and a peak season irrigation schedule for the areas being irrigated by the controller.
- 2. Using the precipitation rate results of the Distribution Uniformity tests calculate the peak season run time for each station.
- 3. Verify operation of program.
- 4. Prepare a memorandum documenting the details and assumptions of the programming. Turn over memorandum to Contracting Officer Representative. Completion of the memorandum is a prerequisite for final inspection and operational testing of the irrigation system. Peak season station run times based on the design are contained in Table 1 attached at end of these specifications.

C. Colored Controller Charts:

- 1. Prepare a map diagram showing location of all valves, piping, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared. Map diagram can be constructed using AutoCAD or PDF computer software. Adjacent lateral pipes to be of different color, use four different colors for lateral pipe.
- 2. Include legend listing components used for the controller. Include a separate sprinkler table listing station number, sprinkler manufacturer and model, zone capacity, and number of sprinklers on the zone.
- 3. Provide one colored full sized controller chart for each irrigation plan sheet showing the area covered by the controller.

Provide four 11"x17" reduced colored charts of the actual "as-built" drawing. Chart must be readable at the reduced size.

4. Laminate one 11"x17" sized colored chart and place laminated chart in lid of each controller.

3.11 PROJECT RECORD DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, two complete sets of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded on Project Documents.
- B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Special attention must be given to pipe routing and controller stationing.
- C. At completion of installation, Contractor must hire a Professional Licensed Surveyor to survey/document locations of all sprinklers, irrigation components enclosed within a valve box, controllers, flower water stations, wire splice boxes and "coordination points". If necessary, Contractor must flag sprinklers for Surveyor. Surveyor must use "SPR" as attribute data for sprinklers, the branding in the valve box lid (for example "GV", "AV", "QC") as the attribute data for components enclosed within a valve box, "CTLR" as the attribute data for controllers, "FWS" for flower water station, "WS" for wire splice boxes and "CP" for coordination points. Contracting Officer Representative will provide AutoCAD file for Surveyor showing coordination points to produce "Survey Drawing". Surveyor is to use the AutoCAD files to develop and provide an AutoCAD file and PDF file of the Survey Drawing.
- D. Prior to project completion, Contractor must provide the project redline drawings and the "Survey Drawing" AutoCAD files to Contracting Officer Representative for delivery to VA's A/E representative. A/E will prepare "Record Drawings" by compiling the information on the Contractor redlines drawings and the "Survey Drawing". Provision of this information prerequisite for Final Inspection.
- E. Prior to project completion provide 1 30" X 42" laminated drawing of the entire system for wall mount, drawing need not be to scale.

3.12 MAINTENANCE

- A. Operate and maintain irrigation system for a duration of 30 calendar days from Final acceptance. Make periodic examinations and adjustments

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to irrigation system components so as to achieve the most desirable application of water.

3.13 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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Table 1 – Peak Season Station Run Times

Station	Plant Type	Applied Depth (in.)	Flow (gpm)	Area (Sq. Ft.)	Pr (In./h)	Run Time (minutes)
`1-01	-	0.24	86	8850	0.935311	15
`1-02	-	0.24	69	6850	0.969526	15
`1-03	-	0.24	86	7758	1.066963	13
`1-04	-	0.24	69	7300	0.90976	16
`1-05	-	0.24	18	1800	0.9625	15
`1-06	-	0.24	107	5000	2.05975	7
`1-07	-	0.24	61	7500	0.782833	18
`1-08	-	0.24	31	7500	0.397833	36
`1-09	-	0.24	46	7500	0.590333	24
`1-10	-	0.24	77	7500	0.988167	15
`1-11	-	0.24	77	7500	0.988167	15
`1-12	-	0.24	77	7500	0.988167	15
`1-13	-	0.24	77	7500	0.988167	15
`1-14	-	0.24	92	3500	2.53	6
`1-15	-	0.24	88	3500	2.42	6
`1-16	-	0.24	77	4000	1.852813	8
`1-17	-	0.24	110	18000	0.588194	24
`1-18	-	0.24	88	4000	2.1175	7
`1-19	-	0.24	110	5000	2.1175	7
`1-20	-	0.24	110	5000	2.1175	7
`1-21	-	0.24	110	6000	1.764583	8
`1-22	-	0.24	110	12000	0.882292	16
`1-23	-	0.24	77	4000	1.852813	8
`1-24	-	0.24	88	8000	1.05875	14
`1-25	-	0.24	37	2000	1.780625	8
`1-26	-	0.24	77	12700	0.583563	25
`1-27	-	0.24	77	12700	0.583563	25
`1-28	-	0.24	110	12700	0.833661	17
`1-29	-	0.24	77	12700	0.583563	25
`1-30	-	0.24	77	12700	0.583563	25
`1-31	-	0.24	46	4000	1.106875	13
`1-32	-	0.24	77	6000	1.235208	12
`1-33	-	0.24	110	12000	0.882292	16
`1-34	-	0.24	88	7700	1.1	13
`1-35	-	0.24	88	14000	0.605	24
`1-36	-	0.24	88	7000	1.21	12

PLANTING IRRIGATION

Dayton National Cemetery
Irrigate Entire Cemetery

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`1-37	-	0.24	110	6000	1.764583	8
`1-38	-	0.24	88	12000	0.705833	20
`1-39	-	0.24	66	9000	0.705833	20
`2-01	-	0.24	110	7500	1.411667	10
`2-02	-	0.24	84	14000	0.5775	25
`2-03	-	0.24	103	15000	0.660917	22
`2-04	-	0.24	125	18000	0.668403	22
`2-05	-	0.24	81	12000	0.649688	22
`2-06	-	0.24	59	12000	0.473229	30
`2-06	-	0.24	59	12000	0.473229	30
`2-07	-	0.24	81	12000	0.649688	22
`2-08	-	0.24	81	12000	0.649688	22
`2-08	-	0.24	81	12000	0.649688	22
`2-09	-	0.24	81	12000	0.649688	22
`2-10	-	0.24	81	12000	0.649688	22
`2-10	-	0.24	81	12000	0.649688	22
`2-11	-	0.24	81	12000	0.649688	22
`2-12	-	0.24	81	12000	0.649688	22
`2-13	-	0.24	66	9500	0.668684	22
`2-14	-	0.24	81	12000	0.649688	22
`2-15	-	0.24	66	9500	0.668684	22
`2-16	-	0.24	66	9500	0.668684	22
`2-17	-	0.24	66	9500	0.668684	22
`2-18	-	0.24	66	9500	0.668684	22
`2-19	-	0.24	66	9500	0.668684	22
`2-20	-	0.24	66	9500	0.668684	22
`2-21	-	0.24	66	9500	0.668684	22
`2-22	-	0.24	66	9500	0.668684	22
`2-23	-	0.24	66	9500	0.668684	22
`2-24	-	0.24	66	9500	0.668684	22
`2-25	-	0.24	66	9500	0.668684	22
`2-26	-	0.24	88	12000	0.705833	20
`2-27	-	0.24	66	9500	0.668684	22
`2-28	-	0.24	88	12000	0.705833	20
`2-28	-	0.24	110	12000	0.882292	16
`2-29	-	0.24	66	9500	0.668684	22
`2-29	-	0.24	66	9500	0.668684	22
`2-30	-	0.24	110	16000	0.661719	22
`2-31	-	0.24	66	9500	0.668684	22
`2-32	-	0.24	110	16000	0.661719	22
`2-33	-	0.24	66	9500	0.668684	22
`2-34	-	0.24	110	16000	0.661719	22

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`2-35	-	0.24	88	8000	1.05875	14
`2-36	-	0.24	14	1500	0.898333	16
`2-37	-	0.24	80	8000	0.9625	15
`2-38	-	0.24	88	6600	1.283333	11
`2-39	-	0.24	110	12000	0.882292	16
`2-40	-	0.24	110	12000	0.882292	16
`2-41	-	0.24	103	17000	0.583162	25
`2-42	-	0.24	103	17000	0.583162	25
`2-43	-	0.24	103	17000	0.583162	25
`2-44	-	0.24	86	14000	0.59125	24
`3-01	-	0.24	69	9000	0.737917	20
`3-02	-	0.24	86	18000	0.459861	31
`3-03	-	0.24	69	14000	0.474375	30
`3-04	-	0.24	114	24000	0.457188	31
`3-05	-	0.24	91	19000	0.460987	31
`3-06	-	0.24	52	11000	0.455	32
`3-07	-	0.24	57	12000	0.457188	31
`3-08	-	0.24	103	21000	0.472083	31
`3-09	-	0.24	86	18000	0.459861	31
`3-10	-	0.24	120	25000	0.462	31
`3-11	-	0.24	86	9000	0.919722	16
`3-12	-	0.24	92	1000	8.855	2
`3-13	-	0.24	110	21500	0.492442	29
`3-14	-	0.24	99	19500	0.488654	29
`3-15	-	0.24	110	12000	0.882292	16
`3-16	-	0.24	88	9500	0.891579	16
`3-17	-	0.24	69	8000	0.830156	17
`3-18	-	0.24	66	13000	0.488654	29
`3-19	-	0.24	103	15000	0.660917	22
`3-20	-	0.24	69	13000	0.510865	28
`3-21	-	0.24	66	19000	0.334342	43
`3-22	-	0.24	66	19000	0.334342	43
`3-23	-	0.24	110	14000	0.75625	19
`3-24	-	0.24	110	14000	0.75625	19
`3-25	-	0.24	69	10500	0.6325	23
`3-26	-	0.24	86	19000	0.435658	33
`3-27	-	0.24	78	7500	1.001	14
`3-28	-	0.24	110	10000	1.05875	14
`3-29	-	0.24	44	8700	0.486782	30
`3-30	-	0.24	110	12000	0.882292	16
`3-31	-	0.24	88	10000	0.847	17
`3-32	-	0.24	88	9500	0.891579	16

PLANTING IRRIGATION

Dayton National Cemetery
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`3-33	-	0.24	88	9500	0.891579	16
`3-34	-	0.24	110	23000	0.460326	31
`3-35	-	0.24	110	14000	0.75625	19
`3-36	-	0.24	103	12700	0.78061	18
`3-37	-	0.24	110	12000	0.882292	16
`3-38	-	0.24	88	17000	0.498235	29
`3-39	-	0.24	110	23000	0.460326	31
`3-40	-	0.24	110	23000	0.460326	31
`3-41	-	0.24	105	10000	1.010625	14
`3-42	-	0.24	110	23000	0.460326	31
`3-43	-	0.24	110	23000	0.460326	31
`3-44	-	0.24	110	13000	0.814423	18
`4-01	-	0.24	69	9000	0.737917	20
`4-02	-	0.24	69	18000	0.368958	39
`4-03	-	0.24	69	18000	0.368958	39
`4-04	-	0.24	69	18000	0.368958	39
`4-05	-	0.24	103	12000	0.826146	17
`4-06	-	0.24	80	13500	0.57037	25
`4-07	-	0.24	52	13500	0.370741	39
`4-08	-	0.24	103	20000	0.495688	29
`4-09	-	0.24	86	9500	0.871316	17
`4-10	-	0.24	97	19000	0.491382	29
`4-11	-	0.24	97	19000	0.491382	29
`4-12	-	0.24	46	9000	0.491944	29
`4-13	-	0.24	86	16000	0.517344	28
`4-14	-	0.24	63	12000	0.505313	28
`4-15	-	0.24	108	20000	0.51975	28
`4-16	-	0.24	103	20000	0.495688	29
`4-17	-	0.24	86	9500	0.871316	17
`4-18	-	0.24	103	12000	0.826146	17
`4-19	-	0.24	86	9500	0.871316	17
`4-20	-	0.24	86	9500	0.871316	17
`4-21	-	0.24	69	8500	0.781324	18
`4-22	-	0.24	88	9800	0.864286	17
`4-23	-	0.24	66	8000	0.794063	18
`4-24	-	0.24	88	16200	0.52284	28
`4-25	-	0.24	66	10700	0.593692	24
`4-26	-	0.24	77	14000	0.529375	27
`4-27	-	0.24	110	19000	0.557237	26
`4-28	-	0.24	110	19000	0.557237	26
`4-29	-	0.24	110	19000	0.557237	26
`4-30	-	0.24	110	19000	0.557237	26

PLANTING IRRIGATION

Dayton National Cemetery
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`4-31	-	0.24	88	16000	0.529375	27
`4-32	-	0.24	69	16000	0.415078	35
`4-33	-	0.24	63	15000	0.40425	36
`4-34	-	0.24	69	16000	0.415078	35
`4-35	-	0.24	86	19000	0.435658	33
`4-36	-	0.24	86	19000	0.435658	33
`4-37	-	0.24	86	19000	0.435658	33
`4-38	-	0.24	103	21000	0.472083	31
`4-39	-	0.24	69	16000	0.415078	35
`4-40	-	0.24	88	9800	0.864286	17
`4-41	-	0.24	91	19000	0.460987	31
`4-42	-	0.24	86	8000	1.034688	14
`4-43	-	0.24	89	14000	0.611875	24
`4-44	-	0.24	15	1000	1.44375	10
`4-45	-	0.24	89	14000	0.611875	24
`4-46	-	0.24	86	14000	0.59125	24
`4-47	-	0.24	52	5000	1.001	14
`5-01	-	0.24	88	14000	0.605	24
`5-02	-	0.24	66	8400	0.75625	19
`5-03	-	0.24	66	4100	1.54939	9
`5-04	-	0.24	88	10000	0.847	17
`5-05	-	0.24	88	15000	0.564667	26
`5-06	-	0.24	66	10000	0.63525	23
`5-07	-	0.24	44	7000	0.605	24
`5-08	-	0.24	66	10000	0.63525	23
`5-09	-	0.24	88	15000	0.564667	26
`5-10	-	0.24	66	6000	1.05875	14
`5-11	-	0.24	110	19000	0.557237	26
`5-12	-	0.24	110	9500	1.114474	13
`5-13	-	0.24	55	10000	0.529375	27
`5-14	-	0.24	44	8000	0.529375	27
`5-15	-	0.24	110	19000	0.557237	26
`5-16	-	0.24	88	14500	0.584138	25
`5-17	-	0.24	88	14500	0.584138	25
`5-18	-	0.24	88	14500	0.584138	25
`5-19	-	0.24	88	8000	1.05875	14
`5-20	-	0.24	83	14000	0.570625	25
`5-21	-	0.24	66	11000	0.5775	25
`5-22	-	0.24	110	19000	0.557237	26
`5-23	-	0.24	66	7000	0.9075	16
`5-24	-	0.24	66	11000	0.5775	25
`5-25	-	0.24	44	4000	1.05875	14

PLANTING IRRIGATION

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`5-26	-	0.24	55	4200	1.260417	11
`5-27	-	0.24	110	9500	1.114474	13
`5-28	-	0.24	110	9500	1.114474	13
`5-29	-	0.24	66	5500	1.155	12
`5-30	-	0.24	44	9500	0.445789	32
`5-31	-	0.24	88	15000	0.564667	26
`5-32	-	0.24	88	15000	0.564667	26
`5-33	-	0.24	110	9500	1.114474	13
`5-34	-	0.24	44	4000	1.05875	14
`5-35	-	0.24	110	9500	1.114474	13
`5-36	-	0.24	110	19000	0.557237	26
`5-37	-	0.24	88	15000	0.564667	26
`5-38	-	0.24	112	19000	0.567368	25
`5-39	-	0.24	88	8500	0.996471	14
`5-40	-	0.24	66	12000	0.529375	27
`5-41	-	0.24	110	9500	1.114474	13
`6-01	-	0.24	51	4800	1.022656	14
`6-02	-	0.24	60	6100	0.946721	15
`6-03	-	0.24	36	3600	0.9625	15
`6-04	-	0.24	9	1500	0.5775	25
`6-05	-	0.24	88	9000	0.941111	15
`6-06	-	0.24	7	1200	0.561458	26
`6-07	-	0.24	67	7000	0.92125	16
`6-08	-	0.24	101	17000	0.571838	25
`6-09	-	0.24	110	12000	0.882292	16
`6-10	-	0.24	88	15000	0.564667	26
`6-11	-	0.24	44	7500	0.564667	26
`6-12	-	0.24	110	12000	0.882292	16
`6-13	-	0.24	110	12000	0.882292	16
`6-14	-	0.24	88	9000	0.941111	15
`6-15	-	0.24	110	12000	0.882292	16
`6-16	-	0.24	66	12000	0.529375	27
`6-17	-	0.24	110	18000	0.588194	24
`6-18	-	0.24	110	18000	0.588194	24
`6-19	-	0.24	110	18000	0.588194	24
`6-20	-	0.24	110	18000	0.588194	24
`6-21	-	0.24	110	18000	0.588194	24
`6-22	-	0.24	66	12000	0.529375	27
`6-23	-	0.24	110	12000	0.882292	16
`6-24	-	0.24	110	12000	0.882292	16
`6-25	-	0.24	110	18000	0.588194	24
`6-26	-	0.24	110	18000	0.588194	24

PLANTING IRRIGATION

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`6-27	-	0.24	44	6500	0.651538	22
`6-28	-	0.24	88	16000	0.529375	27
`6-29	-	0.24	88	16000	0.529375	27
`6-30	-	0.24	88	16000	0.529375	27
`6-31	-	0.24	88	16000	0.529375	27
`6-32	-	0.24	110	19000	0.557237	26
`6-33	-	0.24	44	7500	0.564667	26
`6-34	-	0.24	110	12000	0.882292	16
`6-35	-	0.24	88	9500	0.891579	16
`6-36	-	0.24	44	7000	0.605	24
`6-37	-	0.24	132	14000	0.9075	16
`6-38	-	0.24	88	16000	0.529375	27
`6-39	-	0.24	66	12000	0.529375	27
`6-40	-	0.24	110	12000	0.882292	16
`6-41	-	0.24	110	12000	0.882292	16
`6-42	-	0.24	44	7500	0.564667	26
`9-01	-	0.24	55	4200	1.260417	11
`9-02	-	0.24	44	5000	0.847	17
`9-03	-	0.24	110	12000	0.882292	16
`9-04	-	0.24	42	9100	0.444231	32
`9-05	-	0.24	88	9000	0.941111	15
`9-06	-	0.24	110	12000	0.882292	16
`9-07	-	0.24	78	13000	0.5775	25
`9-08	-	0.24	29	3500	0.7975	18
`9-09	-	0.24	28	3500	0.77	19
`9-10	-	0.24	110	12500	0.847	17
`9-11	-	0.24	72	6000	1.155	12
`9-12	-	0.24	100	21000	0.458333	31
`9-13	-	0.24	88	9500	0.891579	16
`9-14	-	0.24	110	12500	0.847	17

PLANTING IRRIGATION

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SECTION 32 84 01
IRRIGATION EXAMPLE UNIT PRICE SHEET

Dayton National Cemetery VA Project Number: 810CM3026 Unit Price Cost Form							
DATE: 3/9/2015 BY: JDL							
Engineer:							
100% CONSTRUCTION DOCUMENT							
		DESCRIPTION	QUAN.	UNIT	UNIT COST	TOTAL	
		IRRIGATION					
		DEMOLITION		EA			
		6-INCH IRRIGATION WATER TAP/METER		EA			
		WINTERIZATION ASSEMBLY		EA			
		BACKFLOW ASSEMBLY		EA			
		BOOSTER PUMP ASSEMBLY		EA			
		ISOLATION GATE VALVE ASSEMBLY		EA			
		AIR VACUUM RELIEF VALVE ASSEMBLY		EA			
		QUICK COUPLING VALVE ASSEMBLY		EA			
		REMOTE CONTROL VALVE ASSEMBLY		EA			
		POP-UP SPRAY SPRINKLER ASSEMBLY		EA			
		POP-UP ROTOR SPRINKLER ASSEMBLY		EA			
		HORIZONTAL BORING		LF			
		8-INCH MAINLINE PIPE		LF			
		6-INCH MAINLINE PIPE		LF			
		4-INCH MAINLINE PIPE		LF			
		3-INCH MAINLINE PIPE		LF			
		3-INCH LATERAL PIPE		LF			
		2-1/2-INCH LATERAL PIPE		LF			
		2-INCH LATERAL PIPE		LF			
		1-1/2-INCH LATERAL PIPE		LF			
		1-1/4-INCH LATERAL PIPE		LF			
		1-INCH LATERAL PIPE		LF			
		CONTROL WIRE		LF			
		BOOSTER PUMP VAULT AND ACCESSORIES		EA			
		IRRIGATION CONTROL SYSTEM		LS			
		ELECTRICAL		LS			
		SOD IRRIGATION TRENCHES		LF			
		DIRECTIONAL BORE		LF			
SUBTOTAL-GENERAL SITE WORK							
		SUBTOTAL					
		CONTINGENCY		x%		#VALUE!	
		GENERAL CONDITIONS		x%		#VALUE!	
		OVERHEAD & PROFIT		x%		#VALUE!	
		BONDS AND INSURANCE		x%		#VALUE!	
		MARK UP SUBTOTAL		x%		#VALUE!	
TOTAL						#VALUE!	

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**SECTION 32 90 00
PLANTING**

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

- A. This work consists of furnishing and installing all planting materials required for landscaping at all NCA construction projects hereinafter specified in locations as shown. The landscape contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the Contracting Officer's Representative (COR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.

1.2 EQUIPMENT

Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

- A. Section 31 20 00, EARTH MOVING, Stripping Topsoil and Stock Piling.
B. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
C. Section 31 20 11, EARTH MOVING (short form), Topsoil Materials.
D. Section 32 84 00, PLANTING IRRIGATION.
E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 SUBMITTALS

- A. Samples: Submit the following samples for approval before work is started:

Organic Mulch	2.3 kg (5 pounds) of each type to be used.
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- B. Pesticides: EPA approved labeling and MSDS sheet for each such product selected for use. Required for all pesticides, including but not limited to preemergence or post emergence herbicides, insecticides, and/or fungicides.
C. Nursery Source List: Within 21 days of contract award, submit a complete list of nursery sources for plants. Plants that do not meet the specified requirements when delivered to the site will be rejected and replaced at the Contractor's expenses. No substitutions for plant species and/or varieties will be allowed without approval by the Landscape Architect and CO/COR.
D. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the CO/COR for approval:

1. Plants (Department of Agriculture certification by State Nursery Inspector from the state in which the plants originate declaring material to be free from insects and disease).
 2. Fertilizers: submit certificates of analysis for each type of fertilizer.
 5. Seed: Certificates shall include the guaranteed percentages of pure live seed, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted certificates.
 6. Sod
 7. Organic soil amendment: proof of EPA minimum heating requirements for pathogen/ weed seed destruction.
- E. Manufacturer's Literature and Data:
1. Antidesiccant
 2. Erosion control materials
 3. Hydro mulch
 4. Pre-emergent herbicide
 5. Lime and inorganic soil amendments
- E. Licenses: Licenses of Arborist shall be submitted (one copy), to the COR.
- F. See 01 45 29 Testing Laboratory Services for required soil and organic soil amendment tests. Submit results of testing.

1.5 DELIVERY AND STORAGE

- A. Delivery:
1. Notify the COR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
 2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches with a breathable cover. Do not bend, bind, or tie plants in a manner that damages bark, breaks branches, or destroys the plant's natural shape. Do not drop ball and burlap plants during delivery. Do not prune prior to delivery.
 3. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
 4. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
 5. During delivery: Protect sod from drying out and seed from contamination.

6. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Storage:

1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
2. Keep seed, lime, and fertilizer in dry storage away from contaminants.
3. Store plants not installed on the day of arrival at the site as follows:
 - a. Shade and protect plants from the wind when stored outside.
 - b. Heel in bare root plants.
 - c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.
 - d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From March 1 to June 30 for spring and from September 1 to November 15 for fall, but not before irrigation system installed, tested, and approved, if applicable.
- B. Perform turfgrass installation operations within the following dates, but not before irrigation system installed, tested, and approved.
 1. Spring Planting: April 1 to May 15.
 2. Fall Planting: September 1 to October 15.
- C. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting dates or conditions. Submit a written request to the COR stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the COR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the turfgrass and landscape plant materials to achieve an establishment condition and appearance satisfactory to the MSN Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free and Landscape Plant Materials shall be fully rooted,

actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant and turfgrass Establishment Period the Contractor shall:

1. Water all plants and turfgrass to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these conditions is best determined on site by the MSN Agronomist in consultation with the Project Engineer.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COR in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
 - a. Eradicate all weeds. Water, fertilize, overseed, and perform any other operation necessary to promote the growth of turfgrass.
 - b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses mow at heights as appropriate for species and cultivar as directed by the COR in consultation with the MSN Agronomist. Final mowing height is 65 mm (3.0 inch) for cool season turfgrasses and as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.

7. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
8. Replant any areas void of turfgrass during an active growing season only.
 - a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 - b. Seeding shall 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 the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot. Unsatisfactory areas shall be reseeded within seven (7) days during an active growing season.
9. Complete remedial measures directed by the COR in consultation with the MSN Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

- A. Landscape plant and turfgrass acceptance will occur after completion of the LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the PLANT AND TURFGRASS ESTABLISHMENT PERIOD shall be extended at no additional cost to the 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 and ties are in good condition.
 3. Total plants on site as required by specifications and required number of replacements have been installed.
 4. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.
- C. Criteria for acceptance of turfgrass shall be as follows:

1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture and well rooted into the soil below so that gentle pulling of the turfgrass leaves by hand does not dislodge the sod. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
2. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT AND TURFGRASS WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of the GENERAL CONDITIONS, including the following supplements:
1. A One Year Plant and Turfgrass Warranty will begin on the date that the Government accepts the plants and turfgrass but not before the end of the Landscape Plant and Turfgrass Establishment Period.
 2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period and during an active growing season. A one year warranty for the plants and turfgrass that are replaced will begin on the day the replacement work is completed and accepted.
 3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor improper handling, care, or negligence requires replacement in kind and size.
 4. The Government will reinspect all replacement plants and turfgrass at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately and during an active growing season. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.
 5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year, unless otherwise directed by the COR in consultation with the MSN Agronomist.

1.10 APPLICABLE PUBLICATIONS

- A. NCA Handbook 3420 - Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor's official reference guide to all establishment and preliminary maintenance practices employed during this construction project.

- B. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- C. American National Standards Institute (ANSI) Publications:
ANSI Z60.1-04 Nursery Stock
ANSI Z133.1-06 Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements
- D. A - Z Encyclopedia of Garden Plants, American Horticultural Society, most current edition..
- E. American Society for Testing and Materials (ASTM) Publications:
C136-06 Sieve Analysis of Fine and Coarse Aggregates
C516-08 Vermiculite Loose Fill Thermal Insulation
C549-06 Perlite Loose Fill Insulation
D977-05 Emulsified Asphalt (AASHTO M140)
D1557-09 Test Methods for Laboratory Compaction of Soil
D2028-97 (Rev. 2004) ... Cutback Asphalt (Rapid-curing Type)
D2103-08 Polyethylene Film and Sheeting
D5851 (Rev 2006) Planning and Implementing a Water Monitoring Program
- F. Turfgrass Producers International:Turfgrass Sodding.
- G. U. S. Department of Agriculture Federal Seed Act.
Amended July 2011 Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turfgrass material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in A-Z Encyclopedia of Garden Plants.

2.2 ORGANIC SOIL AMENDMENT

- A. All areas to receive turfgrass seeding or sodding will require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.
- B. Organic soil amendment will be spread and incorporated into the finished grade at the depths indicated on the Contract Drawings in order to raise the organic content of the topsoil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.

1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1") screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.
2. Acceptable types of Organic Soil Amendments include well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-7.0
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Soluble Salts	< 6 Ds/m (mmhos/cm)
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements
4. Provide tests of Organic Soil Amendment to demonstrate compliance with the parameters listed above and per requirements of 01 45 29 Testing Laboratory Services.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.

6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the COR/MSN Agronomist.

2.3 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Balled and burlapped stock:
 1. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting. No soil is to be heaped on the top of plant root flares. Any plants delivered with such heaped soil over the root flare will have the soil removed before planting. If the root ball depth does not satisfy ANSI Z60.1 requirements after soil is removed, the plant will be rejected.
 2. Plants wrapped in inorganic burlap will be rejected from the job site.
- C. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- D. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the COR, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
- E. Provide nursery grown, Grade 1, plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.

- F. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
- G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the COR in consultation with the MSN Agronomist authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.
- I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 LABELS

Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.5 TOPSOIL

- A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 6.0 nor more than 7.0, and should be best suited to the region, climate and plant material specific to the project.
- B. Obtain material from stockpiles established under Section 31 20 11, EARTH MOVING, subparagraph, Stripping Topsoil that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters.
- C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the COR of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.6 SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 90 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve. Moisture is not to exceed 10%.
- B. Sulfur: Granular, biodegradable, and containing a 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.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

2.7 PLANT FERTILIZERS

- A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.
- B. For new plant material, provide a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea.), 10% available phosphoric acid, and 10% potash.

2.8 TURFGRASS FERTILIZER

Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash. Liquid starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.9 MULCH

- A. Mulch: Shredded hardwood tree bark, composted minimum one year, with shredding to produce an approved size ranging from fines to 2" with 50% over $\frac{3}{4}$ "; pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; not

exceeding 0.5 percent inert contaminants and free of twigs, limbs, wood shaving, saw dust, and foreign or toxic substances. Salinity to be less than 6 dS/m (mmhos/cm).

B. Mulch shall be stored as to prevent inclusion of foreign material.

C. Mulch for turfgrass

1. Straw for turfgrass seed bed mulch shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
2. Wood cellulose fiber mulch for use with hydraulic application (Hydro mulch) with fertilizer shall consist of specially prepared wood cellulose fiber, processed to contain no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of the application of materials. Do not apply any turfgrass seed in this type mixture. On an air-dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus three percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber shall be manufactured so that:
 - a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogenous slurry.
 - b. When hydraulically sprayed on the ground, the material will form a blotter like cover.
 - c. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.

2.10 ASPHALT ADHESIVE

Asphalt adhesive for application with straw mulch shall be liquid asphalt conforming to ASTM D2028, designation RC-70, or emulsified asphalt conforming to ASTM D977, Grade RS-1.

2.11 EROSION CONTROL

- A. Erosion control blanket material shall be cellulose fiber blanket without netting weighing 10 kg/100 m² (20 pounds per 1000 square feet) in 1250 mm (50 inch) wide rolls.

2.12 STAKES AND GUYING STRAPS

- A. A. Tree Staking Materials:

1. Stakes: 2" hardwood free of defects that would impair strength.
2. Guying material shall be ¾" flat woven polypropylene strap with 900 lb. break strength such as DeepRoot Arbor Tie (1-800-458-7668) or approved equal, black color.

2.13 WATER

Water shall not contain elements toxic to plant life. It shall be obtained from the existing irrigation system at no cost to the Contractor.

2.14 ANTIDESICCANT

Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.15 SEED

- A. Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. Onsite seed mixing shall be done only in the presence of the COR. All turfgrass seeding operations shall be done separately and prior to the application of any mulch material.
- B. Minimum Acceptable Seed Quality standards for all turfgrass seed utilized are as follows: Purity 95%, Germination 85%, Weed Seed Content less than 0.5%, Noxious Weeds 0.0%, Inert Material less than 3%, Germination Test Date no older than 6 months.
- C. All turfgrass seed mixtures, or sod composition shall conform to the species and cultivar requirements detailed here: The seed mixtures listed below are representative a variety of acceptable seed mixtures that roughly approximate these guidelines.

Cool Season Turfgrass Seed Mixtures: Seed is % by weight

Primary mixture* - 40-60% perennial ryegrass, 40-60% Ky bluegrass or to match existing turfgrass composition at Dayton National Cemetery.

SEEDING RATE = 6 lb/1000 sq.ft.

Each of these species components should be a blend composed of a minimum of 2 regionally adapted cultivars.

Seed mix composition shall match the existing turfgrass at the Cemetery.

Proposed seed mix shall be approved by the NCA Agronomist. Any deviation from these turfgrass species requirements must be approved in writing by

the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the CO/COR.

2.16 SOD

- A. Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding. Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Sod must also conform to the turfgrass species limitations as outlined in seeding mixtures in 2.15C above in this spec. Sod composition shall match the existing turfgrass at the Cemetery.
- C. Sod composition shall be approved in writing by the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the CO/COR.
- D. Repairs to existing turf that are necessary due to construction work shall be made using sod (not seed) unless approved by COR.

2.17 HERBICIDES AND OTHER PESTICIDES

All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant locations and bed outlines on project site for approval by the COR before any plant pits or beds are dug. The COR may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION AND SOIL PLACEMENT FOR PLANTING BEDS

- A. CO/COR will inspect subgrades prior to topsoil placement. Notify CO/COR minimum of 1 week prior to topsoil placement to that inspection may take place.
- B. Prior to excavating for planting beds, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- C. Excavate planting beds to depth shown on drawings. Remove existing soil and dispose of legally.
- D. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where

underground utilities, construction, or solid rock ledges are encountered, the CO/COR may select other locations for plant material.

- E. Loosen plant pit subgrade to a depth of six inches with a prybar or shovel. Do not till.
- F. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off property. Leave rough. Do not rake.
- G. Spread topsoil to depths as shown on plans, but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
- H. Rake soil to remove any hard clumps, rocks, or other debris larger than 1 inch in any dimension from top surface.
- I. Till in organic and/or inorganic soil amendments and fertilizers per soil test lab recommendations. See Section 01 45 29 Testing Laboratory Services.

3.3 EXCAVATION FOR TREE/PLANT PITS

- A. Prior to excavating for plant pits, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the CO/COR may select other locations for plant material.
- C. Do not use an auger or tree spade for planting pit excavation. Hand digging, machine digging, or other methods that create a plant pit with rough, loose sides are acceptable. Pits with smooth, hard sides are not acceptable.
- D. Loosen plant pit subgrade to a depth of six inches with a prybar or shovel. Do not till.
- E. Fill plant pits with water and allow to percolate before planting. Where pits will not drain in 24 hours and will affect the health of the plant, notify the Landscape Architect. Landscape Architect may direct relocation of the plant or recommend an underdrain connected to an outfall to provide positive drainage. If underdrains are needed an adjustment will be made to the contract amount.

3.4 SETTING PLANTS

- A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to

plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants so that the root flare is 2" higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil.

- B. For balled and burlapped plants, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
- C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- D. Backfill balled and burlapped and container-grown plants with the soil removed from the planting hole to approximately half the depth of the ball and then tamp and water. It is desirable to use 100% percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material.

3.5 TREE STAKING

- A. Stake trees as detailed on the Drawings as approved by the Landscape Architect. All trees to be plumb for Final Acceptance. Do not wrap tree trunks.

3.6 EDGING PLANT BEDS

- A. Uniformly edge beds and tree mulch circles using a sharp tool to provide a clear cut division line between the planted area and the adjacent turfgrass, if applicable. Do not use any type of manufactured edging material. The properly mowed and maintained turfgrass will serve as edging for all landscape beds.

3.7 MULCHING PLANTS

- A. Mulch within 48 hours after planting to depths indicated on plans and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
- B. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Prune new plants and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove the leader. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.

B. Existing trees to be pruned are shown on the drawings. Perform tree pruning and cavity work by a licensed arborist an arborist in accordance with ANSI Z 133.1. Remove dead wood 13 mm (1/2 inch) or more in diameter, branches interfering with or hindering the healthy growth of the trees, and diseased branches with a clean cut made flush with the branch collar. Cut back or remove branches as necessary to give the trees proper shape and balance. In removing large limbs, make the initial cut on the underside at a safe distance from the trunk or lateral, to prevent ripping of bark. Ensure branches and trimmings do not endanger traffic or cause damage to property during removal. Section large branches or limbs that cannot be removed in one piece without endangering traffic or property. Lower sections by ropes. Repair any damage resulting from the Contractor's negligence during pruning. Workmen are not permitted to climb trees with climbing spurs. To promote proper healing, cut off flush with the branch collar stubs or limbs that have resulted from improper cuts or broken as a result of former pruning. Remove girdling roots.

3.9 TILLAGE FOR TURFGRASS AREAS

Thoroughly till the subsoil to a depth of at least 150 mm (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used. Remove all debris and stones larger than 25 mm (one inch) remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a 50 mm (one inch) depth and remove debris and stones. **Do not till in tree protection zones.**

3.10 FINISH GRADING

After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of 150 mm (6 inches). Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.11 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Spread lime or other soil amendments as recommended by the soil test results.
- B. Incorporate soil amendments into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation.
- C. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft.
- D. Starter fertilizer should be lightly mixed with the top ½ inch of soil.

- E. Immediately restore the soil to an even condition before any seeding or sod placement.

3.12 MECHANICAL SEEDING

- A. Broadcast seed by approved application equipment at the rate specified. All turfgrass seed shall be planted prior to the application of any mulch material. The seed shall be uniformly distributed in a minimum of 2 directions at right angles to each other. Drag the seeded area to inter-mingle the seed and surface soil by means of spike-tooth harrow, cultipacker, or other approved device.
- B. Immediately after dragging, firm the entire area with a roller not exceeding 225 kg/m (150 pounds per foot) of roller width.
- C. Immediately after preparing the seeded area, evenly spread an organic mulch of straw by hand or by approved mechanical blowers at the rate of 0.5 kg/m² (2 tons per acre). Application shall allow some sunlight to penetrate and air to circulate but also reduce soil and seed erosion and conserve soil moisture. Anchor mulch by a mulch tiller, asphalt emulsion, twine, or netting. When asphalt emulsion is used, apply either simultaneously or in a separate application. Take precautionary measures to prevent asphalt materials from marking or defacing structures, pavements, utilities, or plantings.

3.13 HYDRO-MULCHING

When hydro-mulching, mix the slow release starter fertilizer, approved wood cellulose mulch material in the required amount of water to produce a homogenous slurry and then uniformly apply slurry under pressure to deliver the recommended quantity of fertilizer per 1000 sq.ft.

3.14 SODDING

- A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.
- B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area. All sod should be rolled with a light-weight roller after being laid to eliminate air spaces between the sod and the firmed soil.

3.15 WATERING

- A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 50 mm (2 inches). Supervise watering operation to prevent run-off. Supply all 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. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the CO/COR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.16 PROTECTION OF TURFGRASS AREAS

Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.17 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations lay the material evenly and smoothly and in contact with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.
- C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.
- D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 1200 mm (4 feet) longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 300 mm (one foot) intervals at the end. Firmly embed staples in the underlying soil.
- E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Warranty Period.

3.18 RESTORATION AND CLEAN-UP

Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.19 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of
Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

--END--

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Underground water service connection complete and ready for operation including piping, valves, meter pit, connection to the new site water service pipeline to be installed by the City of Dayton, connection to the new backflow preventer, and all appurtenances. Contractor shall bear the expense of work performed by City of Dayton and will be responsible for coordination of said work.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 02, GENERAL REQUIREMENTS.
- B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 11, EARTH MOVING (SHORT FORM).
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).

1.3 DEFINITIONS

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system, beginning at the connection to the site water service pipeline provided by the City of Dayton at the approximate property line. The distribution system comprises the network of piping located throughout the site, as applicable, including valves and other appurtenances used to supply water for domestic purposes.
- B. Site Water Service Pipeline: Pipeline to be provided by the City of Dayton that will be installed from a connection to the City of Dayton's existing distribution system located on Chicamauga Avenue to the existing property line of the site.
- C. Water Service: Pipe connecting building piping to water distribution lines.

1.4 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 product of one manufacturer.
 - 2. 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.
- B. Comply with the rules and regulations of the City of Dayton having jurisdiction over the connection to the site water service pipeline.

- C. All material surfaces in contact with potable water shall comply with NSF 61.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data (Submit all items as one package):
1. Ductile iron pipe, fittings, and appurtenances.
 2. Copper tubing and fittings.
 3. Gate valves.
 4. Ball valves.
 5. Service saddles.
 6. Joint restraint.
 7. Precast concrete Meter Pit.
 8. Adjustable pipe supports.
 9. Disinfection products.
- C. Testing Certifications:
1. Hydrostatic Testing.
 2. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI/ASME):
- B16.1-2005.....Cast Iron Pipe Flanges and Flanged Fittings,
Class 25, 125, 250 and 800
- B16.18-2001.....Cast Copper Alloy Solder Joint Pressure Fittings
- B16.26-2006.....Cast Copper Alloy Fittings for Flared Copper
Tubes
- B40.100-2005.....Pressure Gauges and Gauge Attachments
- C. American Society of Mechanical Engineers (ASME):
- B18.5.2.1M - 2006 Metric Round Head Short Square Neck Bolts
- B18.5.2.2M - 1982 Metric Round Head Square Neck Bolts
- B18.2.2 - 1987 Square and Hex Nuts
- D. American Society for Testing and Materials (ASTM):
- A47/A47M - 99(2004).....Standard Specification for Ferritic Malleable
Iron Castings
- A48/A48M - 03(2008).....Standard Specification for Gray Iron Castings
- A123/A123M-08.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
- A148M/A148M-08.....Standard Specifications for Steel Castings

- A242/A242M-04e1.....Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
- A307/A307-07b.....Standard Specifications for Carbon Steel Bolts and Studs, 415 MPa (60,000 psi) Tensile Strength
- A536-84(2004)e1.....Standard Specifications for Ductile Iron Castings
- A563M - 07.....Standard Specification for Carbon and Alloy Steel Nuts [Metric]
- B42-02e1.....Standard Specification for Seamless Copper Pipe, Standard Sizes
- B61-08.....Standard Specifications for Steam or Valve Bronze Castings
- B62-02.....Standard Specifications for Composition Bronze or Ounce Metal Castings
- B88-03.....Standard Specifications for Seamless Copper Water Tube
- B-633-07.....Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- B828-02.....Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- C94/C94M-09.....Standard Specification for Ready-Mixed Concrete
- C443-05a.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- D2000-08.....Standard Classification System for Rubber Products in Automotive Applications
- F477-08.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F593-02(2008).....Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- F1674-05.....Standard Test Method for Joint Restraint Products for Use With PVC Pipe
- E. American Water Works Association (AWWA):
- B300-04.....Hypochlorites
- B301-04.....Liquid Chlorine
- C104/A21.4-08.....Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
- C105/A21.5-05.....Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids

- C110/A21.10-08.....Ductile-Iron and Gray-Iron Fittings, 80 mm
Through 1200 mm (3 Inches Through 48 Inches) for
Water and Other Liquids
- C111/A21.11-07.....Rubber-Gasket Joints for Ductile-Iron and
Gray-Iron Pressure Pipe and Fittings
- C115/A21.15-05.....Flanged Ductile-Iron and Gray-Iron Pipe with
Threaded Flanges
- C150/A21.50-08.....American National Standard for Thickness Design
of Ductile Iron Pipe
- C151/A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast in Metal
Molds or Sand-Lined Molds, for Water or Other
Liquids
- C153/A21.53-06.....Ductile-Iron Compact Fittings, 80 mm Through
300 mm (3 inches Through 12 inches) for Water
and Other Liquids
- C509-01.....Resilient Seated Gate Valve for Water Supply
Service
- C550-05.....Standard for Protective Interior Coatings for
Valves and Hydrants
- C600-05.....Installation of Ductile-Iron Water Mains and
Their Appurtenances
- C651-05.....Standard for Disinfecting Water Mains
- D2000-08.....Standard Classification System for Rubber
Products in Automotive Applications
- F593-02(2008).....Standard Specification for Stainless Steel
Bolts, Hex Cap Screws, and Studs
- M11-04.....Manual: Steel Pipe: A Guide for Design and
Installation
- M23-02.....Manual: PVC Pipe - Design and Installation
- F. NSF International:
- 61-02.....Drinking Water System Components-Health Effects
(Sections 1-9)
- G. American Welding Society (AWS):
- A5.8-04.....Brazing Filler Metal
- H. Copper Development Association's Copper Tube Handbook-2009

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe, direct buried:
1. Ductile iron pipe conforming to the requirements of AWWA C151,
Special Thickness Class 51 for 100 mm through 300 mm (4 inches
through 12 inches) in diameter with interior double thickness cement

- mortar lining and 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 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. All hardware shall be type 304 stainless steel.
 3. Provide polyethylene encasement over pipe, fittings, and valves in accordance with 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. 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, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.
 2. Wall Pipe Castings: Size and types shown on the drawings. For wall pipe with mechanical joint or flange ends flush with face of wall, provide mechanical joint and flanged ends tapped for studs.
 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, 2 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.
 5. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111.
- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 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. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.
- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior for buried fittings, and shop prime epoxy for exposed fittings.

- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2 MECHANICAL JOINT RESTRAINT GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, 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 ANSI/AWWA C110/A21.10.
 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 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. MJ 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.

2.3 COPPER PIPE AND TUBING

Copper Piping: ASTM B88, Type K, or Type L as shown on the drawings with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP. Fittings for compression-type joint, ASME B16.26, flared tube type.

2.4 VALVES

A. Gate:

1. Conform to AWWA C509. Mechanical joint ends for buried locations and flanged ends for exposed and interior (in vaults and pits) locations. Valves 75 mm (3 inches) and larger shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type (except for outside screw and yoke), with a minimum 1375 kPa (200 pound) WOG. Valves shall open right. 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 not allowed.
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: Outside screw and yoke with hand wheel.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

B. Ball:

1. MSS SP-72, SP-110, Type II, Class 125, Style 1, rated for 1035 kPa at 176 Celsius (150 psig at 350 Fahrenheit), two piece, full port, chrome plated brass ball, end entry body style, 15% glass reinforced PTFE seats, PTFE packing and blow-out proof stem, vinyl covered steel handle, with solder-joint end connections or threaded ends with adapters are acceptable, SWP Rating 1035 kPa (150 PSIG), CWP Rating 4140 kPa (600 PSIG).

2.5 PRECAST CONCRETE METER PIT

A. Precast reinforced concrete:

1. Concrete: 4,000 psi at 28 days
2. Entrained Air: 5% to 9%
3. Reinforcing Steel: ASTM A496-A615 Grade 60
4. Design Loading: AASHTO HS-20-44 with 30% impact and equivalent soil pressure of 130 psf. Flotation forces not accounted for.

B. Access Hatch

1. Design Loading: AASHTO HS-20-44
2. Material: Aluminum
3. Dimensions: 48" x 48"
4. Manufacturer: Bilco JD-2AL, or equal in accordance with City of Dayton requirements.

- C. Steps: Plastic coated, pressure-molded to the steel. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Spacing shall be 12" on center.

2.6 PIPE SUPPORTS

- A. Adjustable pipe support shall consist of adjustable pipe saddle and stanchion with integral base plate.
- B. All materials shall be hot-dipped galvanized steel.
- C. Stanchion shall be minimum 3-inch diameter schedule 40 steel pipe.
- D. Pipe saddle shall be as manufactured by Anvil Figure 264, or approved equal.
- E. Pipe stanchion shall be as manufactured by Anvil Figure 63, or approved equal.
- D. Anchor bolts shall be type 304 stainless steel.

2.7 POTABLE WATER

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.8 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 tablets and shall contain 65 percent chlorine by weight.

PART 3 - EXECUTION

3.1 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 to maintain the product performance as if it were undamaged.
- B. All pipe and fittings shall be subjected to a careful inspection 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 expense 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. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water line and power lines, and all existing 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 well tamped in place to a depth of 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 Section 3.4 "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.

3.2 DUCTILE IRON PIPE

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Perform cutting following manufacturer's recommendations for field cutting of pipe. Repair damaged cement mortar lining in accordance with manufacturer's recommendations.
- 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.

3.3 COPPER PIPE

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 11, EARTH MOVING (SHORT FORM).

3.4 PIPE SUPPORTS

- A. Supports:
1. All piping shall be properly and adequately supported.
 2. Install adjustable pipe supports as shown on the drawings and in accordance with manufacturer's recommendations.

3.5 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 1375 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 2.3 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.

3.6 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 450 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 450 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 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 450 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).

3.7 VALVES

- A. Clean valve interior before installation.
- B. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.8 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/sec (2.5 feet per second) at 275kPa (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 ½)	51(2)	64 (2 1/2-in)
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

The backflow preventers shall not be in place during the flushing.

- C. The Contractor shall be responsible to provide the water source for filling, flushing, and disinfecting the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps,

storage facilities required to complete the specified flushing, and disinfection operations.

- D. The Contractor shall be responsible for the disposal 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 City of Dayton and the Ohio Department of Health. 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.

3.9 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, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.
- E. The Contractor shall 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. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 1375 kPa (150 psi) or 1.5 times the normal working pressure, whichever is greater. Leakage shall not exceed the following requirements.
 - 1. Copper Tubing: No leaks.
 - 2. Ductile Iron Pipe: AWWA C600. Provide to COR.

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