

Prescott National Cemetery

Committal Shelter and Cemetery Improvements

Project Number: 900CM3002



Project Specifications

Bid Documents

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Prepared for:

Department of Veterans Affairs
National Cemetery Administration
Office of Construction Management

SmithGroupJJR
Aqua Engineering

**DEPARTMENT OF VETERANS AFFAIRS
NCA MASTER SPECIFICATIONS**

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SECTION 01 00 00
GENERAL REQUIREMENTS

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SECTION 01 00 00
GENERAL REQUIREMENTS

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for the Committal Shelter and Cemetery Improvements for the Prescott National Cemetery of Arizona, Prescott, AZ, Project No. 900CM3002, as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. Offices of SmithGroupJJR, Inc., 201 Depot Street, Ann Arbor, MI (Telephone 734-662-4457) as Architect-Engineers (A/E), will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by COTR or his duly authorized representative.
- D. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the Contracting Officers Technical Representative (COTR) in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COTR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA security personnel/police, be identified by employer, and restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Any changes to color, finish, assembly, etc. including changes following review of any on-site mock-ups shall be included in the initial construction bid.

H. Training:

1. All employees of general contractor or subcontractors shall have the 30-hour OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP.
2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

ITEM I, GENERAL CONSTRUCTION: Work includes general construction of structures, roads, walks, grading, drainage, electrical work, utility systems, water systems, irrigation, landscaping, installation of a Committal Shelter, retaining walls, flagpoles, parking areas, signage, site furnishings, unit pavers, demolition and alteration necessary to completely or partially remove existing structures, and construction of certain other items.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, one set 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 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 COTR/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 COTR 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. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COTR/Cemetery Director.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COTR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COTR.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COTR.
- 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 site weekly.
- N. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.5 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 COTR. 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 COTR 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 COTR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the COTR. 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.

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as shown on the drawings and as determined by the COTR with agreement of the Cemetery.
- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Provide unobstructed access to the Cemetery areas required to remain in operation.

- G. Construction Fence: Before construction operations begin, the Contractor shall provide, per the contract documents, a temporary construction fence encompassing the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Additional fencing and/or modifications to the construction fence materials and components shall be provided as requested by the COTR at no additional cost. Remove the fence when directed by COTR.
- 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 COTR. 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 COTR. 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 COTR, and Cemetery Director's prior knowledge and written approval. Refer to specification Section 26 05 11, Requirements for Electrical Installations.
 2. The Contractor shall submit a request to interrupt any such services to both COTR 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 COTR 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 COTR.
 5. In case of a contract construction emergency, service will be interrupted on approval of COTR. Such approval will be confirmed in writing as soon as practical.

6. The contractor shall include as part of the contract all connection/tap and permit fees required to be paid to a public utility provider for new permanent service to the construction project including the new service connection to the City of Prescott's water line.
- I. 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.
- J. 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 COTR.
- K. Coordinate the work for this contract with other construction operations as directed by COTR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- L. 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 COTR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the interment 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.

1.6 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COTR of areas in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by to the Contracting Officer. This report shall list:
1. Existing condition and types of surfaces not required to be altered throughout affected areas.
 2. Existence and conditions of items required by drawings to be either reused or relocated, or both.
 3. Shall note any discrepancies between drawings and existing conditions at site.
 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COTR.
 5. The contractor shall take photographs that clearly document the existing conditions at the site and shall provide copies of all the pre-construction photos to the COTR.
- 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 COTR, 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 COTR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing of surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by the Contractor to such flooring and other surfaces, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. 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.

2. Wherever work is performed, surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.7 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 1. Reserved items which are to remain property of the Government are 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 COTR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.

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

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

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

1.9 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any water/irrigation or electric work without approval of the COTR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COTR before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, electrical work, landscape materials, decomposed granite, stone/aggregate, 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 and systems (including irrigation) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.10 PHYSICAL DATA

- A. Data and information furnished 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 SmithGroupJJR, 201 Depot Street, Ann Arbor, MI 48104, (Telephone 734-662-4457).

(FAR 52.236-4)

- B. Subsurface conditions have been developed by core borings and test pits investigated by Speedie and Associates, 3331 East Wood Street, Phoenix, AZ 85040, Telephone (602) 997-6391. Logs of subsurface exploration conducted October 4, 2011 are shown diagrammatically on drawings.
- C. A copy of the geotechnical investigation report by Speedie and Associates dated November 11, 2011 is an appendix to these specifications and shall be considered part of the contract documents.
- D. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.11 PROFESSIONAL SURVEYING SERVICES

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

1.12 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work necessary for construction of the project and/or as requested by the COTR. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the COTR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the surveyor and/or the COTR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the COTR may request the contractor and surveyor to replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor. No additional payment will be provided for all survey work required and/or requested by the COTR for the completion of the services noted above.

(FAR 52.236-17)

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and

grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COTR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COTR before any major items of concrete work are placed. In addition, the Contractor shall also furnish to the COTR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
 1. Lines and elevations of the Committal Shelter, Retaining Walls, and plaza.
 2. Elevations of bottoms of footings and tops of floors of each building and addition..
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines of elevations of all swales.
 5. Lines and elevations of roads, streets and parking lots.
 6. Lines and elevations of all plaza site walls.
 7. Lines and elevations of new stormwater sewers, channel segments/swales, and retaining/abutment walls.
 8. Northing/Easting coordinate locations of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
 9. Lines and plumbness of all site furnishings and site signage.
- E. Upon completion of the work, the Contractor shall furnish the COTR with reproducible drawings, in Autocad form, at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

- A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, 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 COTR's review, as often as requested.
- C. The Contractor shall deliver two approved completed sets of as-built drawings to the COTR within 15 calendar days after acceptance of the project by the COTR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.14 USE OF ROADWAYS

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

1.15 TEMPORARY TOILETS

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

1.16 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COTR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available the contractor shall supply power via portable generators at own expense.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery water distribution system. Provide reduced pressure backflow preventer and meter at each connection. Contractor shall meter and pay for water at the prevailing rates charged to the Government..
 - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COTR's discretion) of use of water from the Cemetery's system.

1.17 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 COTR 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 COTR and shall be considered concluded only when the COTR 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 COTR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.18 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 COTR 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. Completely assemble and install the Government-furnished equipment in place ready for proper installation in accordance with specifications and drawings.

1.19 CONSTRUCTION DIGITAL IMAGES

A. During the construction period through completion, furnish Department of Veterans Affairs with 6 views of digital images, including one color print of each view and one Compact Disc (CD) per visit containing those views taken on that visit. Digital views shall be selected and directed by COTR. Each view shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) and the images will be a minimum of 2272 x 1704 pixels for the 200x250mm (8x 10 inch) prints and 2592 x 1944 pixels for the 400x500 mm (16 x 20 inch) prints, as per these specifications:

1. Normally such images including aerial photographs of the site will be taken at monthly intervals. However, the COTR may also direct the taking of special digital images at any time prior to completion and acceptance of contract. If the number of trips to the site exceeds an average of one per month of the contract performance period then an adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 00 72 00, GENERAL CONDITIONS.

2. In event a greater or lesser number of images than specified above are required by the COTR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

B. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.

C. Prints shall be made on 200 x 250 mm (8 by 10 inch) regular-weight matte archival grade photographic paper and produced by a process with a minimum of 300 pixels per inch (PPI). Prints must be printed using the commercial RA4 process (inkjet prints will not be acceptable). Photographs shall have 200 x 200 mm (8 by 8 inch) full picture print with no margin on three sides and a 50 mm (2 inches) margin on the

bottom for pre-typed self-adhesive identity label to be added by COTR. It is required that the prints are professionally processed so the quality will meet or exceed that of the same size print made with a film camera. Prints must be shipped flat to the COTR.

- D. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% or the original with no loss of information. File names shall contain the date the image was taken, the Project number and a unique sequential identifier. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- E. In case any set of prints are not submitted within five days of date established by COTR for taking thereof, the COTR may have such images/photographs taken and cost of same will be deducted from any money due to the Contractor.

1.20 FINAL ELEVATION DIGITAL IMAGES

- A. A minimum of four (6) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different settings to allow the COTR to select the image to be printed. All images are provided to the COTR on a CD.
- B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on a label affixed to back of the photograph without damage to the photograph and shall be similar to that provided for final construction photographs.
- C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the Cemetery structures constructed under this project (elevations as selected by the COTR from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be place in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the SRE will select one style to frame all six prints. Photographs with frames shall be delivered to the COTR in boxes suitable for shipping.

1.21 HISTORIC PRESERVATION

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 COTR verbally, and then with a written follow up.

1.22 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. Confined Spaces
 11. Trench Safety 12. Lockout/Tagout

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SECTION 01 31 32
GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Geotechnical investigations were conducted for VA in the area where work is to be performed under the Contract and a report of the results prepared.
- B. Refer to "Report on Geotechnical Investigation" Prescott National Cemetery", dated November 11, 2011, by Speedie and Associates.
 - 1. Refer to Appendix A for full copy of geotechnical investigation.

1.2 USE OF DATA

- A. The report of geotechnical investigations was obtained for use in study and design. The report itself is made available for Bidder's information only and is not warranty of subsurface conditions.
- B. Bidder shall visit the site and become acquainted with existing conditions. Prior to bidding, Bidder may make its own subsurface investigations to satisfy itself as to site and subsurface conditions, subject to the following stipulations:
 - 1. Such investigations shall be performed only under time schedules and arrangements approved in advance by VA in writing.
 - 2. The sites of such investigations shall be restored to the respective conditions that existed before such investigations were undertaken.
 - 3. Bidder shall indemnify and hold harmless VA and Architect from and against claims, damages, losses, and expenses attributable to bodily injury or death and to injury to or destruction of tangible property arising out of or resulting from such investigations.
- C. Bidder shall assume full responsibility for interpreting the information furnished in the report, for the conclusions drawn from the information furnished, and from its inspection of the site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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

PART 1 - GENERAL

1.1 DESCRIPTION:

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 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 estimates as determined from the currently approved updated Schedule of Costs unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: two (2) copies of the updated Microsoft Project Gantt Chart, a listing of all project schedule changes, and associated data, made at the update. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.
- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Gantt Chart data, which, in the sole judgment of the Contracting Officer, are necessary for validating the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be reasonably determined.

1.8 PAYMENT AND PROGRESS REPORTING:

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's Representative) and the Contractor. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's Representative). Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Gantt Chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.
 6. Activity/event duration and percent complete shall be updated independently.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contracting Officer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.
- 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 Contracting Officer's Technical Representative (COTR) on behalf of the Contracting Officer.
- 1.6 The Contractor shall prepare and submit to the COTR a complete submittal list of all required documents that will be required for review and approval at the first construction meeting. The Contractor shall maintain and update the submittal list for the duration of construction and shall provide an updated submittal list at each construction progress meeting and when requested by the Engineer.

- A. Upon distribution of submittals, the Contractor 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 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. If requested by the COTR, the Contractor shall submit documentation in digital PDF format to the COTR, Architect/Engineer, and other parties as designated. Shop drawings and large format drawings shall be scanned by the Contractor at their expense into a digital PDF format for distribution. Physical Samples that cannot be transmitted digitally shall be shipped and/or transported to the location(s) designated by the COTR at the Contractor's expense. The Contractor shall provide at a minimum and when requested three duplicate physical samples. Additional copies of submittal documents shall be provided when requested by the COTR. In addition to the digital PDF copies, the Contractor shall provide three original hardcopies of submittal documentation requiring certification, seals, signatures, etc. to the COTR .
- C. Forward submittals in sufficient time to permit proper consideration and approvals. 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.

- D. Submittal documentation shall be clearly HIGHLIGHTED to definitively identify the particular model numbers, sizes, products, materials, components, options, accessories, and other associated appurtenances. Documentation that is not provided in this fashion will be returned to the Contractor for correction and resubmission. The additional labor and expenses incurred by VA and/or their Consultants that is required for reviews and approvals for rejected and/or submittal documentation that requires resubmission more than once will be paid for by the Contractor.
- E. 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.
- F. 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.
- G. Approved samples will be kept on file by the COTR 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.

- H. 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 the Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by the Contractor certifying to such check.
1. 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:
- SmithGroupJJR, Inc.
201 Depot Street, 2nd Floor
Ann Arbor, MI 48104
- 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 COTR.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
811 Vermont Avenue, NW - Room 462
Washington, DC 20420
Telephone Number: (202) 461-8217
Between 9:00 AM - 3:00 PM

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

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA	Aluminium Association Inc. http://www.aluminum.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.aashto.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
AGC	Associated General Contractors of America http://www.agc.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org
AITC	American Institute of Timber Construction http://www.aitc-glulam.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	The Engineered Wood Association http://www.apawood.org

ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	Brick Institute of America http://www.bia.org
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
DHI	Door and Hardware Institute http://www.dhi.org
EEI	Edison Electric Institute http://www.eei.org
EPA	Environmental Protection Agency http://www.epa.gov

ETL	ETL Testing Laboratories, Inc. http://www.etl.com
FCC	Federal Communications Commission http://www.fcc.gov
FPS	The Forest Products Society http://www.forestprod.org
FM	Factory Mutual Insurance http://www.fmglobal.com
GA	Gypsum Association http://www.gypsum.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
ICBO	International Conference of Building Officials http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NBS	National Bureau of Standards See - NIST
NEC	National Electric Code See - NFPA National Fire Protection Association

NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org
NHLA	National Hardwood Lumber Association http://www.natlhardwood.org
NIH	National Institute of Health http://www.nih.gov
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
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.portcement.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
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org

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

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

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

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

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

TPI Truss Plate Institute, Inc.
583 D'Onofrio Drive; Suite 200
Madison, WI 53719
(608) 833-5900

UBC The Uniform Building Code
See ICBO

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

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

WCLIB West Coast Lumber Inspection Bureau
6980 SW Varns Road, P.O. Box 23145
Portland, OR 97223
(503) 639-0651

WWPA Western Wood Products Association
<http://www.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. The Contractor is responsible for all tests required to complete the project at no additional cost to the Government with no limit on the number of tests.

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

D. 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 the COTR 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 COTR 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 COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COTR to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COTR 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 COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COTR 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 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 D6938 wherever possible. Field density tests utilizing ASTM D1556 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 COTR before the tests are conducted.
- a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - b. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - c. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - d. 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.
 - e. 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 COTR. 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 COTR.
- requirements for curing and finishes have been met.

3.2 LANDSCAPING

- A. Test topsoil as indicated in 32 90 00, PLANTING.
- B. Submit laboratory test report of topsoil to COTR.

3.3 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
 - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D
 - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
 - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as

specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.4 SITE WORK CONCRETE

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

3.5 CONCRETE

A. Batch Plant Inspection and Materials Testing:

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed

- within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. COTR 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 COTR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COTR. 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.

2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COTR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m³ (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.6 REINFORCEMENT

- A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.7 ARCHITECTURAL PRECAST CONCRETE

- A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.
- B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Inspect members to insure specification requirements for curing and finishes have been met.

3.8 MASONRY

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

3.9 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
 - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
 - 3. Approve welder qualifications by certification or retesting.
 - 4. Approve procedure for control of distortion and shrinkage stresses.
 - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 - 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.

- b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Verify that correction of rejected welds are made in accordance with AWS D1.1.
 - i. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of

connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.

- d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COTR.

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SECTION 01 56 39
TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

Section Includes: Measures necessary for the protection of existing vegetation to be provided as specified.

1.2 QUALITY CONTROL

A. Qualifications

1. All assessments or treatment of damaged plants shall be done by a company specializing in landscape appraisal and arboriculture.
2. All Contractors shall be approved by the COTR.

- B. All materials and work shall comply with applicable sections of: A Guide for Estimating Value of Trees and Other Plants, Council of Tree and Landscape Appraisers, latest edition.

1.3 DESCRIPTION OF THE WORK

- A. The Contractor shall provide, erect, maintain and remove temporary fencing required to protect all existing vegetation identified by the COTR.
- B. The Contractor shall confine work to areas within contract limit lines and maintain barrier fences in good condition throughout construction of the project.
- C. The Contractor shall be responsible for any violation as established by this section and shall be subject to the fines as stated in the Schedule of Fines.
- D. Clearing and grubbing shall be limited to those areas shown or identified in the field by the COTR. Clearing and grubbing or construction shall not commence before completion of and COTR approval of protective barrier.

1.4 DEFINITIONS

- A. Protective Barrier: A fence installed as a temporary device for the purpose of preventing unauthorized access during the full period of construction and/or to protect existing vegetation from damage and disturbance.
- B. Damage: Physical change to the site or its vegetation caused by equipment, material, labor or grading operations which has occurred after a Notice to Proceed has been issued.

- C. Disturbance: Visual change to the site or vegetation caused by equipment, material, labor or grading operations which has occurred after a Notice to Proceed has been issued.
- D. Trespass: Any encroachment into protected areas caused by equipment, material, labor or grading operations which has occurred after a Notice to Proceed has been issued.
- E. Drip Line: The point where the foliage cover concentrates main water on the ground. This line follows the general configuration of the outermost edge of a tree or shrub formed by its leaves and branches.
- F. Existing Vegetation: Any existing tree, shrub, groundcover, wildflower, grass or weed mass which presently occurs on the site indicated to remain.
- G. Protection: Means of protecting existing site features from trespass, damage or disturbance by the use of barriers or other means necessary to prevent such trespass, damage or disturbance.
- H. Site: The area as shown on the survey belonging to the Owner including areas where construction occurs or access to the site is granted.
- I. Violation: Trespass, disturbance or damage caused by any construction, delivery or transportation vehicle; construction material through storage or usage; solid or liquid debris; or litter observed by the COTR who conveys the observed violation to the Contractor verbally, if possible, and in writing within 7 days of a violation. The written notice shall include the date, the approximate time, the general location and type of violation as indicated in the Schedule of Fines.
- J. Contract Limit Lines: Construction limits defined as shown and as identified in the field by the COTR.
- K. Initial Clearing Zone: Area within the construction limit lines, but not areas enclosed by protective barriers.

1.5 SITE CONDITIONS

- A. The site and surrounding property presently supports large stands of mature woodland. These stands are considered key landscape features, and are to be preserved and protected throughout the work.
- B. Clearing, grubbing and mass grading shall be confined to the initial clearing zone.

1.6 TEMPORARY FENCE

- A. Protection: Prior to commencing clearing operations, vegetation to be saved shall be protected by erecting a barrier in the location indicated and as approved in the field by the COTR. The barrier shall

be a minimum of 10 feet from each trunk or at the drip line, whichever is greater. The barriers shall remain in place until the COTR approves its removal.

- B. Material: Protection barriers shall be constructed of HDPE snow fence fabric. Fence shall be a minimum of 5 feet in height. Material shall be approved by the COTR. Fencing shall be strung on steel posts set at a maximum spacing of 10 feet center to center.

1.7 SCHEDULE OF FINES

- A. Disturbed or damaged trees shall be attended by a tree surgeon approved by the COTR. All costs incurred shall be paid by the Contractor, and the Contractor shall be assessed a fine based on a damage appraisal made in accordance with the latest edition of A Guide for Estimating the Value of Trees and Other Plants by an arborist approved by the COTR.
- B. Trees damaged shall be measured for size of trunk diameter according to the American Standard for Nursery Stock as prepared by the American Association of Nurserymen, Inc.
1. The caliper of the trunk shall be taken 6 inches above ground level for trees larger than 4 inches, up to and including 12 inch caliper.
 2. The caliper of the trunk shall be taken 4 feet, 6 inches above ground level for trees larger than 12 inch caliper.

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely effect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Effect 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. Contractor shall establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Contractor shall record on daily reports any problems in complying with laws, regulations, ordinances and note any corrective action taken.

1.4 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions, 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
- D. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

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

1.5 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the Contractor shall furnish the following:
1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the COTR to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the COTR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - 2) Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - d. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
 - e. Procedures to provide environmental protection that complies with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - f. Permits, licenses, and the location of the solid waste disposal area.

- g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by mandated state agency and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the COTR shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.6.PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the duration of this contract. 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 COTR. 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. Mark/fence/protect monuments, works of art, and markers prior to construction. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
 - 2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
 - a. Protect trees and shrubs to remain on site to protect from damage per contract details.

- b. All damage to existing trees and shrubs shall be immediately repaired by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
- a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local 2-year (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
 - b. Reuse or conserve the collected topsoil sediment as directed by the COTR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING (short form).
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown on the Demolition and Site Preparation Plans. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
6. Manage and control borrow and spoil areas on Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
7. Protect adjacent areas from despoilment by temporary excavations and embankments.

8. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 10. Handle discarded materials other than those included in the solid waste category as directed by the COTR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list protected species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the Arizona Department of Environmental Quality and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials from onsite material processing operations at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, 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 COTR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 7:00 a.m. and 6:00 p.m. unless otherwise permitted by local ordinance or the COTR. Repetitive impact noise on the property shall not exceed the following dB limitations:
- | Time Duration of Impact Noise | Sound Level in dB |
|-------------------------------------|-------------------|
| More than 12 minutes in any hour | 70 |
| Less than 30 seconds of any hour | 85 |
| Less than three minutes of any hour | 80 |
| Less than 12 minutes of any hour | 75 |
2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
- a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	SAWS	75

EARTHMOVING		MATERIALS HANDLING	
GENERATORS	75	VIBRATORS	75
COMPRESSORS	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 COTR 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 COTR. 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

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

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

- E. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery Property; any damaged items shall be repaired or replaced as approved by the (Contracting Officer's Technical Representative (COTR). The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any Repairs, reinforcement, or structural replacement must have COTR's approval.
- F. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- G. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction. Obtain COTR approval prior to any plant material removals and/or pruning activities.
- B. Erosion Control: Contractor shall 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. Contractor shall install silt fence and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.
- C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.

- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 6 inches. On-site topsoil in the project area is negligible.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping. Dispose of grass and associated organic materials off-site.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Planting 32 90 00 for soil amendments required prior to spreading topsoil.
 - a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the COTR.
- E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.
- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the

threat of erosion is gone by surface stabilization. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. Completely demolish and remove structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new improvements.
 - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, aggregate base, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COTR. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5 feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.
- D. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COTR. When Utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area.

3.3 CLEAN-UP

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COTR. 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
CAST-IN-PLACE CONCRETE (SHORT FORM)

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES

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

1.4 REGULATORY REQUIREMENTS

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

Wood, plywood, metal, or other materials, approved by COTR, 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. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

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 4000 psi .
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.

D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.

E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
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 and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following tables:

**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)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

**TABLE II TOTAL AIR CONTENT
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE**

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

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

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation 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:

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

3.3 VAPOR BARRIER:

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.
- B. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
- C. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
- D. Patch punctures and tears.

3.4 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COTR 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 COTR.

3.5 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 COTR.

3.6 FORM REMOVAL:

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

3.7 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by COTR, 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.

3.8 FINISHES:

- A. Vertical and Overhead Surface Finishes:
 - 1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
 - 2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by COTR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.

3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

B. Slab Finishes:

1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer

- be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.
5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs		Unshored suspended slabs	
Specified overall value	F _F 25/F _L 20	Specified overall value	F _F 25
Minimum local value	F _F 17/F _L 15	Minimum local value	F _F 17

3.9 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Aggregate shall be broadcast uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING:

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

3.11 RESURFACING FLOORS:

Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, wetting, and grouting. Apply topping as specified.

3.12 RETAINING WALLS:

- A. Concrete for retaining walls shall be as shown and air-entrained.

- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves as shown.
- C. Finish exposed surfaces to match adjacent concrete surfaces, new or existing.
- D. Porous backfill shall be placed as shown.

3.13 PRECAST CONCRETE ITEMS:

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

- - - E N D - - -

SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes the performance criteria, materials, production, and erection of architectural precast concrete units. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the contract drawings and includes the following:
1. Caps for the site walls.
 2. Caps for the seat walls.
 3. Caps for committal service shelter walls.
 4. Bollards at columbarium plazas.
 5. Sign posts.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- C. Mortar: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING
- D. Masonry Facing: Section 04 20 00, UNIT MASONRY.
- E. Insulation for Insulated Panels: Section 07 21 13, THERMAL INSULATION.
- F. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.
- G. Size, type and color of aggregate for exposed aggregate finish and matrix color: Section 09 06 00, SCHEDULE FOR FINISHES.
- H. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that complies with PCI MNL 117 and the following requirements and is experienced in producing units similar to those indicated for this Project and with a record of successful in-service performance:
1. Assumes responsibility for engineering units to comply with performance requirements. A Comprehensive Engineering Analysis shall be performed by a qualified professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

2. Participates in any nationally recognized Plant Certification program at the time of bidding.
3. Has sufficient production capacity to produce required units without delaying the work.

B. Erector Qualifications:

1. An erector with a minimum of 2 years of experience who has completed architectural precast concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance and who meets the following requirements:
 - a. Retains a nationally recognized Certified Field Auditor, at erector's expense, to conduct a field audit of a project in the same category as this Project prior to start of erection. Submits Erectors Post Audit Declaration.
 - b. The basis of the audit is the PCI MNL 127.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117.

1. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
2. After acceptance of repair technique, maintain one sample panel at the manufacturer's plant and one at the project site in an undisturbed condition as a standard for judging the completed work.
3. When back face of precast concrete unit is to be exposed, show samples of the workmanship, color, and texture of the backup concrete as well as the facing.
4. Demolish and remove sample panels only when directed.

D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01, GENERAL REQUIREMENTS.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide units and connections capable of withstanding: the design criteria specified on the drawings, self weights and weights of materials supported or attached, for the conditions indicated.

1. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, applicable to types of units indicated.
2. Limit deflection of precast members as follows:
 - a. Vertical live load - Span / 360.
 - b. Wind load - Floor to floor height times 0.0025.

3. Design for handling, transportation and erection stresses.
- B. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live load deflection, shrinkage and creep of primary building structure, and other building movements.
- C. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 27 deg C (80 deg F). Use other values, greater or smaller, whenever justified by climatic conditions at the project site.
- D. Calculated Fire-Test-Response Characteristics: Where indicated, provide units whose fire resistance has been calculated according to PCI MNL 124, and is acceptable to authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years or period of warranty, whichever is greater.
- B. Design Mixes: For each concrete mix along with compressive strength and water-absorption tests.
- C. Shop (Erection) Drawings: Detail fabrication and installation of units.
 1. Indicate member locations with distinctive marks that match marks placed on the panels. Provide plans, elevations, dimensions, corner details, shapes, cross sections and relationships to adjacent materials including special reinforcement and lifting devices necessary for handling and erection.
 2. Indicate aesthetic intent including joints, reveals, and extent and location of each surface finish.
 3. Indicate separate face and backup mix locations, and thicknesses. Indicate locations, extent and treatment of dry joints if two-stage casting is proposed.
 4. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, and connections.
 5. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
 6. Indicate sequence of erection.
 7. Indicate locations and details of facing materials, anchors, and joint widths.
 8. Design Modifications:
 - a. If design modifications are necessary to meet the performance requirements and field conditions, submit design calculations and drawings. Do not adversely affect the appearance, durability or

strength of units when modifying details or materials and maintain the general design concept.

- D. Comprehensive Engineering Analysis: Provide calculations signed and sealed by the qualified professional engineer responsible for the product design. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate design criteria and loads. Indicate the location, type, magnitude and direction of all imposed loadings from the precast system to the building structural frame.
- E. Samples: Design reference samples for initial verification of design intent, approximately 300 mm by 300 mm by full depth (12 in. by 12 in. by full depth, representative of finishes, color, and textures of exposed surfaces of units.
- F. Full-size samples for each mock-up cap required, showing the full range of color and texture expected. Supply sketch of each corner or special shape with dimensions. Supply sample showing color and texture of joint treatment.
 - 1. Precast units will be inspected at the site. Units which demonstrate lesser quality than accepted samples (outside the ranges established by the submitted and approved samples) shall not be acceptable.
 - 2. Submit non-shrink grout and sealants and caulk to be used with approved cap stones and obtain approval before manufacture of cap stones starts.
 - 3. Submit samples for anchors and ties, dowels, and other connectors indicated in the shop drawings.
- G. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel.
- H. Qualification Data for fabricator and professional engineer: List of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
- I. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Concrete strengths and mix designs.
- J. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
 - 1. Concrete materials.
 - 2. Reinforcing materials and pre-stressing tendons.
 - 3. Admixtures.
 - 4. Anchors.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Product handling requirements of PCI MNL 117 shall be followed at the plant and project site.
- B. Deliver all units to the project site in such quantities and at such times to assure compliance with the agreed project schedule and proper setting sequence so as to limit unloading units temporarily on the ground.
- C. Lift and support units only at designated points shown on the Shop Drawings.
- D. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
- E. Carefully handle, transport, and store precast members to prevent damage of any kind. Broken, chipped, stained, or damaged units will be subject to rejection unless permission to repair such defects is obtained in writing from the COTR. Members may be shipped after attaining 90% of specified ultimate compressive strength, but not before reaching an age of 7 days.
- F. Units damaged after erection shall be either repaired or replaced as determined by the COTR. No repairs shall be made until the damaged unit has been examined by the COTR and a proposed repair procedure has been submitted to, and accepted by, the COTR in writing. The COTR may require that repairs be made by the manufacturer. Costs for repair work shall be borne by the Contractor.
- G. Cover precast units to protect from soiling or damage by subsequent building operations, using reinforced building paper or other material acceptable to the COTR.

1.7 WARRANTY

- A. Warranty of precast concrete work, including anchorage, joint treatment and related components to be free from defects in materials and workmanship, including cracking and spalling.
- B. After erection, completed work will be weathertight, subject to terms of Article "Warranty of Construction" FAR clause 52.246-21, except warranty period is extended to five years.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
A27/A27M-08.....Steel Castings, Carbon, for General Application

A36/A36M-08.....Carbon Structural Steel
A47/A47M-99(R2009).....Ferritic Malleable Iron Castings
A82-07.....Steel Wire, Plain, for Concrete Reinforcement
A108-07.....Steel Bar, Carbon and Alloy, Cold-Finished
A123/A123M-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
A184/A184M-05.....Fabricated Deformed Steel Bar Mats for Concrete
Reinforcement
A185-07.....Steel Welded Wire Fabric, Plain, for Concrete
Reinforcement
A276-10.....Stainless Steel Bars and Shapes
A283/A283M-03(R2007)....Low and Intermediate Tensile Strength Carbon
Steel Plates
A307-07.....Carbon Steel Bolts and Studs, 60 000 PSI Tensile
Strength
A325/A325M-10.....Structural Bolts, Steel, Heat Treated, 120/105
ksi Minimum Tensile Strength
A416/A416M-10.....Steel strand, Uncoated Seven-Wire for
Prestressed Concrete
A490/A490M-10.....Structural Bolts, Alloy Steel, Heat Treated, 150
ksi Minimum Tensile Strength
A496-07.....Steel Wire, Deformed, for Concrete Reinforcement
A497-07.....Steel Welded Wire Reinforcement, Deformed, for
Concrete
A500-10.....Cold-Formed Welded and Seamless Carbon Steel
Structural Tubing in Rounds and Shapes
A563/A563M-07.....Carbon and Alloy Steel Nuts
A572/A572M-07.....High-Strength Low-Alloy Columbium-Vanadium
Structural Steel
A615/A615M-09a.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
A666-03.....Annealed or Cold-Worked Austenitic Stainless
Steel Sheet, Strip, Plate, and Flat Bar
A675/A675M-03(R2009)....Steel Bars, Carbon, Hot-Wrought, Special
Quality, Mechanical Properties
A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for
Concrete Reinforcement

A767/A767M-09.....Zinc-Coated (Galvanized) Steel Bars for Concrete
Reinforcement
A775/A775M-07.....Epoxy-Coated Steel Reinforcing Bars
A780-09.....Repair of Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings
A884/A884M-06.....Epoxy-Coated Steel Wire and Welded Wire Fabric
for Reinforcement
A934/A934M-07.....Epoxy-Coated Prefabricated Steel Reinforcing
Bars
B227-04.....Hard-Drawn Copper-Clad Steel Wire
B633-07.....Electrodeposited Coatings of Zinc on Iron and
Steel
C33-08.....Concrete Aggregates
C40-04.....Organic Impurities in Fine Aggregate for
Concrete
C150-09.....Portland Cement
C260-06.....Air-Entraining Admixtures for Concrete
C330-09.....Lightweight Aggregates for Structural Concrete
C373-88 (R2006).....Test Method for Water Absorption, Bulk Density,
Apparent Porosity, and Apparent Specific Gravity
of Fired Whiteware Products
C494/C494M-10.....Chemical Admixtures for Concrete
C618-08a.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use as a Mineral Admixture in
Concrete
C881/C881M-02.....for Epoxy-Resin-Base Bonding Systems for
Concrete
C979-05.....Pigments for Integrally Colored Concrete
C989-09.....Ground Granulated Blast-Furnace Slag for Use in
Concrete and Mortars
C1017/C1017M-07.....Chemical Admixtures for Use in Producing Flowing
Concrete
C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
C1218/C1218M-99 (R2008) Test Method for Water-Soluble Chloride in Mortar
and Concrete
C1240-05.....Silica Fume Used in Cementitious Mixtures
D412-06ae2.....Test Methods for Vulcanized Rubber and
Thermoplastic Elastomers—Tension
D2240-05.....Test Method for Rubber Property—Durometer
Hardness
F436/F436M-09.....Hardened Steel Washers

F568M-07.....Carbon and Alloy Steel Externally Threaded
Metric Fasteners

F593-02 (R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs

F844-07a.....Washers, Steel, Plain (Flat), Unhardened for
General Use

C. American Concrete Institute (ACI):

ACI 211.1-91.....Selecting Proportions for Normal, Heavyweight
and Mass Concrete (Reapproved 2002)

ACI 318/318M-08 (318R/318RM-08) Building Code Requirements for Structural
Concrete

D. American Association of State Highway and Transportation Officials

AASHTO LRFD-2010.....LRFD Bridge Design Specifications, U.S., 5th
Edition

AASHTO M251-06.....Elastomeric Bearings

E. Precast/Pre-stressed Concrete Institute (PCI):

MNL-117-96.....Quality Control for Plants and Production of
Architectural Precast Concrete Products

MNL-120-04.....Design Handbook - Precast and Prestressed
Concrete

MNL-124-04.....Design for Fire Resistance of Precast
Prestressed Concrete.

MNL-127-99.....Erector's Manual - Standards and Guidelines for
the Erection of Precast Concrete Products

MNL-135-00.....Tolerance Manual for Precast and Prestressed
Concrete Construction

TR-6-03.....Interim Guidelines for the Use of Self-
Consolidating Concrete

F. Military Specifications (MIL. Spec):

MIL-C882E-89.....Cloth, Duck, Cotton or Cotton-Polyester Blend
Synthetic Rubber, Impregnated, and Laminated,
Oil Resistant.

G. Structural Steel Painting Council (SSPC):

SSPC-Paint 20 (2002)....Zinc-Rich Primers (Type I, Inorganic, and Type
II, Organic).

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes:

1. Mold-Release Agent: Commercially produced liquid-release agent.

- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated.
- C. Reinforcement dowels and connections shall be securely and accurately placed as shown on the Drawings. Connection hardware shall be rigidly attached to the forms, or otherwise positively prevented from moving in any direction. Means of support shall be subject to the approval of the Owner's designated representative.
- D. In general, forms may be designed with a draft of 1/8" in 12", and all forms may have 1/8" radius corners to facilitate removal and reduce breakage.

2.2 REINFORCING MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.
 - 1. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.
- C. Plain Steel Wire: ASTM A 82, as drawn
- D. Plain Steel Welded Wire Fabric: ASTM A185
- E. Supports: Place reinforcement according to PCI MNL 117.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I or III.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33, with coarse aggregates complying with Class 5S
- C. Fine aggregate: ASTM C33; Washed, inert sand with color characteristics to produce concrete of a color which exactly matches the designated sample (silica sands required).
- D. Admixtures: Admixtures containing calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture are not permitted.
 - 1. Coloring Admixture: ASTM C979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading.
 - 2. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
 - 3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 4. Retarding Admixture: ASTM C494/C494M, Type B.
 - 5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 7. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - 8. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.

2.4 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

- B. Carbon-Steel Headed Studs: ASTM A108, Grades 1018 through 1020, cold finished of PCI MNL 117, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.
- C. Carbon-Steel Plate: ASTM A283/A283M.
- D. Malleable Iron Castings: ASTM A47/A47M. Grade 32510.
- E. Carbon-Steel Castings: ASTM A27/A27M, Grade U-60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A563/A563M, Grade A); and flat, unhardened steel washers (ASTM F844).
- K. High-Strength Bolts and Nuts: ASTM A325/A325M or ASTM A490/A490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A563/A563M) and hardened carbon-steel washers (ASTM F436/F436M).
- L. Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- M. Welding Electrodes: Comply with AWS standards.

2.5 GROUT MATERIALS

Non-metallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, Grade A for drypack and Grades B and C for flowable grout and of a consistency suitable for application within a 30-minute working time.

2.6 CONCRETE MIXES

- A. Prepare design mixes to match COTR's sample for each type of concrete required.
 - 1. Limit use of fly ash and granulated blast-furnace slag to 20 percent replacement of Portland cement by weight; metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Design mixes shall be prepared by a qualified independent testing agency or by qualified precast plant personnel at fabricator's option.

- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- D. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Release Strength at Transfer of Prestress: 24.1 MPa (3500 psi).
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.7 MOLD FABRICATION

- A. Molds: Accurately construct and maintain molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement and temperature changes.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: As indicated
 - 3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during placing of concrete.
 - 4. Coat contact surfaces of molds with release agent.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in units as indicated.
- D. Cast-in openings larger than 250 mm (10 inches) in any dimension.

- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
1. Place reinforcing steel and prestressing strand to maintain at least 19 mm (3/4 inch) minimum concrete cover. Increase cover requirements for reinforcing steel to 38 mm (1-1/2 inches) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 2. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
 3. Built-In Items: Provide slots, holes, and other accessories in units to receive dowels and other similar work as indicated.
 4. Anchorages: Provide loose dowels and other miscellaneous steel shapes not provided by other trades, necessary for securing precast units to supporting and adjacent members.
- F. Pre-stress tendons for units by pre-tensioning methods. Comply with PCI MNL 117.
- G. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting and placing concrete.
- I. Identify pickup points of units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each unit on a surface that will not show in finished structure.
- J. Cure concrete, according to requirements in PCI MNL 117.
- K. Repair damaged units to meet acceptability requirements of PCI MNL 117 and the COTR.

2.9 FABRICATION TOLERANCES

Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2.10 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight and sharp. Finish exposed-face surfaces of units to match approved mockups and as follows:

1. Exposed to View:

- a. All surfaces with exposure shall have a light sandblast finish.
- b. Smooth, As-Cast Finish: Where panel face is smooth, cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

2.11 SOURCE QUALITY CONTROL

A. Quality-Control Testing:

- 1. Test and inspect precast concrete according to Section 01 45 29, TESTING LABORATORY SERVICES and PCI MNL 117 requirements respectively.
- 2. If using self-consolidating concrete also test and inspect according to PCI TR-6.
- 3. Strength of precast panels must meet the requirements of ACI 318.

B. Testing: If there is evidence that the concrete strength of precast concrete units may be deficient, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to PCI MNL 117:

- 1. Test results will be made in writing on the same day that tests are performed, with copies to COTR, Contractor, and precast concrete fabricator. Test reports will include the information required in Section TESTING LABORATORY SERVICES and the following:
 - a. Identification mark and type of precast concrete units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

C. Defective or Damaged Work: Units that do not comply with acceptability requirements, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cored units may be repaired, if repaired units match the visual mock-up. The COTR reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- 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 shall immediately notify the Owner's designated representative.

- B. All Material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport.
- C. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.
- D. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Do not install units until supporting structural framing has attained minimum allowable design strength and structure is structurally ready to receive loads from precast.

3.2 ERECTION

- A. Erect level, plumb and square within the specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
 - 4. Unless otherwise shown provide for uniform joint widths of 19mm (3/4 inch).
- B. Connect units in position by bolting, welding, grouting, or as otherwise indicated on approved Erection Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
 - 1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.
 - 2. Welding: Comply with applicable requirements for welding.
 - a. Protect units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.

- b. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
 - c. Clean weld affected metal surfaces and apply a minimum 100 μ m (0.004 inch) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780.
 - d. Visually inspect all welds critical to precast connections. Visually check all welds for completion and remove, reweld or repair all defective welds.
3. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.
- a. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
4. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- C. Attachments: Upon approval of COTR, precast pre-stressed products may be drilled or "shot" for fasteners or small openings. Provided reinforcing or pre-stressing steel is not damaged or cut.
- 1. Should spalling occur, repair according to this specification section.
- D. Setting: Where shown, fill joints with cement mortar specified in Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING.
- 1. Clean surfaces forming beds and other joints for precast concrete panels of dust, dirt, and other foreign matter, and wet thoroughly to prevent suction before precast concrete, elements are set.
 - 2. Set precast element level and true to line with uniform joints filled completely with mortar.
Rake out joints 25 mm (1-inch) deep for pointing or sealants.
Joints required to have only sealant: Kept free of mortar for full depth.
 - 3. Keep exposed faces of precast concrete elements free of mortar.
 - 4. Remove wedges, spacers, or other appliances which are likely to cause staining from joints.
 - 5. Where parging is shown, parge back of elements solid with mortar. Apply parging without skips or holidays.

- E. Pointing: Wash and brush clean, leaving joints free from loose mortar, dust and other foreign material.
1. Carefully point with a slightly concave joint.
 2. Mortar for pointing as specified in Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING. Use same material and color sand used in fabrication of precast concrete elements when specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- F. Sealing of Joints: Where shown and where required to make work watertight: clean, dry and seal joints between precast concrete elements and between precast elements and adjoining materials as specified in Section 07 92 00, JOINT SEALANTS.

3.3 ERECTION TOLERANCES

Erect units level, plumb, square, true, and in alignment without exceeding the erection tolerances of PCI MNL 117, Appendix I.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Testing agency will report test results promptly and in writing to Contractor and COTR.
- C. Repair or remove and replace work that does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS

- A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 6 m (20 feet).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.
- D. Remove and replace damaged units when repairs do not meet requirements.

3.6 CLEANING

- A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

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

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SECTION 04 05 13
MASONRY MORTARING

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies mortar materials and mixes.

1.2 RELATED WORK:

A. Mortar used in Section:

1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 05 16, MASONRY GROUTING.
3. Section 04 20 00, UNIT MASONRY.
4. Section 04 43 00, NATURAL STONE VENEER

B. Mortar Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

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

1.4 TESTS

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

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 1. Testing laboratory's facilities and qualifications of its technical personnel.

2. Indicating that following items meet specifications:

- a. Portland cement.
- b. Masonry cement.
- c. Mortar cement.
- d. Hydrated lime.
- e. Fine aggregate (sand).
- f. Color admixture.

C. Laboratory Test Reports:

1. Mortar, each type.
2. Admixtures.

D. Manufacturer's Literature and Data:

1. Cement, each kind.
2. Hydrated lime.
3. Admixtures.
4. Liquid acrylic resin.
5. Portland Cement-Lime Mix

E. Pointing Mortar color samples:

1. Provide a minimum of five color samples to match the following:
 - a. Approved precast architectural concrete sample
 - b. Approved thin natural stone veneer
2. COTR to review and select pointing mortar color from submitted samples. The COTR reserves the right to request additional samples if those submitted are not deemed a satisfactory match.
3. Final pointing mortar color selections to be used in job mock-ups.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

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

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-05.....Masonry Cement
 - C109-07.....Compressive Strength of Hydraulic Cement Mortars
(Using 2-in. or 50-MM Cube Specimens)
 - C144-04.....Aggregate for Masonry Mortar
 - C150-05.....Portland Cement

C207-06.....Hydrated Lime for Masonry Purposes
C270-07.....Mortar for Unit Masonry
C595-08.....Blended Hydraulic Cement
C780-07.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
C979-05.....Pigments for Integrally Colored Concrete
C1329-05.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

A. ASTM C144 and as follows:

1. Light colored sand for mortar for laying face brick.
2. White plastering sand meeting sieve analysis for mortar joints for pointing and laying of structural facing tile units except that 100 percent passes No. 8 sieve, and not more than 5 percent retained on No. 16 sieve.

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 BLENDED HYDRAULIC CEMENT

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

ASTM C91. Type N, S, or M.

2.5 MORTAR CEMENT

ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT

ASTM C150, Type I.

2.7 LIQUID ACRYLIC RESIN

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

2.8 WATER

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

2.9 POINTING MORTAR

- A. For Precast Architectural Concrete or Natural Stone Veneer joints:
Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.
- B. Color Admixtures:
1. Proportion as specified by manufacturer.

C. Color:

1. For joints in Precast Architectural Concrete Caps: As selected and approved during submittals phase and mock-up approval.
2. For joints in Natural Stone Veneer: As selected and approved during submittals phase and mock-up approval.

2.10 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, except color admixtures if approved by COTR.
2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
3. Do not use antifreeze compounds.

C. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.
2. Match mortar color in approved sample.
3. Color of mortar for exposed work in alteration work to match color of existing mortar unless specified otherwise in section 09 06 00, SCHEDULE FOR FINISHES.

D. Color Admixtures:

1. Proportion as specified by manufacturer.
2. For color, see Section 09 06 00, SCHEDULE FOR FINISHES.

2.11 COLOR ADMIXTURE

A. Pigments: ASTM C979.

B. Use mineral pigments only. Organic pigments are not acceptable.

C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.1 MIXING

A. Mix in a mechanically operated mortar mixer.

1. Mix mortar for at least three minutes but not more than five minutes.

B. Measure ingredients by volume. Measure by the use of a container of known capacity.

C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.

D. Mortar that has stiffened because of loss of water through evaporations:

1. Re-tempered by adding water to restore to proper consistency and workability.

2. Discard mortar that has reached its initial set or has not been used within two hours.

E. Pointing Mortar:

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

3.2 MORTAR USE LOCATION

- A. Use Type M mortar for waterproof parging below grade.
- B. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered) and engineered reinforced unit masonry work.
- C. Use Portland Cement-Lime in bedding mortar for Natural Stone Veneer.
- D. Use pointing mortar for items specified.

- - - E N D - - -

SECTION 04 05 16
MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies grout materials and mixes.

1.2 RELATED WORK:

A. Grout used in Section:

1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 20 00, UNIT MASONRY.

B. Grout Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTS:

A. Test grout and materials specified.

B. Certified test reports.

C. Identify materials by type, brand name and manufacturer or by origin.

D. Do not use materials until laboratory test reports are approved by Resident Engineer.

E. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.

F. Testing:

1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
2. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
3. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS:

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

B. Certificates:

1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Grout.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - f. Coarse aggregate for grout.

C. Laboratory Test Reports:

1. Grout, each type.

2. Admixtures.

D. Manufacturer's Literature and Data:

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

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

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

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-05.....Masonry Cement
 - C150-07.....Portland Cement
 - C207-06.....Hydrated Lime for Masonry Purposes
 - C404-07.....Aggregate for Masonry Grout
 - C476-08.....Grout for Masonry
 - C595-08.....Blended Hydraulic Cement
 - C979-05.....Pigments for Integrally Colored Concrete
 - C1019-09.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 MASONRY CEMENT:

ASTM C91. Type N, S, or M.

2.4 PORTLAND CEMENT:

ASTM C150, Type I.

2.5 LIQUID ACRYLIC RESIN:

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

2.6 WATER:

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

2.7 GROUT:

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

PART 3 - EXECUTION

3.1 MIXING:

- A. Mix in a mechanically operated grout mixer.
 - 1. Mix grout for at least five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.
- B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).
- C. Do not use grout for filling bond beam or lintel units.

- - - E N D - - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

- A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- C. Cavity insulation: Section 07 21 13, THERMAL INSULATION.
- D. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- F. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Concrete masonry units, when exposed in finish work.
 - 2. Anchors, and ties, one each and joint reinforcing 305 mm (12 inches) long.
- C. Certificates:
 - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 - 2. Indicating that the following items meet specification requirements:
 - a. Face brick.
 - b. Solid and load-bearing concrete masonry units.
 - 3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
- D. Manufacturer's Literature and Data:
 - 1. Anchors, ties, and reinforcement.
 - 2. Reinforcing bars.

1.4 WARRANTY

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

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A615/A615M-09.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - A675/A675M-09.....Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
 - A951-06.....Steel Wire for Masonry Joint Reinforcement.
 - C67-08.....Sampling and Testing Brick and Structural Clay Tile
 - C90-08.....Load-Bearing Concrete Masonry Units
 - C216-07a.....Facing Brick (Solid Masonry Units Made From Clay or Shale)
 - C476-08.....Standard Specification for Grout for Masonry
 - C612-04e1.....Mineral Fiber Block and Board Thermal Insulation
 - C744-08.....Prefaced Concrete and Calcium Silicate Masonry Units.
 - D1056-07.....Flexible Cellular Materials - Sponge or Expanded Rubber
 - D3574-08.....Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams
 - F1667-05.....Fasteners: Nails, Spikes and Staples
- C. Masonry Industry Council:
- Hot and Cold Weather Masonry Construction Manual, 1999.
- D. American Welding Society (AWS):
- D1.4-05.....Structural Welding Code - Reinforcing Steel.
- E. Masonry Standards Joint Committee; Specifications for Masonry Structures (ACI 530.1-08/ASCE 6-05/TMS 602-05) (MSJC).
- F. American Concrete Institute (ACI)
- ACI 315-99.....Details and Detailing of Concrete Reinforcement

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
- 1. Unit Weight: Normal weight.

2.2 REINFORCEMENT

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

B. Where 6 mm diameter (No. 2) bars are shown, provide plain, round, carbon steel bars, ASTM A675, 550 MPa (Grade 80).

C. Joint Reinforcement:

1. Form from wire complying with ASTM A951.
2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (1 5/8-inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcing at least 3000 mm (10 feet) in length.
6. Joint reinforcing in rolls is not acceptable.
7. Joint reinforcing that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.
9. Ladder Design:
 - a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
 - b. Cross wires 4 mm (0.16 inch) diameter.
10. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
 - b. Longitudinal wires deformed.

2.3 ANCHORS, TIES, AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.

B. Joint Reinforcement:

1. Form from wire complying with ASTM A951.
2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (0.16 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement at least 3000 mm (10 feet) in length.
6. Joint reinforcement in rolls is not acceptable.
7. Joint reinforcement that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
9. Ladder Design:
 - a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
 - b. Cross wires 4 mm (0.16 inch) diameter.
10. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
 - b. Longitudinal wires deformed.

C. Adjustable Veneer Anchor for Frame Walls:

1. Two piece, adjustable anchor and tie.
 2. Anchor and tie may be either type; use only one type throughout.
 3. Loop Type:
 - a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.
 - b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer.
 4. Angle Type:
 - a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.
- D. Corrugated Wall Tie:
1. Form from 1.5 mm (0.0598 inch) thick corrugated, galvanized steel 30 mm (1-1/4 inches) wide by lengths so as to extend at least 100 mm (4 inches) into joints of new masonry plus 38 mm (1-1/2 inch) turn-up.
 2. Provide 5 mm (3/16 inch) hole in turn-up for fastener attachment.

2.4 PREFORMED COMPRESSIBLE JOINT FILLER

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
- C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

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

3.2 CONSTRUCTION TOLERANCES

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

B. Maximum variation from plumb:

1. In 3,000 mm (10 feet) - 6 mm (1/4 inch).
2. In 6,000 mm (20 feet) - 10 mm (3/8 inch).

C. Maximum variation from level:

1. In any bay or up to 6,000 mm (20 feet) - 6 mm (1/4 inch).
2. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).

D. Maximum variation from linear building lines:

1. In any bay or up to 6,000 mm (20 feet) - 13 mm (1/2 inch).
2. In 12,000 mm (40 feet) or more - 19 mm (3/4 inch).

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:

1. Minus 6 mm (1/4 inch).
2. Plus 13 mm (1/2 inch).

F. Maximum variation in prepared opening dimensions:

1. Accurate to minus 0 mm (0 inch).
2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

A. Keep finish work free from mortar smears or spatters, and leave neat and clean.

B. Anchor masonry as specified in Paragraph, ANCHORAGE.

C. Wall Openings:

1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
2. If items are not available when walls are built, prepare openings for subsequent installation.

D. Tooling Joints:

1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
2. Tool while mortar is soft enough to be compressed into joints and not raked out.
3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
4. Tool Exposed interior joints in finish work concave unless specified otherwise.

E. Lintels:

1. Lintels are not required for openings less than 1,000 mm (3 feet 4 inches) wide that have hollow metal frames.
2. Openings 610 mm (2 feet 0 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and

- bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
3. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, and brick masonry unless shown otherwise.
 4. Length for minimum bearing of 100 mm (4 inches) at ends.
- F. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- G. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- H. Wetting and Wetting Test:
1. Test and wet brick in accordance with BIA 11B.
 2. Do not wet concrete masonry units before laying.

3.4 REINFORCEMENT

- A. Joint Reinforcement:
1. Use as joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
- B. Steel Reinforcing Bars:
1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.

3.5 CONCRETE MASONRY UNITS

- A. Kind and Users:
1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
 2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
- B. Laying:
1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length.
 2. Do not wet concrete masonry units before laying.
 3. Bond external corners of partitions by overlapping alternate courses.
 4. Lay first course in a full mortar bed.
 5. Set anchorage items as work progress.
 6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.

7. Provide a 6 mm (1/4 inch) open joint for caulking between exterior walls, concrete work.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar.
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
12. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.

3.6 GROUTING

A. Preparation:

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

B. Placing:

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

3.7 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the COTR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.

- E. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

3.8 CLEANING AND REPAIR

- A. General:
 - 1. Clean exposed masonry surfaces on completion.
 - 2. Protect adjoining construction materials and landscaping during cleaning operations.
 - 3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
 - 4. Remove mortar droppings and other foreign substances from wall surfaces.
- B. Concrete Masonry Units:
 - 1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
 - 2. Allow mud to dry before brushing.

- - - E N D - - -

SECTION 04 43 00
NATURAL STONE VENEER

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for construction of natural stone veneer.

1.2 RELATED WORK

- A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Concrete Masonry back-up wall: Section 04 20 00, UNIT MASONRY.
- C. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- D. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- F. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Stone Veneer, sample, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of stone, bond, and proposed mortar joints.
 - 2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
- C. Certificates:
 - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 - 2. Indicating that the following items meet specification requirements:
 - a. Stone veneer.
- D. Manufacturer's Literature and Data:
 - 1. Anchors, ties, and reinforcement.
 - 2. Reinforcing bars.

1.4 WARRANTY

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

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A82/A82M-07.....Standard Specification for Steel Wire, for
Concrete Reinforcement
 - A153/A153M-09.....Standard Specification for Zinc Coating (Hot-
Dip) on Iron and Steel Hardware
 - A951-06.....Steel Wire for Masonry Joint Reinforcement
 - C119-08.....Standard Terminology Relating to Dimension Stone
 - C568-08a.....Standard Specifications for Limestone Dimension
Stone
 - C615-03.....Standard Specification for Granite Dimension
Stone
 - C616-08Standard Specification for Quartz-Based
Dimension Stone
 - C1242-05..... Standard Guide for Selection, Design, and
Installation of Dimension Stone Anchoring
Systems
 - C1353-09..... Standard Test Method for Abrasion Resistance of
Dimension Stone Subjected to Foot Traffic Using
a Rotary Platform, Double-Head Abraser
 - C1515-01.....Standard Guide to Cleaning of Exterior Dimension
Stone, Vertical and Horizontal Surfaces, New or
Existing
 - C1528-09.....Standard Guide for Selection of Dimension Stone
for Exterior Use
 - D1056-07.....Standard Specification for Flexible Cellular
Materials - Sponge Expanded Rubber
 - D7089-06.....Standard Practice for Determination of the
Effectiveness of Anti-Graffiti Coating for Use
on Concrete, Masonry, and Natural Stone Surfaces
by Pressure Washing
- C. Masonry Industry Council:
All Weather Masonry Construction Manual, 2000.
- D. Federal Specifications (FS):
FF-S-107C-00.....Screws, Tapping and Drive
- E. International Masonry Industry All Weather Council (IMIAC): Recommended
Practices and Guide Specification for Cold Weather Masonry Construction

PART 2 - PRODUCTS

2.1 ACCEPTABLE STONE PRODUCTS

- A. Quartz Based Stone: Comply with ASTM C 616,
Classification II Quartzitic Sandstone
1. Face Size: As indicated
 2. Natural Stone Thin Veneer: 1 ½" thick.
 3. Color Range shall be light to medium pink snap cut stone.
 4. Thin veneer stone to be Arizona Sandston, color Rosa, as supplied by
AZ Flagstone Supply, or approved eual.
AZ Flagstone Supply
100 Sierra Rd
Sedona, AZ 86336
928-848-0083

2.2 REINFORCEMENT AND ANCHORAGES

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply paragraphs below, unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82; with ASTM A153/153M, Class B-2 coating.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but at least 16mm (5/8 inch) cover on outside face. Outer ends of wires are bent 90 degrees and extend 50 mm (2 inches) parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 100 mm (4 inches).
1. Where withes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 32 mm (1-1/4 inches).
 2. Wire: Fabricate from 4.8 mm (3/16 inch) diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls, unless otherwise indicated.
 3. Acceptable Product: Heckman Building Products Inc.; No. 262.
- D. Adjustable Masonry-Veneer Anchors
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 445 N (100 lbf) load in both tension and compression without deforming or developing play in excess of 1.3 mm (0.05 inch).
 2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

- a. Anchor Section: Zinc-alloy barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
- b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 4.8 mm (0.188 inch) diameter, hot-dip galvanized steel wire.
- c. Acceptable Product: Heckmann Building Products, Inc.; No. 75 Pos-I-Tie.

2.3 ACCESSORIES

- A. Joint Sealant: Refer to Section 07 92 00.
- B. Galvanized Diamond Mesh Metal Lath: 1.8 kg/ sq m (3.4lb/sq yd) self furring, diamond mesh lath complying with ASTM C847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G60 (Z180)
- C. Lath Attachment Devices: Material and type required by ASTM C1063 for installation indicated.
- D. Weep Holes: Leave-out of full head mortar joints.
- E. Mortar: Refer to Section 04 05 13.
- F. Expansion Joint Fillers: ASTM D1056 Class RE-11.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

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

3.3 COURSING

- A. Place masonry to lines and level indicated.
- B. Arrange and trim stones for adequate fit in a range ashlar pattern with course heights as indicated, random lengths, uniform joint widths with offset between vertical joints as indicated.

3.4 PLACING AND BONDING

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

3.5 TOLERANCES

- A. Alignment of Columns: Maximum of 6 mm (1/4 inch) from true line.
- B. Variation from Unit to Adjacent Unit: 0.8 mm (1/32 inch) maximum.
- C. Variation from Plane of Wall: 6 mm (1/4 inch) in 3 m (10 feet) and 12 mm (1/2 inch) in 6 m (20 feet) or more.
- D. Variation from Plumb: 6 mm (1/4 inch) per story non-cumulative, 12 mm (1/2 inch) in two stories or more.
- E. Variation from Level Coursing: 3 mm (1/8 inch) in 1 m (3 feet); 6 mm (1/4 inch) in 3 m (10 feet); 6 mm (1/4 inch) maximum.
- F. Variation of Joint Thickness: 3 mm (1/8 inch) in 1 m (3 feet).
- G. Maximum variation from Cross Sectional Thickness of Walls: Plus or minus 6 mm (1/4 inch).

3.6 REINFORCEMENT AND ANCHORAGES

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

3.7 MASONRY FLASHINGS

- A. Extend flashings to exterior face of veneer, turn up a minimum of 200 mm (8 inches) and seal onto face of sheathing over stud framed back-up.

- B. Lap end joints minimum 150 mm (6 inches) and seal watertight per manufacturer's recommendation.
- C. Use flashing manufacturer's recommended adhesive and termination sealant.
- D. Create end dams at end of window heads, and other vertical elements to channel water to nearest weep hole away from windows and other items which might allow water to travel vertically.

3.8 LINTELS

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

3.9 WEEPS AND VENTS

Install weep holes in veneer at 600 mm (24 inches) on center horizontally for clay masonry and 800 mm (32 inches) on center for 400 mm (16 inch) long concrete masonry, above through-wall flashing, above shelf angles, and at bottom of walls.

3.10 CONTROL/EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcing across control joints.
- B. Size control joints in accordance with Section 07 92 00 for sealant performance, but in no case larger than adjacent mortar joints in exposed face brick.
- C. Provide expansion joints as indicated.

3.11 BUILT-IN WORK

- A. As work progresses, build-in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built in the work supplied by other Sections.
- B. Build-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in mortar joints. Fill frame voids solid with mortar. Fill masonry cores with grout minimum 300 mm (12 inches) from framed openings.
- D. Do not build-in organic materials subject to deterioration.

3.12 CUTTING AND FITTING

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

3.13 CLEANING

- A. Remove excess mortar and smears.
- B. Replace defective mortar. Match adjacent work.

- C. Clean soiled surfaces with non-acidic solution which will not harm masonry or adjacent materials. Consult masonry manufacturer for acceptable cleaners. Leave surfaces thoroughly clean and free of all mortar and other soiling.
- D. Use non-metallic tools in cleaning operations.
- E. ASTM C1515 and D7089.

3.14 PROTECTION

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

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 QUALITY ASSURANCE

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Fabricator shall provide certificates, shop drawings and inspections. Past experience of proposed fabricator shall be reviewed and approved by the COTR prior to start of work.
- B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the COTR.

1.4 TOLERANCES

- A. Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information (AISC ASD Manual, Ninth Edition, Page 1-145 // LRFD Manual, Second Edition, Page 1-183 //), except as follows:
 - 1. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).
 - 2. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 REGULATORY REQUIREMENTS

- A. AISC: Specification for Structural Steel Buildings - Allowable Stress Design. // LRFD Specification for Structural Steel Buildings. //
- B. AISC: Code of Standard Practice for Steel Buildings and Bridges.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings: Complete
- C. Certificates:

1. Structural steel.
 2. Steel for all connections.
 3. Welding materials.
 4. Shop coat primer paint.
- D. Test Reports:
1. Welders' qualifying tests.
- E. Design Calculations and Drawings:
1. Connection calculations, if required.
- F. Record Surveys.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Ninth Edition, 1989)
 2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Second Edition, 1995)
 3. Code of Standard Practice for Steel Buildings and Bridges (March 2000).
- C. American National Standards Institute (ANSI):
- B18.22.1-03.....Plain Washers
- B18.22M-05.....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
- A6/A6M-08a.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
- A36/A36M-08.....Standard Specification for Carbon Structural Steel
- A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A123/A123M-08.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A242/A242M-04e1.....Standard Specification for High-Strength Low-Alloy Structural Steel
- A283/A283M-07.....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- A307-07b.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

- A325-07a.....Standard Specification for Structural Bolts,
Steel, Heat Treated, 120/105 ksi Minimum Tensile
Strength
- A490-08a.....Standard Specification for Heat-Treated Steel
Structural Bolts 150 ksi Minimum Tensile
Strength
- A500-07.....Standard Specification for Cold Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes
- A501-07.....Standard Specification for Hot-Formed Welded and
Seamless Carbon Steel Structural Tubing
- A572/A572M-07.....Standard Specification for High-Strength
Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-06a.....Standard Specification for Structural Steel
Shapes
- E. American Welding Society (AWS):
D1.1-08.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering
Foundation:
Specification for Structural Joints Using ASTM A325 or A490 Bolts (2000)
- G. Military Specifications (Mil. Spec.):
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing,
Repair (2003)
- H. Occupational Safety and Health Administration (OSHA):
29 CFR Part 1926-2006...Safety Standards for Steel Erection

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A36, A242, and A283, GRADE A992.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
1. High-strength bolts, including nuts and washers: ASTM A325 and A490, as required.
 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Zinc Coating: ASTM A123.
- G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

PART 3 - EXECUTION

3.1 CONNECTIONS (SHOP AND FIELD)

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

3.2 FABRICATION

Fabrication in accordance with Chapter M, Specification for Steel Buildings - Allowable Stress Design and Plastic Design, Load and Resistance Factor Design.

3.3 SHOP PAINTING

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

3.4 ERECTION

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

3.5 FIELD PAINTING

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

3.6 SURVEY

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

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SECTION 05 31 00
STEEL DECKING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 DESIGN REQUIREMENTS

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

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Underwriters' Label: Provide metal floor deck units listed in Underwriters' Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.
- B. FM Listing: Provide metal roof deck units which have been evaluated by Factory Mutual Global and are listed in "Factory Mutual Research Approval Guide" for "Class 1" fire rated construction.

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 Society for Testing and Materials (ASTM):
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A611-97.....Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled
 - A653/A653M-08.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
 - C423-08a.....Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- C. American Institute of Steel Construction (AISC):
 - 1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Latest Edition)
 - 2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Latest Edition)
- D. American Iron and Steel Institute (AISI):
 - 1. Specification and Commentary for the Design of Cold-Formed Steel Structural Members
- E. American Welding Society (AWS):
 - D1.3-08.....Structural Welding Code - Sheet Steel
- F. Factory Mutual (FM Global):
 - 1. Loss Prevention Data Sheet 1-28: Design Wind Loads (2002)
 - 2. Factory Mutual Research Approval Guide (2005)
- G. Military Specifications (Mil. Spec.)
 - MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair (2003)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Decking: ASTM A653, Structural Quality.
- B. Galvanizing: ASTM A653, G90.
- C. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B.
- D. Primer for Shop Painted Sheets: Manufacturer's standard primer (2 coats). When finish painting of steel decking is specified in Section 09 91 00, PAINTING primer coating shall be compatible with specified finish painting.
- E. Miscellaneous Steel Shapes: ASTM A36.
- F. Welding Electrode: E60XX minimum.
- G. Sheet Metal Accessories: ASTM A653, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:
 - 1. Metal Cover Plates: For end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings. Same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.
 - 2. Continuous Sheet Metal Edging: At openings, concrete slab edges and roof deck edges. Same quality as deck units but not less than 1.3 mm (18 gauge) steel. Side and end closures supporting concrete and their attachment to supporting steel shall be designed by the manufacturer to safely support the wet weight of concrete and construction loads. The deflection of cantilever closures shall be limited to 3 mm (1/8 inch) maximum.
 - 3. Metal Closure Strips: For openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.
 - 4. Ridge and Valley Plates: Provide 1.3 mm (18 gauge), minimum 100 mm (4 inch) wide ridge and valley plates where roof slope exceeds 40 mm per meter (1/2 inch per foot).
 - 5. Cant Strips: Provide bent metal 45 degree leg cant strips where indicated on the Drawings. Fabricate cant strips from 1 mm (20 gauge) metal with a minimum 125 mm (5 inch) face width.
 - 6. Seat Angles for Deck: Provide where a beam does not frame into a column.
 - 7. Sump Pans for Roof Drains: Fabricated from single piece of minimum 1.9 mm (14 gauge) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown.

Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 75 mm (3 inches) wide. Recess pans not less than 38 mm (1 1/2 inches) below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

2.2 REQUIREMENTS

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

PART 3 - EXECUTION

3.1 ERECTION

- A. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Remove any oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.
- B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
- C. Do not use floor deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace any deck units that become damaged after erection and prior to casting concrete at no cost to the Government.
- D. Provide steel decking in sufficient lengths to extend over 3 or more spans.
- E. Place steel decking units at right angles to supporting members. End laps of sheets of roof deck shall be a minimum of 50 mm (2 inches) and shall occur over supports.
- F. Fastening Deck Units:
 - 1. Fasten floor deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. with a minimum

of two welds per unit at each support. Where two units abut, fasten each unit individually to the supporting steel framework.

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

G. Cutting and Fitting:

1. Cut all metal deck units to proper length in the shop prior to shipping.
2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the Structural Drawings.
3. Other penetrations shown on the approved metal deck shop drawings but not shown on the Structural Drawings are to be located, cut and reinforced by the trade requiring the opening.
4. Make all cuts neat and trim using a metal saw, drill or punchout device; cutting with torches is expressly prohibited.
5. Do not make any cuts in the metal deck that are not shown on the approved metal deck drawings. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and any other openings and supports in the immediate area. Do not cut the opening until the sketch has

been reviewed and accepted by the COTR. Provide any additional reinforcing or framing required for the opening at no cost to the Government. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected metal deck.

6. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

3.2 WELDING

Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.3.

3.3 FIELD REPAIR

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

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
 - 1. Support for Wall and Ceiling Mounted Items:

1.2 RELATED WORK

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

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS AND PRODUCT DATA.
- B. Shop Drawings:
 - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
 - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
 - 3. Provide templates and rough-in measurements as required.
- C. Manufacturer's Certificates:
 - 1. Anodized finish as specified.
 - 2. Live load designs as specified.
- D. Design Calculations for specified live loads including dead loads.
- E. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

1.4 QUALITY ASSURANCE

- A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.
- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
B18.6.1-81(R1997).....Wood Screws
B18.2.2-87(R2005).....Square and Hex Nuts
- C. American Society for Testing and Materials (ASTM):
A36/A36M-08.....Structural Steel
A47-99(R2004).....Malleable Iron Castings
A48-03(R2008).....Gray Iron Castings
A53-07.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
Welded and Seamless
A123-08.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A269-08.....Seamless and Welded Austenitic Stainless Steel
Tubing for General Service
A307-07.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile
Strength
A653/A653M-08.....Steel Sheet, Zinc Coated (Galvanized) or Zinc-
Iron Alloy Coated (Galvannealed) by the Hot-Dip
Process
B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes
C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
F436-09.....Hardened Steel Washers
F468-06.....Nonferrous Bolts, Hex Cap Screws, and Studs for
General Use
F593-02(2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs
F1667-05.....Driven Fasteners: Nails, Spikes and Staples
- D. American Welding Society (AWS):
D1.1-04.....Structural Welding Code Steel
D1.2-03.....Structural Welding Code Aluminum
D1.3-98.....Structural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
AMP 500-505-1988.....Metal Finishes Manual
- F. Structural Steel Painting Council (SSPC):
SP 1-05.....No. 1, Solvent Cleaning
SP 2-05.....No. 2, Hand Tool Cleaning
SP 3-05.....No. 3, Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A36.
- B. Stainless Steel: ASTM A167, Type 302 or 304.
- C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified.
For structural shapes use alloy 6061-T6 and alloy 6061-T4511.
- D. Cast-Iron: ASTM A48, Class 30, commercial pattern.
- E. Primer Paint: As specified in Section 09 91 00, PAINTING.
- F. Grout: ASTM C1107, pourable type.

2.2 HARDWARE

- A. Rough Hardware:
 - 1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
 - 2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal is used.
- B. Fasteners:
 - 1. Bolts with Nuts:
 - a. ASME B18.2.2.
 - b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
 - c. ASTM F468 for nonferrous bolts.
 - d. ASTM F593 for stainless steel.
 - 2. Screws: ASME B18.6.1.
 - 3. Washers: ASTM F436, type to suit material and anchorage.
 - 4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.3 FABRICATION GENERAL

- A. Material
 - 1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
 - 2. Use material free of defects which could affect the appearance or service ability of the finished product.
- B. Size:
 - 1. Size and thickness of members as shown.
- C. Connections
 - 1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
 - 2. Field riveting will not be approved.

3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable member's machine screws or bolts.

D. Fasteners and Anchors

1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship

1. General:
 - a. Fabricate items to design shown.
 - b. Furnish members in longest lengths commercially available within the limits shown and specified.
 - c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
 - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
 - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
 - f. Prepare members for the installation and fitting of hardware.

- g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
- h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
- 2. Welding:
 - a. Weld in accordance with AWS standards as listed in article Applicable Publications.
- 3. Joining:
 - a. Miter or butt members at corners.
 - b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
- 4. Anchors:
 - a. Provide as indicated.
- 5. Cutting and Fitting:
 - a. Accurately cut, machine and fit joints, corners, copes, and miters.
 - b. Fit removable members to be easily removed.
 - c. Design and construct field connections in the most practical place for appearance and ease of installation.
 - d. Fit pieces together as required.
 - e. Fabricate connections for ease of assembly and disassembly without use of special tools.
 - f. Joints firm when assembled.
 - g. Conceal joining, fitting and welding on exposed work as far as practical.
 - h. Do not show rivets and screws prominently on the exposed face.
 - i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.
- F. Finish:
 - 1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
 - 2. Aluminum: NAAMM AMP 501.
 - a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
 - b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
 - c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.

- d. Painted: AA-C22R10.
- 3. Steel and Iron: NAAMM AMP 504.
 - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
 - b. Surfaces exposed in the finished work:
 - 1) Finish smooth rough surfaces and remove projections.
 - 2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
 - c. Shop Prime Painting:
 - 1) Surfaces of Ferrous metal:
 - a) Provide as defined in SSPC-SP2 and SP3.
 - 2) Non ferrous metals: Comply with MAAMM-500 series.
- G. Protection:
 - 1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
 - 2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

2.4 SUPPORTS

- A. General:
 - 1. Fabricate ASTM A36 structural steel shapes as shown.
 - 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
 - 3. Field connections may be welded or bolted.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
 - 1. Provide temporary bracing for such items until concrete or masonry is set.
 - 2. Place in accordance with setting drawings and instructions.
 - 3. Build strap anchors, into masonry as work progresses.
- C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
- D. Field weld in accordance with AWS.
 - 1. Design and finish as specified for shop welding.
 - 2. Use continuous weld unless specified otherwise.

- E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
- G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.

3.2 INSTALLATION OF SUPPORTS

- A. Anchorage to structure.
 - 1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
 - 2. Secure supports to concrete inserts by bolting or continuous welding as shown.
 - 3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts unless shown otherwise.
 - 4. Secure steel plate or hat channels to studs as detailed.

3.3 CLEAN AND ADJUSTING

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

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SECTION 07 11 13
BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials and workmanship for bituminous dampproofing on concrete and masonry surfaces.

1.2 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Product description.
 - 2. Application instructions.

1.3 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - D226-06.....Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - D449-03(R2008).....Asphalt Used in Dampproofing and Waterproofing
 - D1227-95(R2007).....Emulsified Asphalt Used as a Protective Coating for Roofing

PART 2 - PRODUCTS

2.1 ASPHALT (HOT APPLIED):

ASTM D449, Type I.

2.2 ASPHALT SATURATED FELT:

ASTM D226, Type I, 7 kg (15 pound).

2.3 ASPHALT EMULSION (COLD APPLIED):

ASTM D1227, Type III (spray grade)

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

- A. Surfaces to receive dampproofing shall be clean and smooth.
- B. Remove foreign matter, loose particles of mortar or other cementitious droppings.
- C. Clean and wash soil or dirt particles from surface.
- D. Remove free water; surfaces may remain damp.

3.2 APPLICATION:

- A. Comply with Manufacturer written instructions for methods and rates of dampproofing application, cleaning and installation of any protection course.
- B. Apply each coat at the rate of not less than 1 L/m² (2-1/2 gallons per 100 square feet) and allow not less than 24 hours drying time after application.

3.3 LOCATION:

- A. Apply to surfaces where shown.

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SECTION 07 13 52
MODIFIED BITUMINOUS SHEET WATERPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies modified bituminous sheet material used for exterior below grade waterproofing.

1.2 MANUFACTURER'S QUALIFICATIONS:

- A. Approval by Contracting Officer is required of products and services of proposed manufacturers, and installers, and will be based upon submission by Contractor that:
1. Manufacturer regularly and presently manufactures bituminous sheet waterproofing as one of its principal products.
 2. Installer has technical qualifications, experience, trained personnel and facilities to install specified items.
 3. Manufacturer's product submitted has been in satisfactory and efficient operation on three similar installations for at least three years.
 4. Submit list of installations, include name and location of project and name of owner.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Bituminous sheet.
 2. Primer.
 3. Mastic.
 4. Protection material, temporary and permanent.
 5. Printed installation instructions for conditions specified.
- C. Certificates:
1. Indicating bituminous sheet manufacturer's approval of primer, and roof cement.
 2. Indicating bituminous sheet waterproofing manufacturer's qualifications as specified.
 3. Approval of installer by bituminous sheet manufacturers.
 4. Water test report.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to job in manufacturer's original unopened container.

- B. Do not store material in areas where temperature is lower than 10 degrees C (50 degrees F,) or where prolonged temperature is above 32 degrees C (90 degrees F).

1.5 ENVIRONMENTAL REQUIREMENTS:

Ambient Surface and Material Temperature: Not less than 4 degrees C (40 degrees F), during application of waterproofing.

1.6 WARRANTY:

Warrant bituminous sheet waterproofing installation against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is two years.

1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by basic designation only.
- B. Federal Specifications (Fed. Spec.):
UU-B-790A.....Building Paper, Vegetable Fiber: (Kraft, Water-INT AMD 1 Proof, Water Repellent and Fire Resistant)
- C. American Society for Testing and Materials (ASTM):
C578-08.....Rigid Cellular Polystyrene Thermal Insulation
D41-05.....Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
D2822-05.....Asphalt Roof Cement
D6380-03 (R2009).....Asphalt Roll Roofing (Organic Felt)
- D. American Hardboard Association (AHA):
A135.4-2004.....Basic Hardboard

PART 2 - PRODUCTS

2.1 BITUMINOUS SHEET:

- A. Cold applied waterproofing membrane composed primarily of modified bituminous material prefabricated in sheet form designed for below grade exterior. Sheet reinforced with fibers at manufacturer's option.
- B. Thickness of Bituminous Sheet: 1.5 mm (60 mils), plus or minus 0.13 mm (5 mils), and bonded to a 0.1 mm (4 mil) thick plastic sheet.
- C. Provide with a release sheet to prevent bonding of bituminous sheet to itself.

2.2 PRIMER CEMENT:

- A. Furnished by manufacturer of bituminous sheet as required for particular application in accordance with sheet manufacturer's instructions.

B. Primer: ASTM D41.

2.3 PROTECTION MATERIAL:

A. Polystyrene: ASTM C578, Type I or VIII, 13 mm (1/2-inch) minimum thickness.

B. Hardboard: PS-58, Service Type, 6 mm (1/4-inch) thick.

2.4 MOLDED SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 112 to 220 L/min per m (9 to 18 gpm per ft) ..

2.5 PATCHING COMPOUND:

A factory prepared, non-shrinking, fast setting, cementitious adhesive compound containing no ferrous metal or oxide.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Surface Condition:

1. Before applying waterproofing materials, ensure concrete and masonry surfaces are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion.

2. Fill voids, joints, and cracks with patching compound.

B. Concrete surfaces cured a minimum of seven days, free from release agents, concrete curing agents, and other contaminates.

3.2 APPLICATION:

A. Priming:

1. Prime concrete and masonry surfaces.

2. Application method, amount of primer and condition or primer before installation of bituminous sheet as recommended by primer manufacturer.

3. Reprime when required in accordance with manufacturer's instructions.

B. Bituminous Sheet Installation:

1. Remove release sheet prior to application.

2. Lay bituminous sheet from low point to high point so that laps shed water.

3. Treat expansion, construction and control joints and evident working cracks as expansion joints. Apply bituminous sheet in double thickness over joint by first applying a strip of bituminous sheet not less than 200 mm (8 inches) wide, centered over joint.
4. Lap seams not less than 50 mm (2 inches).
5. Lay succeeding sheet with laps, and roll or press into place.
6. Repair misaligned or inadequately lapped seams in accordance with manufacturer's instructions.
7. Seal seams and terminations in accordance with sheet manufacturer's instructions.

C. Corner Treatment:

1. At inside and outside corners apply double cover using an initial strip not less than 280 mm (11 inches) wide, centered along axis of corner.
2. Cover each strip completely by the regular application of bituminous sheet.
3. Provide a fillet or cant on inside corners.
4. Form cants using patching compound
5. Do not use wood, fiber, and insulating materials for cants.

D. Projection Treatment:

1. Apply a double layer of bituminous sheet around pipes and similar projections at least 150 mm (6 inches) wide.

3.3 PROTECTION:

- A. Protect bituminous sheet before backfill or wearing courses are placed.
- B. Install protection material and hold in place in accordance with instructions of manufacturer of waterproofing materials.

C. Permanent Protection:

1. Vertical Surfaces:

- a. Install hardboard or polystyrene protection material.
- b. Extend protection full height from footing to top of backfill.
- c. If graded backfill is used, use hardboard.
- d. Molded sheet drainage panel may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

E. Temporary Protection:

1. When waterproofing materials are subjected to damage by sunlight and can not be immediately protected as specified, protect waterproofing

materials by waterproof building paper or suitable coating approved by manufacturer of waterproofing system used.

3.4 PATCHING:

Repair tears, punctures, air blisters, and inadequately lapped seams, in accordance with manufacturer's instructions before protection course is applied.

3.5 TESTING:

- A. Before any protection or wearing course is applied, test all horizontal applications of waterproofing with a minimum of 25 mm (1-inch) head of water above highest point and leave for 24 hours.
- B. Mark leaks and repair when waterproofing is dry.
- C. Certify, to COTR, that water tests have been made and that areas tested were found watertight.

3.6 INSPECTION:

Do not cover waterproofed surfaces by other materials or backfill until work is approved by COTR.

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SECTION 07 21 13
THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies thermal and acoustical insulation for buildings.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Insulation, each type used
 - 2. Adhesive, each type used.
 - 3. Tape
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.3 STORAGE AND HANDLING

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C553-08.....Mineral Fiber Blanket Thermal Insulation for
Commercial and Industrial Applications
 - C578-08b.....Rigid, Cellular Polystyrene Thermal Insulation
 - C591-08.....Unfaced Preformed Rigid Cellular
Polyisocynurate Thermal Insulation
 - C665-06.....Mineral Fiber Blanket Thermal Insulation for
Light Frame Construction and Manufactured
Housing
 - C954-07.....Steel Drill Screws for the Application of
Gypsum Panel Products or Metal Plaster Base to
Steel Studs From 0.033 (0.84 mm) inch to 0.112
inch (2.84 mm) in thickness
 - C1002-07.....Steel Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or Metal
Plaster Bases to Wood Studs or Steel Studs

D312-00 (R2006) Asphalt Used in Roofing
E84-09 Surface Burning Characteristics of Building
Materials

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

- A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.
- B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.
- C. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Glass fiber reinforced	6 percent recovered material

2.2 GLASS FIBER BATT INSULATION

ASTM 665, Type III, Faced

2.3 ADHESIVE

As recommended by the manufacturer of the insulation.

2.4 TAPE

Pressure sensitive adhesive on one face.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
- B. Install batt insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
- C. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

3.2 GLASS FIBER BATT

- A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.
- B. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.

- C. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.

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SECTION 07 24 00
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

Exterior Finish Systems specified in this section consist of a Direct Exterior Finish Systems (DEFS), all of which are applied over cement board, or glass fiber reinforced gypsum board sheathing.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Two 300 mm (one-foot) square samples of the finishes over sheathing board identical to the proposed installation in thickness, color, texture, insulation, and workmanship.
- C. Test Reports and Manufacturer's Literature
 - 1. Manufacturer's literature and instructions for installation of the system. Include manufacturer's recommended details for corner treatment, sills, soffits, dentils, quoins, lintels, openings and other special applications.
 - 2. Summary of test results by the Exterior Finish System manufacturer to substantiate compliance with the specified performance requirements. Furnish complete test reports as required.
 - 3. Statement by Exterior Finish System manufacturer that all components of the system proposed for use on this project are approved by that manufacturer.
 - 4. Statement by the Installer of the Exterior Finish System that they are experienced with the installation, having done at least three (3) projects using this system and can furnish names and locations of these projects if required.

1.3 DELIVERY AND STORAGE

- A. Deliver materials in unopened packages with manufacturer's labels intact, legible and grade seals unbroken.
- B. Store and handle in strict compliance with manufacturer's instructions. Protect from damage.
- C. Remove from premises any damaged or deteriorated material.

1.4 ENVIRONMENTAL CONDITIONS

Unless a higher temperature is required by the system manufacturer, the ambient air temperature shall be 7 degrees Celsius (45 degrees F) or

greater and rising at the time of installation of the system and shall be predicted to remain at 7 degrees Celsius (45 degrees F) or greater for at least 24 hours after installation.

1.5 WARRANTY

Exterior Finish system shall be warranted against water leakage past the weather resistive barrier and other defects in materials and workmanship, and shall be subject to the terms of Article "Warranty of Construction", FAR clause 52.246-21, except that the warranty period shall be ten years.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- B117-07.....Operating Salt Spray (Fog) Apparatus
 - C67a-09.....Sampling and Testing Brick and Structural Clay
Tile
 - C177-04.....Steady-State Heat Flux measurements and Thermal
Transmission Properties by Means of the
Guarded-Hot-Plate Apparatus
 - C297-04.....Flatwise Tensile Strength of Sandwich
Constructions
 - C578-09.....Rigid, Cellular Polystyrene Thermal Insulation
 - C666-03 (2008).....Resistance of Concrete to Rapid Freezing and
Thawing
 - C920-08.....Elastomeric Joint Sealants
 - D968-05 (R2007).....Abrasion Resistance of Organic Coatings by
Falling Abrasive
 - D2794-93 (R2004).....Resistance of Organic Coatings to the Effects
of Rapid Deformation (Impact)
 - E84-09.....Surface Burning Characteristics of Building
Materials
 - E96-05.....Water Vapor Transmission of Materials
 - E108a-07.....Fire Tests of Roof Coverings
 - E330-02.....Structural Performance of Exterior Windows,
Curtain Walls, and Doors by Uniform Static Air
Pressure Difference

- E331-00 (2009).....Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- E2511-09.....Standard Guide for Detailing of EIFS Clad Wall Assemblies
- G90-05.....Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight
- C. Exterior Insulation Manufacturers Association (EIMA)
- 101.86-1992.....Resistance of Exterior Insulation and Finish Systems to the Effects of Rapid Deformation (Impact)
- D. International Code Council Evaluation Service (ICC-ES)
- AC235-08.....Criteria for EIFS Clad Drainage Wall Assemblies

PART 2 PRODUCTS

2.1 SYNTHETIC STUCCO

- A. Description: Reinforced cement board joints, synthetic stucco base coat and simulated stucco finish coat applied directly to the cement board.
- B. Joint Reinforcement:
1. Reinforcing tape: Minimum 100 mm (4 inch) wide, polymer coated, open mesh glass fiber tape.
 2. Tape embedding material: Ready-to-mix Portland cement mortar base coat containing dry latex polymers.
- C. Accessories:
1. Trim, control joints and corner beads as recommended by Exterior Finish System manufacturer.
- D. Stucco finish:
1. Base coat: Ready-to-mix, Portland cement mortar containing dry latex polymers.
 2. Finish coat: Pre-colored, ready-mixed, polymeric coating.

3. Performance requirements:

<u>Property</u>	<u>As Required Test Method</u>	<u>Requirement</u>
Surface Burning Characteristics	ASTM E 84	Class A
Abrasion Resistance	ASTM D 968	500 liters of light smoothing. No loss of film integrity.
Bond Strength (with cement board)	ASTM C 297	50 psi
Salt Spray Resistance	ASTM B 117	300 hours exposure. No deleterious effects
Freeze/Thaw Resistance (with cement board)	ASTM C 666 proc. B	100 Cycles. No deterioration, no delamination
Accelerated Weathering	ASTM G 90	2000 hours. No deterioration
Rapid Deformation	ASTM D2794	No cracking or impact failure

E. Sealant: ASTM C 920, material having a minimum joint movement of 50% with 100% recovery. Type, grade and use shall be as recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 GENERAL

Comply with ASTM E2511.

3.2 INSPECTION

Examine substrate, opening supports and conditions under which this work is to be performed. Notify COTR in writing of conditions detrimental to the proper completion of this work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.3 CONTROL JOINTS

- A. See drawings for location of building control joints and surface control joints. Install surface control joints as follows:
1. Direct Exterior Finish: Install at 6 meters (20 feet) o.c. maximum in either direction, erecting the continuous vertical joints first at building expansion joints, intersection of dissimilar substrates or finishing materials where concentrated stresses or movement is

anticipated. Leave a 13 mm (1/2") minimum continuous gap between board panels to receive control joint.

3.4 SEALANTS

- A. Apply according to manufacturer's recommendations and the following:
- B. Direct Exterior Finish System/Unit Finish/: Caulk all intersections of cement board with windows, doors, control joints, other openings and locations as shown on drawings. Do not caulk locations intended for water drainage.

3.5 ACCESSORIES

Install according to manufacturer's recommendation.

3.6 FINISH

- A. Synthetic Stucco Finish:
 - 1. Joint Reinforcement: Pre-fill cement board joints and trim with synthetic stucco Base Coat mixed according to manufacturer's directions. Immediately embed reinforcing tape into wet Base Coat and tightly trowel to board surface to avoid crowning joints. Cure for a minimum of four hours before application of base coat.
 - 2. Base Coat: Apply base coat a minimum of 1.6 mm (1/16") uniformly smooth and flat over the entire surface including joints and trim. Dampen board surface as necessary under rapid drying conditions. Embed reinforcing fabric in basecoat while wet and cover with basecoat material so pattern of fabric is not visible.
 - 3. Finish: Trowel apply ready-mixed exterior finish to base coat texturing surface as specified to a uniform thickness of 1.6 mm to 4.8 mm (1/16" to 3/16"). Dampen base coat as necessary under rapid drying conditions. Joining between batches shall occur at surface breaks such as corners, control joints, windows, etc.

3.7 CLEAN UP

Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of system.

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SECTION 07 41 13
STANDING SEAM METAL ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the installation of batten seam roofing.

1.2 RELATED WORK

- A. Sealant: Section 07 92 00, JOINT SEALANTS.
- B. Fascia and Trim: 07 60 00 Flashing and Sheet Metal

1.3 INSTALLATION REQUIREMENTS

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

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only:
- B. American Society for Testing and Materials (ASTM):
 - A792/A792M-09.....Standard Specifications for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - B32-08.....Standard Specification for Solder Metal
 - C920-08.....Standard Specifications for Elastomeric Joint Sealants
 - D226-06.....Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Weatherproofing
 - D227-03.....Standard Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
 - D4397-09.....Standard Specifications for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
 - E1514-98 (2003).....Standard Specification for Structural Standing Seam Steel Roof Panel Systems
- C. Federal Specification (Fed. Spec.):
 - UU-B-790A INT AMD.....Building Paper, Vegetable Fiber: (Kraft, Waterproof, Water Repellent and Fire Resistant)
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual 2003

PART 2 - PRODUCTS

2.1 METAL ROOF PANEL

- A. Aluminum-Zinc Alloy Coated Sheet Steel
- B. ASTM E1514
- C. Factory formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated, and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for a weathertight installation.
- D. Vertical rib, snap joint, standing seam metal roof panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels and snapping panels together.
- E. Panel Coverage: 608 mm (24 inches).

2.2 SEALANTS

- A. ASTM C920
- B. Type, Grade, and Class as recommended in writing by the manufacturer.

2.3 SEALANT TYPE

- A. Pressure sensitive, 100% solids, Gray Polyisobutylene compound with release-paper backing.
- B. 12 mm (1/2 inch) wide x 3mm (1/8 inch) thick.

2.4 UNDERLAYMENT

- A. Felts: ASTM D226, Type I or ASTM D227
- B. Polyethylene sheet: 0.38 mm (15 mil) ASTM D4397

2.5 FASTENERS

- A. Self drilling, or self tapping zinc plated hex head carbon-steel screws with neoprene washer or stainless steel cap.
- B. ASTM B32: Flux type and alloy composition as required for use with metals to be soldered.

2.6 BUILDING PAPER

Fed. Spec. UU-B-790, Type I, Grade C.

2.7 FINISHES

- A. Factory finished complying with SMACNA's recommendations for applying and designating finishes
- B. Exterior Finish: Fluoropolymer
- C. Color: As indicated

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Install fascia and trim to comply with requirements specified in Division 7 Section "Flashing and Sheet Metal"
- C. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

3.3 METAL ROOF PANEL INSTALLATION, GENERAL

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

6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install ridge and hip caps as metal roof panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

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

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

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

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

3.4 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

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

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

B. Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet, along lower panel edges, and at perimeter of all openings

3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.6 ERECTION TOLERANCES

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

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

- - - E N D - - -

SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

Formed sheet metal work for flashing are specified in this section.

1.2 RELATED WORK

- A. Composition base flashings and stripping in metal roof flanges.
- B. Sealant compound and installation: Section 07 92 00, JOINT SEALANTS.
- C. Color of factory coated metal and anodized aluminum: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Paint materials and application: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Flashings
 - 2. Copings
 - 3. Gravel Stop-Fascia
 - 4. Gutter and Conductors
 - 5. Expansion joints
 - 6. Fascia-cant
- C. Manufacturer's Literature and Data:
 - 1. Two-piece counterflashing
 - 2. Thru wall flashing
 - 3. Expansion joint cover, each type
 - 4. Non-reinforced, elastomeric sheeting
 - 5. Copper clad stainless steel
 - 6. Polyethylene coated copper
 - 7. Bituminous coated copper
 - 8. Copper covered paper
 - 8. Fascia-cant
- D. Certificates: Stating that aluminum has been given - specified // finish // thickness of anodizing. // Coating formulators approvals as specified.

1.4 APPLICABLE PUBLICATIONS

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

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

A167-99-09.....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip

A653/A653M-08.....Steel Sheet Zinc-Coated (Galvanized) or Zinc
Alloy Coated (Galvanized) by the Hot- Dip
Process

B32-08.....Solder Metal

B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate

B370-09.....Copper Sheet and Strip for Building
Construction

D173-03.....Bitumen-Saturated Cotton Fabrics Used in
Roofing and Waterproofing

D412-06.....Vulcanized Rubber and Thermoplastic Elastomers-
Tension

D1187-97 (R2002).....Asphalt Base Emulsions for Use as Protective
Coatings for Metal

D1784-08.....Rigid Poly (Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly (Vinyl Chloride) (CPVC)
Compounds

D3656-07.....Insect Screening and Louver Cloth Woven from
Vinyl-Coated Glass Yarns

D4586-07.....Asphalt Roof Cement, Asbestos Free

C. American National Standards Institute/Single Ply Roofing Institute
(ANSI/SPRI):

ES-1-2003.....Wind Design Standard for Edge Systems Used with
Low Slope Roofing Systems

D. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA): Architectural Sheet Metal Manual (2003 Edition).

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

AMP 500-06.....Metal Finishes Manual

F. American Architectural Manufacturers Association (AAMA):

605-98.....Voluntary Specification for High Performance
Organic Coatings on Architectural Extrusions
Panels

G. Federal Specification (Fed. Spec):

A-A-1925A.....Shield, Expansion; (Nail Anchors)

UU-B-790A.....Building Paper, Vegetable Fiber

H. International Building Code (IBC):
2009 Edition

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.
- B. Stainless Steel: ASTM A167, Type 302B, dead soft temper.
- C. Aluminum Sheet: ASTM B209, alloy 3003-H14.
- D. Galvanized Sheet: ASTM, A653.
- E. Non-reinforced, Elastomeric Sheeting: ASTM D412J. Bituminous Paint: ASTM D1187, Type I.
- F. Fasteners:
 - 1. As recommended by the manufacturer for each type, unless specified otherwise.

2.2 SHEET METAL THICKNESS

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

2.3 FABRICATION, GENERAL

- A. General: Fabricate sheet metal flashing and trim to comply with SMACNA guidelines.
- B. Joints:
 - 1. Form nonexpansion, but moveable in metal to accommodate sealant to comply with SMACNA guidelines.
 - 2. Conceal all fasteners where possible.
- C. Flat and lap joints shall be made in direction of flow.
- D. Edges of bituminous coated copper, copper covered paper, non-reinforced elastomeric sheeting and polyethylene coated copper shall be jointed by lapping not less than 100 mm (4 inches) in the direction of flow and cementing with asphalt roof cement or sealant as required by the manufacturer's printed instructions.
- E. Soldering:
 - 1. Comply with ASTM B32

F. Expansion and Contraction Joints:

1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations.

G. Cleats:

1. Fabricate cleats, metal edges, drips, edge strips, and attachment devices from the same material as accessory being anchored.

H. Metal Options:

1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.

2.4 FINISH

- A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.
- B. In accordance with NAAMM Metal Finishes Manual, unless otherwise specified.

2.5 COUNTERFLASHING

- A. Either copper or stainless steel, unless specified otherwise.
- B. Comply with SMACNA guidelines for installation tolerances.
- C. Fabricate to lap base flashing a minimum of 100 mm (4 inches) with drip.
- D. One-piece Counterflashing:
 1. Back edge turned up and fabricates to lock into reglet in concrete.
 2. Upper edge formed to extend full depth of masonry unit in mortar joint with back edge turned up 6 mm (1/4 inch).
- E. Two-Piece Counterflashing:
 1. Receiver to extend into masonry wall depth of masonry unit with back edge turned up 6 mm (1/4 inch) and exposed edge designed to receive and lock counterflashing upper edge when inserted.
 2. Counterflashing upper edge designed to snap lock into receiver.
- F. Surface Mounted Counterflashing; one or two piece:
 1. Use at existing or new surfaces where flashing cannot be inserted in vertical surface.
 2. One piece fabricate upper edge folded double for 65 mm (2 1/2 inches) with top 19 mm (3/4 inch) bent out to form "V" joint sealant pocket with vertical surface. Perforate flat double area against vertical surface with horizontally slotted fastener holes at 400 mm (16 inch) centers between end holes. Option: One piece surface

mounted counter-flashing (cap flashing) may be used. Fabricate as detailed on Plate 51 of SMACNA Architectural Sheet Metal Manual.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Anchor sheet metal flashing and trim and other components of the work securely in place with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete flashing and trim assemblies.
2. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
3. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
4. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
5. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
6. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.
7. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nails not over 100 mm (4 inches) on center unless specified otherwise.
8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.

9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
10. Nail continuous cleats on 75 mm (3 inch) centers in two rows in a staggered position.
11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:
 - a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - b. Paint dissimilar metal with a coat of bituminous paint.
 - c. Apply an approved caulking material between aluminum and dissimilar metal.
15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
16. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.
17. Bitumen Stops:
 - a. Install bitumen stops for built-up roof opening penetrations through deck and at formed sheet metal gravel stops.
 - b. Nail leg of bitumen stop at 300 mm (12 inch) intervals to nailing strip at roof edge before roofing material is installed.

3.2 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of masonry building walls; at top of concrete floors; under masonry, concrete, or stone copings and elsewhere as shown.

2. Where exposed portions are used as a counter flashings, lap base flashings at least 100 mm (4 inches) and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing as specified.
4. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge where not part of counter flashing.
5. Turn back edge up 6 mm (1/4 inch) unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 38 mm (1 1/2 inch) into unit unless shown otherwise.
7. Under copings terminate both edges beyond face of wall approximately 6 mm (1/4 inch) with drip edge.
8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.
9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 25 mm (1 inch) and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.
13. When flashing terminates in reglet extend flashing full depth into reglet and secure with lead or plastic wedges spaced 150 mm (6 inch) on center.
14. Continue flashing around columns:
 - a. Where flashing cannot be inserted in column reglet hold flashing vertical leg against column.
 - b. Counterflash top edge with 75 mm (3 inch) wide strip of saturated cotton unless shown otherwise. Secure cotton strip with roof cement to column. Lap base flashing with cotton strip 38 mm (1 1/2 inch).

- B. Flashing at Top of Concrete Foundation Walls Where concrete is exposed.
Turn up not less than 200 mm (8 inch) high and into masonry backup mortar joint or reglet in concrete backup as specified.
- C. Flashing at Cavity Wall Construction: Where flashing occurs in cavity walls turn vertical portion up against backup under waterproofing, if any, into mortar joint. Turn up over insulation, if any, and horizontally through insulation into mortar joint.
- D. Flashing at Veneer Walls:
 - 1. Install near line of finish floors over shelf angles or where shown.
 - 2. Turn up against sheathing.
 - 3. At stud framing, hem top edge 19 mm (3/4 inch) and secure to each stud with stainless steel fasteners through sheathing.
 - 4. At concrete backing, extend flashing into reglet as specified.
 - 5. Coordinate with installation of waterproofing or asphalt felt for lap over top of flashing.
- E. Lintel Flashing when not part of shelf angle flashing:
 - 1. Install flashing full length of lintel to nearest vertical joint in masonry over veneer.
 - 2. Turn ends up 25 mm (one inch) and fold corners to form dam and extend end to face of wall.
 - 3. Turn back edge up to top of lintel; terminate back edge as specified for back-up wall.
- F. Door Sill Flashing:
 - 1. Install flashing under bottom of plate sills of doors over curbs opening onto roofs. Extend flashing out to form counter flashing or receiver for counter flashing over base flashing. Set in sealant.
 - 2. Extend sill flashing 200 mm (8 inch) beyond jamb opening. Turn ends up one inch in vertical masonry joint, extend end to face of wall. Join to counter flashing for water tight joint.
 - 3. Where doors thresholds cover over waterproof membranes install sill flashing over water proof membrane under thresholds. Extend beyond opening to cover exposed portion of waterproof membrane and not less than 150 mm (6 inch) beyond door jamb opening at ends. Turn up approximately 6 mm (1/4 inch) under threshold.
- G. Flashing at Masonry, Stone, or Precast Concrete Copings:
 - 1. Install flashing with drips on both wall faces unless shown otherwise.

2. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

3.3 COUNTERFLASHING

A. General:

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

B. One Piece Counterflashing:

1. Where flashing is installed at new masonry, coordinate to insure proper height, embed in mortar, and end lap.
2. Where flashing is installed in reglet in concrete insert upper edge into reglet. Hold flashing in place with lead wedges spaced not more than 200 mm (8 inch) apart. Fill joint with sealant.
3. Where flashing is surface mounted on flat surfaces.
 - a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:
 - 1) Locate fasteners in masonry mortar joints.
 - 2) Use screws to sheet metal or wood.
 - b. Fill joint at top with sealant.
4. Where flashing or hood is mounted on pipe.
 - a. Secure with draw band tight against pipe.
 - b. Set hood and secure to pipe with a one by 25 mm x 3 mm (1 x 1/8 inch) bolt on stainless steel draw band type clamp, or a stainless worm gear type clamp.
 - c. Completely fill joint at top with sealant.

C. Two-Piece Counterflashing:

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

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK:

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.

1.3 QUALITY CONTROL:

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

1.4 SUBMITTALS:

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

3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations:

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

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 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).

1.7 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.

1.8 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 shall be extended to two years.
- B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run

concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.9 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 Society for Testing and Materials (ASTM):
- C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material.
 - C612-04.....Mineral Fiber Block and Board Thermal Insulation.
 - C717-09.....Standard Terminology of Building Seals and Sealants.
 - C834-05.....Latex Sealants.
 - C919-08.....Use of Sealants in Acoustical Applications.
 - C920-08.....Elastomeric Joint Sealants.
 - C1021-08.....Laboratories Engaged in Testing of Building Sealants.
 - C1193-09.....Standard Guide for Use of Joint Sealants.
 - C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - E84-09.....Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS:

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

3. Class 25.
4. Grade P.
5. Shore A hardness of 25-40.

C. S-3:

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

E. 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.
6. Minimum elongation of 1200 percent.

F. 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.

G. S-12:

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

2.2 CAULKING COMPOUND:

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

- B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

2.3 COLOR:

- A. Sealants used with exposed masonry shall match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.
- D. Caulking shall be light gray or white, unless specified otherwise.

2.4 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, 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, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

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

2.7 CLEANERS-NON POUROUS SURFACES:

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

PART 3 - EXECUTION

3.1 INSPECTION:

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

3.2 PREPARATIONS:

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION:

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

3.4 SEALANT DEPTHS AND GEOMETRY:

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

3.5 INSTALLATION:

- A. General:
 1. Comply with manufacturer's written installation instructions for products and applications indicated.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 CLEANING:

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

3.7 LOCATIONS:

- A. Exterior Building Joints, Horizontal and Vertical:
 1. Metal to Metal: Type S-1, S-2
 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. Threshold Setting Bed: Type S-1, S-3, S-4
 6. Masonry Expansion and Control Joints: Type S-6
- B. Metal Reglets and Flashings:
 1. Flashings to Wall: Type S-6
 2. Metal to Metal: Type S-6
- C. Horizontal Traffic Joints:
 1. Concrete Paving, Unit Pavers: Type S-11 or S-12
- D. Interior Caulking:
 1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, C-2 and C-3.
 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2 and C-3.

3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or
Exterior Walls: Types C-1, C-2 and C-3.
4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1, C-2
and C-3.

- - - E N D - - -

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies steel doors, steel frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

1.2 RELATED WORK

- A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.
- B. Door Hardware: Section 08 71 00, DOOR HARDWARE.

1.3 TESTING

An independent testing laboratory shall perform testing.

1.4 SUBMITTALS

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

1.5 SHIPMENT

- A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.
- B. Fasten temporary steel spreaders across the bottom of each door frame.

1.6 STORAGE AND HANDLING

- A. Store doors and frames at the site under cover.
- B. Protect from rust and damage during storage and erection until completion.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
L-S-125B.....Screening, Insect, Nonmetallic
- C. Door and Hardware Institute (DHI):
A115 Series.....Steel Door and Frame Preparation for Hardware,
Series A115.1 through A115.17 (Dates Vary)
- D. Steel Door Institute (SDI):
113-01 (2006R).....Thermal Transmittance of Steel Door and Frame
Assemblies
100-(ANSI A250.8-03)....Standard Steel Doors and Frames

(2008R)

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

A167-99(R2004).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
A568/568-M-07.....Steel, Sheet, Carbon, and High-Strength, Low-
alloy, Hot-Rolled and Cold-Rolled
A1008-08.....Steel, sheet, Cold-Rolled, Carbon, Structural,
High Strength Low Alloy and High Strength Low
Alloy with Improved Formability
B209/209M-07.....Aluminum and Aluminum-Alloy Sheet and Plate
B221/221M-08.....Aluminum and Aluminum-Alloy Extruded Bars,
Rods, Wire, Profiles and Tubes
D1621-04.....Compressive Properties of Rigid Cellular
Plastics
D3656-07.....Insect Screening and Louver Cloth Woven from
Vinyl Coated Glass Yarns

F. The National Association Architectural Metal Manufactures (NAAMM):

AMP 500-06.....Metal Finishes Manual

G. National Fire Protection Association (NFPA):

80-08.....Fire Doors and Fire Windows

H. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory

I. Intertek Testing Services (ITS):

Certifications Listings...Latest Edition

J. Factory Mutual System (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A167, Type 302 or 304; finish, NAAMM Number 4.
- B. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.

2.2 FABRICATION GENERAL

A. GENERAL:

- 1. Follow ANSI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08 71 00, DOOR HARDWARE. Tolerances as per SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.

2. Close top edge of exterior doors flush and seal to prevent water intrusion.
 3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
- B. Heavy Duty Doors: ANSI A250.8, Level 2, Model 2 of size and design shown. Core construction types a, d, or f, for interior doors, and, types b, c, e, or f, for exterior doors.

2.3 METAL FRAMES

- A. General:
1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.
 2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.
- B. Reinforcement and Covers:
1. ANSI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
 2. Provide mortar guards securely fastened to back of hardware reinforcements
- C. Two piece frames:
1. One piece unequal leg finished rough buck sub-frames as shown, drilled for anchor bolts.
 2. Unequal leg finished frames formed to fit subframes and secured to subframe legs with countersunk, flat head screws, spaced 300 mm (12 inches) on center at head and jams on each side.
 3. Preassemble at factory for alignment.
- D. Frame Anchors: ANSI A250.8
1. Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
 - a. Anchors for observation windows and other continuous frames set in stud partitions.
 - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
 - 2) Anchors spaced 600 mm (24 inches) on centers maximum.
 - b. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.4 SHOP PAINTING

ANSI A250.8.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Plumb, align and brace frames securely until permanent anchors are set.
 - 1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
 - 2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
 - 3. Protect frame from accidental abuse.
 - 4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
 - 5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.
- B. Floor Anchors:
 - 1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
 - 2. Power actuated drive pins may be used to secure frame anchors to concrete floors.
- C. Jamb Anchors:
 - 1. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

Install doors and hardware as specified in Sections, Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 71 00, DOOR HARDWARE.

- - - E N D - - -

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

- A. Caulking: Section 07 92 00 JOINT SEALANTS.
- B. Application of Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.

1.3 GENERAL

- A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Hardware for application on metal doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- C. The following items shall be of the same manufacturer, if possible, except as otherwise specified:
 - 1. Mortise locksets.
 - 2. Hinges for hollow metal doors.
 - 3. Surface applied overhead door closers.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:

1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

1.5 DELIVERY AND MARKING

Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COTR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COTR's office until all other similar items have been installed in project, at which time the COTR will deliver items on file to Contractor for installation in predetermined locations on the project.

1.6 INSTRUCTIONS

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters "HW" followed by a number. Each number designates a set of hardware items applicable to a door type.
- B. Manufacturers' Catalog Number References: Where manufacturers' products are specified herein, products of other manufacturers which are considered equivalent to those specified may be used. Manufacturers whose products are specified are identified by abbreviations as follows:

Adams-Rite	Adams Rite Mfg. Co.	Glendale, CA
Glynn Johnson	Glynn Johnson Co.	Chicago, IL
LCN	LCN Closers	Princeton, IL
Firemark	Rixon-Firemark Co.	Chicago, IL
Hager	Hager Hinge Company	Saint Louis, MO
Stanley	The Stanley Works	New Britain, CT
Trimco	Triangle Brass Mfg. Co.	Los Angeles, CA
Unican	Simplex Security Systems	Collinsville, CT
Von Duprin	Von Duprin Hardware Co.	Indianapolis, IN
Zero	Zero Weather Stripping Co.	New York, NY

C. Keying: All cylinders shall be keyed into existing Grand Master Key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the COTR.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. American Society for Testing and Materials (ASTM):
F883-04.....Padlocks
- C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
A156.1-06.....Butts and Hinges
A156.2-03.....Bored and Pre-assembled Locks and Latches
A156.3-08.....Exit Devices
A156.4-08.....Door Controls (Closers)
A156.5-01.....Auxiliary Locks and Associated Products
A156.6-06.....Architectural Door Trim
A156.8-05.....Door Controls-Overhead Stops and Holders
A156.13-05.....Mortise Locks and Latches
A156.15-06.....Release Devices-Closer Holder, Electromagnetic
and Electromechanical

A156.16-02.....American National Standard for Auxiliary
Hardware

A156.18-06.....Materials and Finishes

A156.21-06.....Thresholds

A156.22-05.....Door Gasketing and Edge Seal Systems

A156.23-04.....Electromagnetic Locks

A156.24-03.....Delayed Egress Locking Systems

A156.26-06.....Continuous Hinges

A156.31-07Electric Strikes and Frame Mounted Actuators

A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):

80-07.....Fire Doors and Fire Windows

101-09.....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):

Building Materials Directory (2009)

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112 for doors 900 mm (3 feet) wide or less and Type A2111 for doors over 900 mm (3 feet) wide. Hinges for exterior doors shall have non-removable pins.

B. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.2 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:

1. The closer shall have 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.

2. Where specified, closer shall have hold-open feature.

3. Size Requirements: Size closers in accordance with manufacturer's recommendations or provide multi-size closers, sizes 1 through 6.

4. Material of closer shall be cast aluminum.

5. Arm and brackets for closers shall be steel or malleable iron.

6. Closers shall have full size cover.

7. Closers shall have adjustable hydraulic back-check and separate valves for closing and latching speed.

2.3 DOOR STOPS

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide stop Type L02011 or L02181, as applicable for exterior doors.

2.4 FLOOR DOOR HOLDERS

Conform to ANSI Standard A156.16. Provide extension strikes for Types L01301 and L01311 holders where necessary.

2.5 LOCKS AND LATCHES

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pins. Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw. Provide temporary keying device or construction core of allow opening and closing during construction and prior to the installation of final cores.
- B. In addition to above requirements, locks and latches shall comply with following requirements:
 1. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. Knobs for series 4000 lock and latch sets shall have 57 mm (2-1/4 inch) diameters. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock

outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)

2. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.

2.6 KEYS

- A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	Quantity
Cylinder locks	2 keys each
Cylinder lock change key blanks	10 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	1 key

2.7 THRESHOLDS

Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

2.8 WEATHERSTRIPS (FOR EXTERIOR DOORS)

Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length ($0.000774\text{m}^3/\text{s/m}$).

2.9 FINISHES

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
 1. Hinges --exterior doors: 626 or 630.
 2. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
 3. Thresholds: Mill finish aluminum.
 4. Other primed steel hardware: 652.

2.10 BASE METALS

Apply specified U.S. Standard finishes on different base metals as following:

Finish	Base Metal
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

- A. For new buildings locate hardware on doors at heights specified below unless otherwise noted:
- B. Hardware Heights from Finished Floor:
1. Locksets and latch sets centerline of strike 1000 mm (40-5/16 inches).
 2. Deadlocks centerline of strike 1200 mm (48 inches).
 3. Locate other hardware at standard commercial heights.

3.2 INSTALLATION

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted regular arm. Where closers are mounted on doors they shall be mounted with hex nuts and bolts; foot shall be fastened to frame with machine screws.
- B. Substitute parallel arm or top jamb mounting for regular arm mounting where the following conditions occur:
1. Where door swing, in full open position, would be limited to less than 90 degrees due to partition construction and closer location.
 2. Where exterior doors open outward.
- C. Hinge Size Requirements:

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

- D. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim.
- E. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COTR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.
- F. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

- G. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.
- H. After locks have been installed; show in presence of COTR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Cemetery Director along with the bitting list. Also a copy of the invoice shall be sent to the COTR for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 HARDWARE SETS

Following sets of hardware correspond to hardware symbols shown on drawings. Where hardware set for a single door is specified for a pair of doors; equip each leaf of such pair of doors with set noted. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.

HARDWARE SETS
<u>HW 9</u> (Exterior Storage) Lockset (F07) Cylinder Butts as required Stop Threshold Weatherstripping Door Bottom Seal Lockguard Silencers

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Prescott National Cemetery
Committal Shelter and Cemetery Improvements

Solicitation _____
Project 900CM3002

SECTION 09 06 00
SCHEDULE FOR FINISHES

SECTION 09 06 00-SCHEDULE FOR FINISHES

NCA Facility: Prescott National Cemetery
Location: Prescott, Arizona
Project No. and Name: 900CM3002 Committal Shelter and Cemetery Improvements
Submission: Construction Documents
Date:

SECTION 09 06 00
SCHEDULE FOR FINISHES

PART I - GENERAL

1.1 DESCRIPTION

This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS

Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS

Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES—provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. MASTER PAINTING INSTITUTE: (MPI)
2001.....Architectural Painting Specification Manual

PART 2- PRODUCTS

2.1 DIVISION 31 - EARTHWORK

- A. SECTION 32 31 13, CHAIN LINK FENCES AND GATES

Finish Chain Link Fabric	Finish Posts and Rails	Manufacturer	Mfg. Color Name/No.
Coated			
Galvanized			

Painted (P)			
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B. SECTION 32 14 16, BRICK UNIT PAVING.

Size	Pattern	Manufacturer	Mfg. Color Name/No.

C. SECTION 32 17 23, PAVEMENT MARKINGS.

Color	Manufacturer	MFG. Color Name/No.
Yellow		
White		

D. CONCRETE PAVERS

Size	Shape	Manufacturer	Mfg. Color Name/No.

E. BOLLARDS (ORNAMENTAL)

Material	Finish	Style Name/ No.	Manufacturer	Mfg. Color Name/No.
Precast concrete				
Stone				

F. SITE AND STREET FURNISHINGS

Item	Style Name/No.	Finish	Manufacture	Mfg. Color Name/No.
Benches				
Planters				
Tree Grates				
Trash Receptacles				
Ash Receptacles				

2.3 DIVISION 03 - CONCRETE

A. SECTION 03 30 00, CAST IN PLACE CONCRETE // SECTION 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE //

Surface	Finish Description

B. SECTION 03 45 00, PRECAST ARCHITECTURAL CONCRETE

Finish Color	Texture	Finish	Manufacturer	Mfg. Color Name/No.

2.4 DIVISION 04 - MASONRY

A. Section 04 05 13, MASONRY MORTARING and Section 04 05 16, MASONRY GROUTING

Finish Code	Manufacturer	Mfg. Color Name

B. Section 04 20 00, UNIT MASONRY

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1. FACE BRICK (FB)				
Finish Code	Size	Pattern	Manufacturer	Mfg. Color Name/No.

2.CONCRETE MASONRY UNIT (CMU)				
Type	Size	Pattern	Finish	Mfg. Color Name/No.
CMU Standard				

C. UNIT MASONRY (04 20 00)

Stone Type	Color	Manufacturer	Mfg. Color & Texture No.

D. STONE MASONRY

Material	Size	Color, Texture, Finish, Grain	Pattern	Stone Source

E. STONE FACING

Name of Stone	Color, Texture, Finish	Stone Source

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2.5 DIVISION 05 - METALS

A. SECTION 05 12 00, STRUCTURAL STEEL FRAMING

Component	Finish	Color

C. SECTION 05 31 00, STEEL DECKING, SECTION 05 36 00, COMPOSITE METAL DECKING

Finish	Color

D. SECTION 05 40 00, COLD-FORMED METAL FRAMING

Finish	Color

E. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Loose Lintels	
Aluminum Plate Door Sill	
Steel Pipe Railings and Gates (not on Steel Stairs)	
Ornamental Railings	

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2.6 DIVISION 06 WOOD, PLASTICS, AND COMPOSITES

2. SEATS AND BENCHES (TYPE 20 A, 12 E, 13 B)		
Room No. and Name	Component	Finish/Color
	Seat	
	Support	

2.7 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

C. SECTION 07 40 00, ROOFING AND SIDING PANELS

Type	Shape	Ext. Finish	Int. Finish	Manufacturer	Mfg. Color Name/No.

H. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Copings	Copper	
	Stainless steel	
	Aluminum	
Hanging Gutters and Downspouts	Copper	
	Stainless steel	
	Aluminum	

Roof Insulated Expansion Joint Covers	Vinyl sheet	
Gravel Stops	Aluminum mill	
	Aluminum	
	Copper	
	Stainless steel	
Scuppers		

I. STANDING SEAM ROOFING (NO VA GUIDE SECTION)

Material	Finish/Color

J. SECTION 07 71 00 / 07 72 00, ROOF SPECIALITIES AND ACCESSORIES

Item	Material	Finish	Manufacturer	Manufacturer/Color Name/Number.
Copings	Extruded Aluminum			
Gravel Stops and Fascia System	Extruded Aluminum			
Fascia Systems	Extruded Aluminum			
Roof Expansion Joint Covers	Extruded Aluminum	Mill		

K. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
Masonry Expansion Joints			
CMU Control Joints			
Precast Concrete Panels			
New to Existing Walls			

Building Expansion Joints			
Masonry Sealed Joints			
Stone Sealed Joints			

2.8 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	
Component	Color of Paint Type and Gloss
Door	Dunn Edwards DE6055 Wild West, Gloss Level 5
Frame	Dunn Edwards DE6055 Wild West, Gloss Level 5
Window frame	

H. SECTION 08 71 00, BUILDERS HARDWARE

Item	Material	Finish
Hinges		
Door Closers		
Closer/ Holder		
Floor Stops		
Door Holders		
Lock/ Latches		
Key Cabinet	Steel	
Armor Plates	Metal Plastic	

Kick Mop Plates	Metal Plastic	
Door Edging		
Exit Device		
Flush Bolts		
Door Pulls		
Push Plates		
Combination Push Pull Plate		
Weather Strip		
Threshold		

K. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards

		Gloss @60	Sheen @85
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-"a velvet-like" finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4	a "satin-like" finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7	a high gloss	more than 85 units	

2. Paint code	Gloss	Manufacturer	Mfg. Color Name/No.
P1	Gloss Level 6	Dunn Edwards	DE6055 Wild West

P2	Gloss Level 4	Dunn Edwards	DE6169 Milk Mustache
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
P			
3. Stain Code (S)	Gloss and Transparency	Manufacturer	Mfg. Color Name/No.
	Semi		
S			
S			
S			
S			
S	Opaque		

S			
S			
S			
S			
4. Clear coatings Code(CC)	Gloss	Manufacturer	Mfg. Color Name/No.
CC			
CC			

2.10 DIVISION 10 - SPECIALTIES

E. SECTION 10 13 00 / 10 14 00, EXTERIOR SIGNS

Component	Finish	Manufacturer	Mfg. Color Name/No.

2.14 DIVISON 16 - ELECTRICAL

A. SECTION 26 51 00, BUILDING LIGHTING INTERIOR

Fixture Type	Exterior Finish	Color

B. SECTION 26 56 00, SITE LIGHTING

Type and Component	Exterior Finish	Manufacturer	Mfg. Name/No.

PART III EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

DESIGNER NOTES: Edit to suit project. Check abbreviations with technical section to avoid conflict or duplicate abbreviations for different materials.

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Acoustical Ceiling	AT
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR
Carpet	CP
Carpet Module Tile	CPT
Concrete	C
Concrete Masonry Unit	CMU
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Fabric Wallcovering	WF

Facing Tile	SCT
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Fluorocarbon	FC
Granite	GT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Polypropylene Fabric Wallcovering	PFW
Porcelain Paver Tile	PPT
Rubber Base	RB

Rubber Tile Flooring	RT
Stain	ST
Stone Flooring	SF
Suspension Decorative Grids	SDG
Veneer Plaster	VP
Vinyl Base	VB
Vinyl Coated Fabric Wallcovering	W

Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD

3.2 FINISH SCHEDULE SYMBOLS

DESIGNER NOTES: Do not substitute these symbols. Add new symbols as required.

Symbol Definition

** Same finish as adjoining walls
- No color required
E Existing
XX To match existing
EFTR Existing finish to remain
RM Remove

--- E N D---

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies steel studs wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

1.2 RELATED WORK

- A. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.
- B. Pull down tabs in steel decking: Section 05 36 00, COMPOSITE METAL DECKING.

1.3 TERMINOLOGY

- A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists.
- C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Studs, runners and accessories.
 - 2. Screws, clips and other fasteners.
- C. Shop Drawings:
 - 1. Typical metal stud and furring construction system including details around openings and corner details.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C754.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society For Testing And Materials (ASTM)
A123-09.....Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

A653/A653M-08.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire

C11-08.....Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07.....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-08.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-08.....Non-Structural Steel Framing Members

C754-08.....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03(R2008).....Installation of Interior Lathing and Furring

C954-07.....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

E580-08.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

PART 2 - PRODUCTS

2.1 STEEL STUDS AND RUNNERS (TRACK)

- A. ASTM C645, with flange edges of studs bent back 90 degrees and doubled over to for 3/16 inch wide minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Minimum base metal thickness: 0.8 mm (0.0329 inch) (33 mil).
 2. Depth: As indicated
 3. Perforated metal studs of a lighter gauge will not be accepted.

2.2 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

- A. Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this section.

3.2 INSTALLING STUDS

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
 - 1. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where otherwise indicated. Continue framing over frames of doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
- C. Install steel studs and furring in sizes and at spacing indicated.
- D. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- E. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two (2) studs at each jamb, unless otherwise indicated.
- F. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.3 TOLERANCES

- A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.
- B. Plumb and align vertical members within 3 mm (1/8-inch.)
- C. Level or align ceilings within 3 mm (1/8-inch.)

- - - E N D - - -

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

- A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Sealants: Section 07 92 00, JOINT SEALANTS.

1.3 TERMINOLOGY

- A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Cornerbead and edge trim.
 - 2. Finishing materials.
 - 3. Gypsum board, each type.
- C. Shop Drawings:
 - 1. Typical gypsum board installation of all assemblies, showing corner details, edge trim details and the like.
- D. Samples:
 - 1. Cornerbead.
 - 2. Edge trim.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

In accordance with the requirements of ASTM C840.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing And Materials (ASTM):
 - C11-08c.....Terminology Relating to Gypsum and Related Building Materials and Systems
 - C475-02 (R2007).....Joint Compound and Joint Tape for Finishing Gypsum Board
 - C840-08.....Application and Finishing of Gypsum Board

C1002-07.....Steel Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or Metal
Plaster Bases to Wood Studs or Steel Studs
C1047-05.....Accessories for Gypsum Wallboard and Gypsum
Veneer Base
C1177-08.....Glass Mat Gypsum Substrate for Use as Sheathing
C1325-08.....Fiber Mat Reinforced Cementitious Backer Unit
C1396-09.....Gypsum Board

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

- A. Gypsum Board: ASTM C1396, (Type X,) 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
- B. Water Resistant Gypsum Backing Board: ASTM C1396, 16 mm (5/8 inch) thick.
- C. Mold Resistant Panels: ASTM C1177, typex, 16mm (5/8 inch) thick. The panels shall pass the requirements of ASTM G21 and ASTM D3273 for Mold and Mildew resistance.
- D. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

2.2 ACCESSORIES

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

2.4 FASTENERS

- A. ASTM C1002 and ASTM C840, except as otherwise specified.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

- A. ASTM C475 and ASTM C840.

PART 3 - EXECUTION

3.1 GYPSUM BOARD HEIGHTS

- A. Extend gypsum board from floor to heights as follows, unless shown otherwise:
 - 1. Floor to underside of Roof Deck.

3.2 INSTALLING GYPSUM BOARD

- A. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- B. Accessories:
 - 1. Install the following accessories in accordance with ASTM C1047.
 - a. Corner Beads
 - b. Edge Trim (casing beads).

3.3 INSTALLING GYPSUM SHEATHING

- A. Install in accordance with ASTM C840.

3.4 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use level 2 finish in utility, maintenance and service areas. Follow manufacturer's fire testing reports where fire resistant construction is shown on drawings.

3.5 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide fire protection equivalent to the fire rated construction.

- - - E N D - - -

SECTION 09 91 00
PAINTING

PART 1-GENERAL

1.1 DESCRIPTION

- A. Section specifies prime coats which may be applied in shop under other sections.
- B. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.

1.2 RELATED WORK

- A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Samples:
 - 1. After painters' materials have been approved and before work is started submit samples showing each type of finish and color specified.
 - 2. Samples to show color: Composition board, 150 by 150 (6 inch by 6 inch).
- D. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. High temperature aluminum paint.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
 - 1. Name of manufacturer.
 - 2. Product type.
 - 3. Batch number.
 - 4. Instructions for use.
 - 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
 - 1. Federal Specification Number, where applicable, and name of material.
 - 2. Surface upon which material is to be applied.
 - 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
 - ACGIH TLV-BKLT-2009.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
 - ACGIH TLV-DOC-2009.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):
 - A13.1-07.....Scheme for the Identification of Piping Systems
- D. American Society for Testing and Materials (ASTM):
 - D260-86 (2001).....Boiled Linseed Oil
- E. Federal Specifications (Fed Spec):
 - TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
- F. Master Painters Institute (MPI):
 - No. 4-08.....Interior/ Exterior Latex Block Filler
 - No. 5-02.....Exterior Alkyd Wood Primer
 - No. 7-02.....Exterior Oil Wood Primer
 - No. 8-07.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)
 - No. 9-07.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)

- No. 10-07.....Exterior Latex, Flat (AE)
No. 11-07.....Exterior Latex, Semi-Gloss (AE)
No. 26-03.....Cementitious Galvanized Metal Primer
No. 27-07.....Exterior / Interior Alkyd Floor Enamel, Gloss
(FE)
No. 43-06.....Interior Satin Latex, MPI Gloss Level 4
No. 44-08.....Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-02.....Interior Primer Sealer
No. 46-04.....Interior Enamel Undercoat
No. 47-02.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
(AK)
No. 48-05.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 49-02.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
No. 50-08.....Interior Latex Primer Sealer
No. 51-02.....Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-06.....Interior Latex, MPI Gloss Level 3 (LE)
No. 53-06.....Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-06.....Interior Latex, Semi-Gloss, MPI Gloss Level 5
(LE)
No. 59-07.....Interior/Exterior Alkyd Porch & Floor Enamel,
Low Gloss (FE)
No. 60-07.....Interior/Exterior Latex Porch & Floor Paint, Low
Gloss
No. 68-07.....Interior/ Exterior Latex Porch & Floor Paint,
Gloss
No. 77-08.....Epoxy Cold Cured, Gloss (EC)
No. 79-08.....Marine Alkyd Metal Primer
No. 94-07.....Exterior Alkyd, Semi-Gloss (EO)
No. 95-03.....Fast Drying Metal Primer
No. 101-08.....Epoxy Anti-Corrosive Metal Primer
No. 108-08.....High Build Epoxy Coating, Low Gloss (EC)
No. 114-06.....Interior Latex, Gloss (LE) and (LG)
No. 119-07.....Exterior Latex, High Gloss (acrylic) (AE)
No. 134-06.....Primer, Galvanized, Water Based
No. 135-06.....Non-Cementitious Galvanized Primer
No. 138-06.....Interior High Performance Latex, MPI Gloss Level
2 (LF)
No. 139-06.....Interior High Performance Latex, MPI Gloss Level
3 (LL)
No. 140-06.....Interior High Performance Latex, MPI Gloss Level
4

No. 141-06.....Interior High Performance Latex (SG) MPI Gloss
Level 5

G. Steel Structures Painting Council (SSPC):

SSPC SP 1-04.....Solvent Cleaning

SSPC SP 2-04.....Hand Tool Cleaning

SSPC SP 3-04.....Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Paint (AP)

B. Exterior Latex, Semi-Gloss (AE): MPI 11.

C. Interior Satin Latex: MPI 43.

2.2 PAINT PROPERTIES

A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE

A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.

2. Lead-Base Paint:

a. Lead based paint is not permitted to be used.

b. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

3. Asbestos: Materials shall not contain asbestos.

4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.

5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

6. Use high performance acrylic paints in place of alkyd paints, where possible.

7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydrocarbons by weight.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
 - 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 - 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:
 - 1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
 - 2. Maintain interior temperatures until paint dries hard.
 - 3. Do no exterior painting when it is windy and dusty.
 - 4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
 - 5. Apply only on clean, dry and frost free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
 - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.

3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
 - 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 - 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.

3. See other sections of specifications for specified surface conditions and prime coat.
4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
 - a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

E. Zinc-Coated (Galvanized) Metal, Aluminum Surfaces Specified Painted:

1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with Organic Zinc Rich Coating. Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.

F. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.

2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13, MASONRY MORTARING // Section 04 05 16, MASONRY GROUTING//. Do not fill weep holes. Finish to match adjacent surfaces.
5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

G. Gypsum Plaster and Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.3 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COTR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by COTR, except in spaces sealed from existing occupied spaces.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 - 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- I. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.5 PRIME PAINTING

- A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel. Apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Wood and Wood Particleboard:
 - 1. Use same kind of primer specified for exposed face surface.
 - a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5 (Exterior Alkyd Wood Primer) for repainting bare wood primer except where Interior Wood Stain, Semi-Transparent (WS) is scheduled.

- b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - c. Transparent finishes as specified under Transparent Finishes on Wood.
- F. Metals:
- 1. Steel and iron: MPI 95 (Fast Drying Metal Primer)
 - 2. Zinc-coated steel and iron: MPI 135 (Non-Cementitious Galvanized Primer)
 - 3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
 - 4. Terne Metal: MPI 95 (Fast Drying Metal Primer)
 - 6. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
 - 7. Asphalt coated metal: Aluminum Paint (AP).
- G. Gypsum Board
- 1. Surfaces scheduled to have MPI 11 (Exterior Latex, Semi-Gloss (AE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)).
- H. Cement Plaster or stucco, Interior Surfaces of Ceilings and Walls:
- 1. MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) except use two coats where substrate has aged less than six months.

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Steel and Ferrous Metal:
- 1. Two coats of MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
- C. Machinery without factory finish except for primer: MPI 9 (Exterior Alkyd Enamel (EO)).

3.7 INTERIOR FINISHES

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Metal Work:
- 1. Apply to exposed surfaces.
 - 2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
 - 3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
 - b. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

C. Gypsum Board:

1. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)).

3.8 REFINISHING EXISTING PAINTED SURFACES

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.

3.9 PAINT COLOR

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.
- C. Coat Colors:
 1. Color of priming coat: Lighter than body coat.
 2. Color of body coat: Lighter than finish coat.
 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
 1. Paint to match color of casework where casework has a paint finish.
 2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.10 PROTECTION CLEAN UP, AND TOUCH-UP

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

SECTION 10 14 14
EXTERIOR SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies exterior directional signs, traffic regulatory signs and information signs including temporary traffic control (TTC) signs used during construction. This section also includes bronze sea
- B. Provide all labor, material, equipment. Supplies, tools, services, freight, taxes, and insurance necessary to fabricate and install the signs of the sizes, materials and designs illustrated on the Drawings in conformance with these Specifications.1s and emblems.

1.2 RELATED WORK

- A. Post Setting Excavation, Material, Backfill, Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Concrete Bases for posts: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM)
- C. Precast Architectural Concrete Posts: Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE.
- D. Section 04 43 00, NATURAL STONE VENEER.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Sign manufacturer that regularly and presently manufactures signs similar to those specified as one of their principal products.
- B. Obtain each sign type indicated from a single manufacturer.
- C. Contractor Qualifications: Bidders must have five or more years in the architectural sign industry and shall have proven ability to successfully complete projects in a timely manner. Bidders will have completed at least five exterior projects of equal scope within the last five years. A qualification review may be required of the successful bidder prior to the project award.
- D. Laws and Regulations: Presenting a bid confirms that the bidder is familiar with all applicable Federal, State, county and city laws, ordinances, and regulations, including but not limited to the Americans with Disabilities Act (ADA), Arizona State Building Code, the National Electric Code, and the Occupational Health and Safety Act (OSHA) requirements.

1.4 QUALITY ASSURANCE

- A. The Sign Contractor shall comply with the following standards, except where more stringent requirements are stated within this Specification:

1. Workmanship: All workmanship shall be the highest standard and must be acceptable to the COTR.
2. Materials: All materials and fixtures shall be new, of the highest quality generally available, and shall be approved by the COTR.
3. Finishes: All surfaces to be painted or powder coated shall be first prepared to finished quality, then primed as necessary and according to industry standards. All metal finishes shall conform to the details noted on the drawings and shall be free from surface irregularities, sharp edges, burrs, or other defects. All welds must be ground as close to the surface as possible. All items shall be of uniform finish and like items consistent in form, size, finish, and material. Exterior signs and sign components are to be weather-proofed to the highest standard.
4. Typography and Graphics: All three-dimensional and two-dimensional graphics and typography shall be correctly spaced according to the drawings. All typography will be true, clean, and photographically precise and must accurately reproduce the font shown in the drawings and/or noted in the specifications. Sign Contractor must purchase fonts as specified. "Typographic" elements, symbols, arrows, maps, patterns, etc., as shown in the drawings will be reproduced precisely and without jagged or digitized edges. Letter and word spacing of copy shall conform to the optically even spacing demonstrated on the drawings, and shall be confirmed through approval of spacing template and sign shop drawings.
5. Specified Products: Products of named manufactures may be substituted for equivalent or better product only if approved by COTR.
6. Installation: All signs shall be mounted true and level with all fasteners concealed unless otherwise shown on the drawings. All mounting devices shall be adjusted for surface irregularity to achieve the desired position indicated on the drawings.
Installation shall comply with all applicable Municipal and Building Codes, ADA and ANSI regulations. Insofar as practical, fabricate, assemble and fit work in the shop. Assembled signs and components must be trial fit at the shop to insure proper and efficient field assembly.
7. Field Verification: All dimensions, conditions, materials, surfaces, grades, partitions, and mullions where signs are

coordinated, substructure, and locations must be field verified by Sign Contractor. Field inspection is essential. Sign Contractor is to identify sign locations where fit is a problem, and prepare adjustments to specific signs for COTR approval.

8. Warranty: Sign Contractor shall provide a written warranty for all work (material, labor, and sign items) for a period of no less than five years from the time substantial completion or installation, whichever is latest. Signs shall be warranted to withstand 80 mph winds and shall not rust, fade, peel, oil can or in any way deteriorate for a five year period.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Product Data: For each type of product specified.
- C. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by COTR, other returned to Contractor.
 - 1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.
 - 2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
 - 3. Sample of typeface and symbols in a typical full size layout.
 - 4. Sample of precast concrete for color, finish and recessed field.
- D. Manufacturer's Literature: Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
 - 1. Show fabrication and installation details for signs, dimensional letters, Department of Veterans Affairs and National Cemetery seals, and Columbarium numbering medallions/markers.
 - 2. Identify materials and finishes
 - 3. Show mounting heights, locations of supplementary supports by others, accessories, joints, welds and anchorage.
- F. Full size layout patterns for dimensional letters.
- G. Phased layout plans showing locations, type, and duration of TTC signs to be used during construction for approval by the COTR prior to start of construction.

- H. Provide shop drawings, clay proofs, photographs, and associated products to clearly define and illustrate the 3-dimensional bas-relief (high relief) bronze seals and emblems.

1.6 DELIVERY AND STORAGE

- A. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- B. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- C. Store products in dry condition inside enclosed facilities.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
- A117.1-98.....Accessible and Usable Buildings and Facilities
- N2.1-89.....Warning Symbols, Radiation
- C. Americans with Disabilities Act - 1990
- D. American Society for Testing and Materials (ASTM):
- A6 / A6M - 09 Standard Specification for General
Requirements for Rolled Structural Steel Bars,
Plates, Shapes, and Sheet Piling
- A123-02..... Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
- ASTM A283/A283M-03(2007) Standard Specification for Low and
Intermediate Tensile Strength Carbon Steel
Plates
- ASTM A500 / A500M - 09... Standard Specification for Cold-Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes
- A924 / A924M - 09a Standard Specification for General
Requirements for Steel Sheet, Metallic-Coated
by the Hot-Dip Process
- B209-07..... Aluminum and Aluminum-Alloy Sheet and Plate
- B221-06..... Aluminum and Aluminum-Alloy Extruded Bars,
Rods, Wire, Shapes, and tubes.
- ASTM B916 - 01(2007)..... Standard Test Method for Adherence of
Porcelain Enamel Coatings to Sheet Metal

- ASTM D7031 - 04..... Standard Guide for Evaluating Mechanical and
Physical Properties of Wood-Plastic Composite
Products
- D7032-10..... Wood/Plastic Composite Deck Boards and
Guardrail Systems (Guards and Handrails)
- E. Federal Specifications (Fed Spec):
- MIL-PRF-8184F..... Plastic Sheet, Acrylic, Modified.
- MIL-P-46144C..... Plastic Sheet, Polycarbonate
- E. Porcelain Enamel Institute:
- Specification for Architectural Porcelain Enamel on Steel PRI S
- F. US Dept of Transportation, Federal Highway Administration, Manual on
Uniform Traffic Devices (MUTCD):
- Ch. 6F..... Temporary Traffic Control Zone Devices
- 23.CFR.655..... Color Specifications
- G. National Building Granite Quarries Association (NBGQA) - Specifications
for Architectural Granite.
- H. American Welding Society (AWS):
- D1.1-04..... Structural Welding Code Steel
- D1.2-03..... Structural Welding Code Aluminum
- D1.3-98..... Structural Welding Code Sheet Steel

PART 2 - PRODUCTS

2.1 GENERAL

- A. Signs of type, size and design shown on the drawings and as specified.
- B. Signs complete with lettering, framing and related components for a
complete installation.
- C. Provide graphics items as completed units produced by a single
manufacturer, including necessary mounting accessories, fittings and
fastenings.
- D. Do not scale drawings for dimensions. Contractor shall verify and be
responsible for all dimensions and conditions shown by these drawings.
Contractor to verify dimensions of existing sign panel and frame
replacements. COTR to be notified of any discrepancy in drawing, in
field directions or conditions, and/or of any changes required for all
such construction details.
- E. The Sign Contractor, by commencing work of this section, assumes
overall responsibility, as part of his warranty of work, to assure that
assemblies, components and parts shown or required within the work of
this section, comply with the Contract Documents. The Contractor shall

further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

- F. Engineering: Sign Contractor shall be responsible for making and installing products which meet the requirements of both the Specifications and the aesthetic intent of the Drawings, and which work efficiently, correctly and safely. Signs must withstand 80 mph wind loads. All engineering requirements are responsibility of the Contractor.

2.2 MATERIALS

- A. Wood/Plastic Composite (WPC): ASTM D 7032-10
1. Sizes as and color as indicated on drawings.
- B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matte finish water white clear acrylic shall not be acceptable.
- C. Polycarbonate: MIL-P-46144C; Type I, class 1.
- D. Vinyl: 0.1 mm thick machine cut, having pressure sensitive adhesive and integral colors.
- E. Concrete Post Footings: See Section 03 30 53, Cast-in-place Concrete.
- F. Aluminum
1. Sheet and Plate: ASTM B209
2. Extrusions and Tubing: ASTM B221
- G. Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).
- H. Bronze Plate: ASTM B 36/B 36/M
- I. WPC Post anchors: Galvanized steel base plates, ASTM A 283.
- J. Steel support posts in concrete footing: galvanized steel tubing, ASTM A 500.
- K. Cold galvanizing primer: ASTM A 780
- L. Precast concrete shall be as specified in Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE, unless noted otherwise on drawings.

2.3 SIGN STANDARDS

- A. Typography:
1. Type Style: Optima Bold. Initial caps or all caps as indicated in Sign Message Schedule.
2. Arrow: See graphic standards in drawings.
3. Letter spacing: See graphic standards on drawings.
4. VA Logo, National Cemetery Logo, and Logo types: See drawings.

5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only and shall be approved by the COTR; final text for signs is listed in Sign Message Schedule.

6. Precast concrete section markers shall include an aluminum sign panel mounted as shown on drawings.

B. Sign Colors and Finishes: As specified and approved in the Shop Drawing & Submittal process.

2.4 SIGN TYPES

A. Post and Panel Signs:

1. Sign posts shall be constructed of precast concrete as detailed in the drawings.

2. Sign panels to be aluminum frame and panel as detailed in the drawings.

3. Sign to be installed as noted on drawings in a concrete footing. Concrete footing shall have a minimum 1067 mm (42 inch) depth to the bottom of footing.

B. Temporary Traffic Control (TTC) Devices:

1. Sign shall be the size and shape detailed in the drawings. Sign shall be made of metal or approved equal, as approved by the COTR.

C. Non-illuminated do not drink sign panels shall be coated aluminum signs with lettering and graphic symbols as shown on the drawing details.

D. Text and Graphics:

1. Types A, B, C, and 'DO NOT DRINK' signs:

a. Surface applied reflective white opaque vinyl letters, numbers and graphics shall be of a quality and life expectancy equal to or exceeding that for Engineering Grade 3M Scotchlite, unless otherwise noted. Color shall match existing. Font Type Style shall be Times New Roman Bold, unless otherwise approved during design review for the specific project.

2.5 ACCESSORIES

Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.6 FABRICATION

- A. Shop fabricate so far as practicable.
- B. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- C. No signs are to be manufactured until final sign message schedule and location review has been completed by the COTR and forwarded to Contractor.
- D. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- E. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- F. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- G. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- H. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- I. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- J. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- K. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- L. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. Doors

and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.

2.7 DOUBLE-POST-PANEL SIGNS

- A. Sign panel assembly shall be constructed with extruded aluminum support channels and fasteners that secure a removable powder-coated aluminum sign panel assembly. Aluminum sign panel faces shall be 1/8" minimum thick. The design for the sign panel system shall be such that the sign panels can be removed and replaced, if damaged, without having to move the posts that secure the sign panel assembly. The sign panel assembly shall be constructed so there are no gaps or holes in the assembly that could let insects enter and construct nests or otherwise become a nuisance. The top of the sign panel assembly shall be constructed such that it is water tight from above and shall not have unsealed joints where water can collect or enter the assembly. The sign configuration and mounting shall be as depicted in the drawings.
- B. Lettering shall be as indicated on the "Site Details" Contract Drawing.
- C. Exposed fasteners shall be aluminum, tamper-proof type, and shall be colored to match the color for the sign panels.
- D. Finishes of exposed aluminum surfaces:
 - 1. Pretreatment: Before the finish is applied, a five-stage pretreatment must be applied to assure maximum adhesion and corrosion resistance:
 - a. Stage 1: High alkaline cleaner to prepare the surface
 - b. Stage 2: Water rinse
 - c. Stage 3: Combination of chromic, phosphoric and hydrofluoric acids that produce the chrome-phosphate conversion coating for maximum adhesion and corrosion resistance.
 - d. Stage 4: Water rinse
 - e. Stage 5: Water rinse
 - 2. Coating: After pretreatment, the metal is dried and paint is then applied. The aluminum shall have an electrostatically applied baked-on flexible acrylic finish that meet or exceeds industry standard tests, achieving a 75 - 125 micron (3.0 - 5.0 mil) thickness, super-tough finish with maximum exterior durability and superior adhesion characteristics. Color as indicated on the drawings and approved submittal.
 - 3. Tests:

- a. AAMA 2604 (covers Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels)
- b. ASTM D2247 (Humidity resistance of 1,000 hours)
- c. ASTM B117 (Salt spray resistance of 1,000 hours)
- d. Accelerated weathering for 500 hours under Method 6152 of Federal Test Method 141 shall show no adhesion loss, with only slight fading, chalking and water staining.
- e. Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for one year in Florida facing south at a 45 degree angle.
- f. Minimum hardness of 2H using ASTM D3363.
- g. Color of exposed portions of fastenings shall match sign panel being attached.

2.8 BRONZE SEALS - SERVICE EMBLEMS

- A. Furnish and install the service emblems, Department of Veteran Affairs Seal in Bronze as indicated on the contract drawings.
- B. The five bronze service emblems shall be of the sculpted BAS relief style. The five emblems include one of each military branch: Army, Navy, Air Force, Marines and Coast Guard. Shop drawings of each and sample of material showing color, texture and border shall be submitted for approval prior to fabrication.
- C. Department of Veteran Affairs Bronze Seals shall be of the sculpted BAS relief style, unless otherwise directed by the COTR, with the size and graphics as approved during the submittal review and approval process. The size, location and attachment for the plaque shall be as agreed to during the design review process, incorporating adequate security concerns to reduce or deter theft.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed

where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact COTR for clarification.

- C. Contractor shall own and be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Proceed with installation only when weather conditions permit installation of signs in exterior locations as outlined in manufacturer's written instructions.
- E. Set sign posts as indicated in the Drawings and Specifications. Dig holes in firm, undisturbed or compacted soil. Set post in a 12-inch diameter concrete footing with bottom a minimum of 42 inches below surface on firm, undisturbed soil or select granular borrow as indicated in the Drawings. Top of footing shall be eighteen inches below finish grade to allow placement of aggregate base prior to forming, and pouring concrete mow strip. Place concrete mow strip around posts in a continuous pour and consolidate/vibrate to eliminate voids. Trowel finish around post and slope to direct water away from posts. Grade area around finished concrete mow strip as shown and dispose of excess earth as directed by the COTR.
- F. Check each post for plumb, and top alignment, and maintain in position during placement and finishing operations.
- G. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.
- H. Verify field conditions and measurements before fabrication, and indicate measurements on Shop Drawings.
- I. Remove or correct signs or installation work that COTR determines as unsafe or as an unsafe condition.
- J. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- K. Locate signs as shown on the Site Signage Plan and Details.
- L. Contractor will be responsible for verifying that below each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.

- M. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.
- N. Temporary Traffic Control (TTC) signs shall be placed 6'-0" from the nearest edge of paving, at a height of no less than 5'-0". Refer to Ch.6 of the MUTCD standards as described in the Applicable Publications paragraph.
- O. At completion of installation turn over to COTR additional stock of signs and sign components listed in Sign Message Schedule: Individually box or crate by Sign Type or Part Number and labeled accordingly.

3.2 CLEAN UP

- A. Keep work areas clean during operations.
- B. At completion of sign installation, clean exposed sign surfaces. Clean, repair, restore and any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- C. Clean area of debris, rubbish, excess material and remove and properly dispose of off-site.
- D. Protect signs from damage until acceptance by COTR.

3.3 PROTECTION

Protect finished surfaces from damage during fabrication, erection and after completion of the work.

- - - END - - -

SECTION 10 75 00
FLAGPOLES

PART 1 - GENERAL

1.1 DESCRIPTION

Fixed high dimensional, ground set, uniform conical taper, seamless tube flag pole.

1.2 RELATED WORK

- A. Excavation and backfill: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Concrete for ground set flagpole: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Flagpole, including base and finial ball, showing construction and installation.
- C. Manufacturer's Literature and Data: Flagpole

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A167-99 (R2009).....Stainless and Heat-resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - B209-07.....Aluminum and Aluminum Alloy-Sheet and Plate
 - B241/B241M-10.....Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 FABRICATION

- A. Fabricate flagpole of seamless extruded aluminum tube, uniform conical taper of approximately 1 in 70 (one inch in every 6 feet). Taper shall not exceed 50 percent of outside diameter of pole. When flagpoles are shipped in more than one section, provide self-aligning sleeves for field joint.
- B. Base: Aluminum plate or stainless steel, of stock design similar to that shown.

- C. Finial Ball: 2 mm (0.0747 inch) thick spun aluminum sphere, with seams of ball welded flush and watertight. Mount ball on threaded rod to fit truck. Diameter of ball shall be approximately same as pole butt diameter. Gold anodized finish.
- D. Truck: Equip pole with extra heavy, revolving, non-fouling, concealed halyard truck complete with 26 stainless steel ball bearings and a stainless steel sheave.
- E. Halyards: Stainless steel concealed halyard assembly with internal swivel, mated to sized stainless steel cable flage arrangement, two bronze swivel snaps, a coated counterweight, beaded nylon ball over steel cable retainer ring and stainless steel links.
- F. Winch: One gearless stainless steel direct drive winch internally mounted on a rotator plate system. Accessed behind a locking door fitted to a flush mounted, reinforced, cast alum. Frame, the winch is operated with a removable handle inserted through the access door.
- G. Collar: FC11 Spun alum. Ornamental flash collar finished to match the shaft, the dia. of the collar to be at least 1" greater than the foundation sleeve.
- H. Foundation Sleeve: Fabricated from #16 GA. Galvanized steel.

2.3 FINISH

- A. Finish exposed surfaces of flagpoles.
- B. Flagpole shaft: Satin brushed aluminum, then heavily waxed.
- C. Finial ball: Gold anodized aluminum, then heavily waxed.
- D. Base and cleats: Finish to match flagpole.
- E. Stainless Steel (base): As recommended by flagpole manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set flagpoles in concrete base. Provide galvanized, corrugated steel sleeve or tube of length shown welded to steel base plates for installation in concrete.
- B. Wrap top of sleeve with two layers of asphalt felt for distance of 600 mm (2 feet) down.
- C. Fill space between pole and metal sleeve to within two inches of top with fine dry sand and fill balance of space with waterproof compound as shown.

3.2 VERTICAL TOLERANCES

- A. All effort shall be made by contractor to set the flagpole as close to vertical (plumb) as possible.
- B. Post construction flagpole installation shall have a maximum deviation of 0.5% from true vertical (plumb).

1. 30 feet flagpole; the maximum deviation at the top of flagpole is no more than 2 inches from true vertical (plumb).
 2. 50 feet flagpole; the maximum deviation at the top of flagpole is no more than 3 inches from true vertical (plumb).
 3. 70 feet flagpole; the maximum deviation at the top of flagpole is no more than 4 inches from true vertical (plumb).
- C. Contractor shall provide a signed and sealed surveyor's certificate indicating that the flagpole has been installed within the tolerance identified. If necessary, the contractor shall re-set the flagpole to be within the tolerances indicated.

3.3 LIGHTNING ROD

Weld lightning ground rod of 19 mm (3/4-inch) diameter galvanized steel to base plate at bottom of sleeve or tube, and to steel support plate at grade.

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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 temporary and permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval for sizes and settings of these devices.
- D. 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.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 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 COTR 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 COTR 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

Where variations from the contract requirements are requested in accordance with Section 00 72 00, GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

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 COTR, 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 COTR. 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 00, 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 00, GENERAL REQUIREMENTS.

- F. Coordinate location of equipment and conduit with other trades to minimize interferences. See Section 00 72 00, GENERAL CONDITIONS.

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.
 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list 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 00, GENERAL REQUIREMENTS.
1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.

3. 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 COTR 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 specified in Section 26 51 00, INTERIOR LIGHTING or shown on the drawings.

1.12 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this

reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.13 TRAINING

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COTR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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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

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. Provide adequate information for proper review of material specified on the drawings.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and 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)

D. National Fire Protection Association (NFPA):

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

E. 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: UF or USE shall be in accordance with UL 493.
3. Isolated power system wiring: Type XHHW with a dielectric constant
of 3.5 or less.

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.		

- a. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the COTR.
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 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

2.6 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 COTR.
 - 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.

3.2 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.

3.3 FEEDER IDENTIFICATION

- A. In each interior pulbox 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.

3.4 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 00, EARTH MOVING.
 - 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.

3.5 EXISITNG WIRING

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.

3.6 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 COTR:
 - 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

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced. Publications are referenced in the text by the basic designation only.

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

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

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

C. 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

D. National Fire Protection Association (NFPA):

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

E. 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

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 SPLICE CASE GROUND ACCESSORIES

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.
 - 3. Isolation transformers and isolated power systems shall not be system grounded.
- 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

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. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
 - 1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.
- F. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- H. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- I. 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.
- J. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

3.4 CORROSION INHIBITORS

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

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 ELECTRICAL ROOM GROUNDING

Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

3.7 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:
 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a

- 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
 3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.

3.8 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 COTR prior to backfilling. The Contractor shall notify the COTR 24 hours before the connections are ready for inspection.

3.9 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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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. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- C. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- D. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- E. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- F. 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:
- B. Shop Drawings:
 - 1. Size and location of main feeders
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- C. Certification: Prior to final inspection, deliver to the COTR 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. Where permitted by the NEC, 19 mm (3/4 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.

2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.

3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.

5. Flexible galvanized steel conduit: Shall Conform to UL 1.

6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.

7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

C. Conduit Fittings:

1. Rigid steel and IMC 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. Rigid aluminum conduit fittings:

- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
- b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
- c. Set screw fittings: Not permitted for use with aluminum conduit.

3. Electrical metallic tubing fittings:

- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
- b. Only steel or malleable iron materials are acceptable.
- c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm

- (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
- d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and 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.
6. Direct burial plastic conduit fittings:
- a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.
7. 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. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1 1/2 by 1 1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.

4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- 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.
 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- 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 COTR 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 COTR as required by limited working space.
- B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. 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. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
 12. Do not use aluminum conduits in wet locations.
 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- 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 COTR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
 2. Align and run conduit in direct lines.
 3. 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.

4. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
 1. Rigid steel or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- 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.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 2. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 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.
 - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
 - 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
 - 6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 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 lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):
 - 1. Pre-coated rigid galvanized steel conduit in accordance with the requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

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 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.

3.8 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.

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

1.2 RELATED WORK

- A. Section 31 20 11, EARTH MOVING (short form): Trenching, backfill and compaction.
- B. Section 05 50 00, METAL FABRICATIONS: Ladders.
- C. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.
- F. 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 handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.
 - 3. If necessary to locate ducts or handholes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the COTR for approval prior to construction.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

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

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American 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
- C. 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.
- D. Institute of Electrical and Electronic Engineers (IEEE):
C2-2002National Electrical Safety Code
- E. 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
- F. National Fire Protection Association (NFPA):
70 2008.....National Electrical Code (NEC)
- G. 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

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

SS-S-210A-1981.....Sealing Compound, Preformed Plastic for

Expansion joints And Pipe Joints

PART 2 - PRODUCTS

2.1 FIBERGLASS HANDHOLES

Shall be matched die molded of dark green fiberglass with approximate dimensions of 810 mm (32 inches) high, top surface of 1090 by 950 mm (43 by 37½ inches), and top opening of 810 by 660 mm (32 by 26 inches). When buried, the unit shall be capable of supporting an ultimate downward load of 2955 kg (6500 pounds) distributed over a 150 by 150 mm (6 by 6 inch) area imposed anywhere on the cover surface. Unit shall have precut 150 by 150 mm (6 by 6 inches) cable entrance at the center bottom of each side. A fiberglass weatherproof cover with nonskid surface shall be provided for each handhole. Covers shall be capable of being locked into position.

2.2 DUCTS

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

B. 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 (6 AWG) minimum.

2.4 WARNING TAPE:

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:

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

PART 3 - EXECUTION

3.1 HANDHOLE CONSTRUCTION AND INSTALLATION

A. General Requirements:

1. Locate handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.

B. Access for Handholes: Make the top of frames and covers flush with finished grade.

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 towards handholes, 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 PVC-coated 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 PVC-coated 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. PVC-coated rigid steel conduits shall be coupled to the ducts with suitable adapters, and the whole encased with 75 mm (3 inches) of concrete.
7. PVC coated rigid steel conduit turns of direction for all duct lines shall have minimum 1200 mm (4 feet) radius in the horizontal and vertical directions. PVC conduit sweeps for all duct lines shall have a minimum 12000 mm (40 feet) radius in the horizontal and 1200 mm (4 feet) in the vertical directions. Where a 12000 mm (40 feet) radius is not possible, horizontal turns of direction shall be rigid steel.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above bottom of trench during the concrete pour. Spacer spacing shall not exceed 1500 mm (5 feet).
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, and chilled water.
10. Clearances between individual ducts:
 - a. For like services, not less than 75 mm (3 inches).
 - b. For power and signal services, not less than 150 mm (6 inches).
 - c. Provide plastic spacers to maintain clearances.
 - d. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.

11. Duct lines shall terminate as shown on the drawings. All ducts shall be fitted with end bells.
 12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to insure maximum strength and rigidity of the duct bank.
 13. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.
 14. Duct Bank Markers:
 - a. Duct bank markers, where required, shall be located at the ends of duct banks except at handholes at approximately every 60 meter (200 feet) along the duct run and at each change in direction of the duct run. Markers shall be placed 600 mm (2 feet) to the right of the duct bank, facing the longitudinal axis of the run in the direction of the electrical load.
 - b. The letter "D" with two arrows shall be impressed or cast on top of the marker. One arrow shall be located below the letter and shall point toward the ducts. Second arrow shall be located adjacent to the letter and shall point in a direction parallel to the ducts. The letter and arrow adjacent to it shall each be approximately 75 mm (2 inches) long. The letter and arrows shall be V-shaped, and shall have a width of stroke at least 6 mm (1/4 inch) at the top and a depth of 6 mm (1/4 inch).
 - c. In paved areas, the top of the duct markers shall be flush with the finished surface of the paving.
 - d. Where the duct bank changes direction, the arrow located adjacent to the letter shall be cast or impressed with an angle in the arrow the same as the angular change of the duct bank.
- B. 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. 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.
 4. Do not kink the ducts or conduits.

- C. Concrete-Encased and Direct Burial Duct and Conduit Identification:
Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts or conduits before backfilling trenches. Warning tape shall be preprinted with proper identification.
- D. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
- E. 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 COTR.
- F. 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.
- G. Connections to Existing Manholes: For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.
- H. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the duct banks and remove loose concrete from the conduits before installing new concrete-encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.
- I. Partially Completed Duct Banks: During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 600 mm (2 feet) back into the

envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (1 foot) apart. Restrain reinforcing assembly from moving during pouring of concrete.

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SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the dry type general-purpose transformers.

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. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, impedance, dimensions, weight, mounting details, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.
 - 3. Complete nameplate data including manufacturer's name and catalog number.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.
 - 2. If changes have been made to the originally submitted maintenance and operating manuals, then two weeks prior to final inspection submit four copies of updated maintenance and operating manuals to the COTR.
- D. Certifications: Two weeks prior to the final inspection, submit four copies of the following to the COTR:
 - 1. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.

2. Certification that the equipment has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
ST 20-97.....Dry-Type Transformers for General Applications

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE DRY TYPE TRANSFORMERS

- A. Unless otherwise specified, dry type transformers shall be in accordance with NEMA, NEC and as shown on the drawings. Transformers shall be UL listed or labeled.
- B. Dry type transformers shall have the following features:
 1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers will not be accepted.
 2. Rating and winding connections shall be as shown on the drawings.
 3. Transformers shall have copper windings.
 4. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.
 5. Insulation systems:
 - a. Transformers 30 KVA and larger: UL rated 220 degrees C system having an average maximum rise by resistance of 150 degrees C in a maximum ambient of 40 degrees C.
 - b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degrees C system having an average maximum rise by resistance of 115 degrees C in a maximum ambient of 40 degrees C.
 6. Core and coil assemblies:
 - a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
 - b. Cores shall be grain oriented, non-aging, and silicon steel.
 - c. Coils shall be continuous windings without splices except for taps.
 - d. Coil loss and core loss shall be minimal for efficient operation.
 - e. Primary and secondary tap connections shall be brazed or pressure type.
 - f. Coil windings shall have end fillers or tie downs for maximum strength.

7. Certified sound levels determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

8. Nominal impedance shall be as shown on the drawings. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
9. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.
11. Enclosures:
- a. Not less than code gage steel.
 - b. Outdoor enclosures shall be NEMA 3R.
 - c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
 - d. Ventilation openings shall prevent accidental access to live components.
 - e. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram and sound level indicated on it.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.
- B. Install the transformers with adequate clearance at a minimum of 100 mm (4 inches) from wall and adjacent equipment for air circulation to remove the heat produced by transformers.
- C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.
- D. Use flexible metal conduit to enclose the conductors from the transformer to the raceway systems.

3.2 SPARE PARTS

- A. Deliver the following spare parts for the project to the COTR two weeks prior to final inspection:
 - 1. Six stand-off insulators.
 - 2. Six insulated protective caps.
 - 3. One spare set of high voltage fuses for each size fuse used in the project.

3.3 TRAINING

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Section 01 00 00 GENERAL REQUIREMENTS.

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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 09 91 00, PAINTING: Identification and painting of panelboards.
- 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 and outlet boxes.
- D. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

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 COTR:
 - 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

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):

PB-1-2006.....Panelboards

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

C. National Fire Protection Association (NFPA):

70-2005National Electrical Code (NEC)

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

D. 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.
- E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.

F. 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. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panels, and with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
11. 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.

2.3 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 for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated on the drawings.
 2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frames and higher.
- 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.
 8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
 9. Shunt trips shall be provided where indicated

10. 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.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the Manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.
- C. In accordance with Section 09 91 00, PAINTING, paint the panelboard system voltage, and feeder sizes as shown on the riser diagram in 1 inch block lettering on the inside cover of the cabinet door. Paint the panel designation in one inch block letters on the outside of the cabinet doors.
- D. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved by the COTR. 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.
- E. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.
- F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- G. 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.

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SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets 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 to ground for possible ground fault currents.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- 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, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COTR: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

1.5 APPLICABLE PUBLICATIONS

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

- B. National Fire Protection Association (NFPA):
 - 70-08.....National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
 - WD 1-99.....General Color Requirements for Wiring Devices
 - WD 6-02Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-07.....Surface Metal Raceways and Fittings
 - 20-08.....General-Use Snap Switches
 - 231-08.....Power Outlets
 - 467-07.....Grounding and Bonding Equipment
 - 498-08.....Attachment Plugs and Receptacles
 - 943-08.....Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., and conform to NEMA WD 6.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Heavy duty, specification grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
 - 1. Bodies shall be gray in color.
 - 2. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, heavy duty, specification grade, suitable for mounting in a standard outlet box.
 - a. Ground fault interrupter shall consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.
- C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

- D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or cemetery grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 TOGGLE SWITCHES

- A. Toggle Switches: Shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be gray in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.
1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
 3. Ratings:
 - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
 - b. 277 volt circuits: 20 amperes at 120-277 volts AC.

2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be gray unless otherwise specified.
- C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.
- D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- E. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
1. Enclosures:
 - a. Thickness of steel shall be not less than 1mm (0.040 inch) steel for base and cover. Nominal dimension shall be 1-1/2 by 40mm by 70mm (2-3/4 inches) with inside cross sectional area not less than 2250mm (3.5 square inches). The enclosures shall be thoroughly

cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.

2. Receptacles shall be duplex, heavy duty specification grade. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 600mm (24 inches) on centers.
4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
6. Bond the strips to the conduit systems for their branch supply circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown on the drawings.
- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.
- C. Outlet boxes for light and dimmer switches shall be mounted on the strike side of doors.
- D. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material.
- E. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.
- F. Install wall switches 1200mm (48 inches) above floor, OFF position down.
- G. Install wall dimmers 1200mm (48 inches) above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.

- H. Install convenience receptacles 450mm (18 inches) above floor, and 152mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- I. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.
- J. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
- K. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

- - - E N D - - -

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of the interior lighting systems.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.
 - 1. Material and construction details include information on housing, optics system and lens/diffuser.
 - 2. Physical dimensions and description.
 - 3. Wiring schematic and connection diagram.
 - 4. Installation details.
 - 5. Energy efficiency data.
 - 6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
 - 7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).
 - 8. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

C. Manuals:

1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COTR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
C62.41-02.....Guide on the Surge Environment in Low Voltage
(1000V and less) AC Power Circuits
- C. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)
101-09.....Life Safety Code
- D. National Electrical Manufacturer's Association (NEMA):
C78.138-98Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
C78.43-07Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
C78.81-05Electric Lamps - Double-capped Fluorescent Lamps Dimensional and Electrical Characteristics
C78.901-05.....Electric Lamps - Single Base Fluorescent Lamps Dimensional and Electrical Characteristics
C82.1-04.....Ballasts for Fluorescent Lamps - Specifications
C82.2-02.....Method of Measurement of Fluorescent Lamp Ballasts
C82.4-02.....Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps
C82.11-02.....High Frequency Fluorescent Lamp Ballasts
- E. Underwriters Laboratories, Inc. (UL):
496-08.....Safety Lampholders
542-05.....Lampholders, Starters, and Starter Holders for Fluorescent Lamps

844-06.....Electric Lighting Fixtures for Use in Hazardous
(Classified) Locations
924-06.....Emergency Lighting and Power Equipment
935-01.....Fluorescent-Lamp Ballasts
1029-94.....High-Intensity-Discharge Lamp Ballasts
1029A-06.....Ignitors and Related Auxiliaries for HID Lamp
Ballasts
1598-08.....Luminaires
1574-04.....Standard for Track Lighting Systems
2108-04.....Standard for Low-Voltage Lighting Systems
8750-08.....Light Emitting Diode (LED) Light Sources for Use
in Lighting Products

F. Federal Communications Commission (FCC):

Code of Federal Regulations (CFR), Title 47, Part 18

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES (LUMINAIRES)

- A. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.
- B. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
 - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 - 4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.
- C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
 - 1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for bi-pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.

2. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures.
 3. Incandescent: Shall have porcelain enclosures and conform to the applicable requirements of UL496.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
 3. Exterior finishes shall be as shown on the drawings.
- H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- I. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
 2. Flat lens panels shall have not less than 3.2mm (1/8 inch) of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.
 3. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.
- J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Group areas as defined in NFPA 70, and shall comply with UL 844.

2.2 BALLASTS

- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V) electronic programmed-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be

designed for full light output unless dimmer or bi-level control is indicated; including the following features:

1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.87 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 11. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
 12. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
- B. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.

7. Lamp Current Crest Factor: 1.7 or less.
8. Ballast Factor: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.3 FLUORESCENT EMERGENCY BALLAST

- A. Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
 1. Emergency Connection: Operate one fluorescent lamp continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 5. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.4 LAMPS

- A. Linear and U-shaped T5 and T8 Fluorescent Lamps:
 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
 3. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color Rendering Index (CRI) of greater than 70, average rated life of 20,000 hours, and be suitable for use with dimming ballasts, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Align, mount and level the lighting fixtures uniformly.

C. Lighting Fixture Supports:

1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
4. Hardware for recessed fluorescent fixtures:
 - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
 - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
 - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
6. Hardware for recessed lighting fixtures:
 - a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a

horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.

- b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
- D. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- E. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- F. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- G. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.
- H. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

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SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior luminaries, controls, poles and supports.

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, fittings, and boxes for raceway systems.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

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, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaries, lamps and controls.
- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COTR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - 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

- 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. Aluminum Association Inc. (AA):
AAH35.1-2006Alloy and Temper Designation Systems for
Aluminum
- C. American Association of State Highway and Transportation Officials (AASHTO):
LTS-4-2006.....Structural Supports for Highway Signs,
Luminaries and Traffic Signals
- D. American Concrete Institute (ACI):
318-2008Building Code Requirements for Structural
Concrete
- E. American National Standards Institute (ANSI):
IEEE C57.12-2006.....General Requirements For Liquid-Immersed
Distribution, Power, and Regulating
Transformers
- F. American Society for Testing and Materials (ASTM):
A123/A123M-2009Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A153/A153M-2009.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware - AASHTO No.: M232
B108-03a-2008Aluminum-Alloy Permanent Mold Castings
D3487-2008.....Mineral Insulating Oil Used in Electrical
Apparatus
AC 150/5345-43E-1995....Specification for Obstruction Lighting
Equipment
- G. Illuminating Engineering Society of North America (IESNA)
HB-9-2000.....Lighting Handbook
RP-8-2000 (R-2005).....Roadway Lighting
- H. National Electrical Manufacturers Association (NEMA):
C78.41-2006.....Electric Lamps - Guidelines for Low-Pressure
Sodium Lamps

- C78.42-2007Electric Lamps - Guidelines for High-Pressure
Sodium Lamps
- C78.43-2007Electric Lamps - Single-Ended Metal-Halide
Lamps
- C78.1381-1998.....(R 1997) Electric Lamps - 70-Watt M85 Metal-
Halide Lamps
- C81.61-2005Electrical Lamp Bases
- C82.4-2002Ballasts for High-Intensity-Discharge and Low-
Pressure Sodium Lamps (Multiple-Supply Type)
- C136.17-2005Roadway Lighting Equipment - Enclosed Side-
Mounted Luminaires for Horizontal-Burning High-
Intensity-Discharge Lamps
- ICS 2-2008Industrial Control and Systems Controllers,
Contactors and Overload Relays Rated 600 Volts
- ICS 6-2006Industrial Control and Systems Enclosures
- I. National Fire Protection Association (NFPA):
- 70-2008National Electrical Code (NEC)
- J. Underwriters Laboratories, Inc. (UL):
- 496-2008Edison-Base Lamp holders
- 773-1995.....Plug-in, Locking Type Photo controls, for Use
with Area Lighting
- 773A-2006Non-industrial Photoelectric Switches for
Lighting Control
- 1029-1994.....High-Intensity-Discharge Lamp Ballasts
- 1598-2008Luminaires

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 LUMINAIRES

- A. UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and relamping.
- B. IESNA HB-9 and RP-8 light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.

- D. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. IESNA Cutoff Category: full-cutoff

2.3 LAMPS

- A. Install the proper lamps in every luminaire installed
- B. Lamps to be general-service, outdoor lighting types.
- C. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381
- D. Mercury vapor lamps shall not be used.

2.4 CONTROLS

- A. Each Lighting System:
 - 1. Shall be controlled by one of the following methods as shown for each system on the drawings:
 - a. A photocell to act as the pilot device. The photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.
 - b. A time clock to act as the pilot device.
 - 2. Mount and connect photocells and time clocks as shown on the drawings.
 - 3. Photocells shall have the following features:
 - a. Quick-response, cadmium-sulfide type.
 - b. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
 - c. Energizes the system when the north sky light decreases to approximately 1.5 foot candles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.

4. Time clocks shall have the following features:
 - a. A spring-actuated, reserve power mechanism for operating the timer during electrical power failures and that automatically winds the spring when the electrical power is restored.
5. The arrangement and method of control and the control devices shall be as shown on the drawings.

2.5 EXISTING LIGHTING SYSTEMS

For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Foundation Excavation: Depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm (6 inch) maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.
- C. Photocell Switch Aiming: Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm. Set adjustable window slide for proper footcandles photocell turn-on.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding a conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose.

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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 excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

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 Contracting Officer's Technical Representative's (COTR) approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures 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 test procedure presented in standard Proctor compaction test, 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 00, GENERAL REQUIREMENTS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION

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.
- B. Furnish to COTR, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.

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 (Insert name of local state) State Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General Fill: On-site soils may be suitable for fill provided that they meet the characteristics herein. Fill material shall consist of natural soils that have a maximum Liquid Limit of 45 and a plasticity index of not more than 20. It should be free from organic matter, debris or other deleterious materials. In general, the material should have an upper particle size diameter of 2 inches.

- B. Granular Fill/Engineered Fill: Granular fill should be used in confined areas such as trenches, backfill around foundations and shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
6 inch	100
3 inch	95-100
Loss by Wash	0-15

- C. Sand-Gravel Fill: Sand-gravel fill should be used for underfloor fill and shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch	100
1/2 inch	45-85
No. 4	20-85
No. 30	5-30
Loss by Wash	0-5

- D. Crushed Stone Fill (Aggregate Base): Crushed stone fill shall meet the following gradations:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 1/2 inch	100
1 inch	85-100
1/2 inch	50-75
No. 8	20-45
Loss by Wash	0-10

- E. Bedding: Bedding for utilities shall be crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

- F. Drainage Aggregate: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2 inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COTR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, decomposed granite, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do

not leave material within the burial profile up to 2400 mm (8 feet) below finished grade.

- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the COTR. Remove materials from the Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs, that are to remain, than the farthest extension of their limbs.
- 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 have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. 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. Stockpile topsoil and protect as directed by the COTR. 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 the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.

- E. Contractor shall dispose of all excess soil, aggregate, and debris materials that are not required for use as part of the project and/or as directed by the COTR. No additional payment will be provided for the excavation, loading, transportation, and the legal disposal of excess materials off-site.
- 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 COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COTR.
- 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 COTR. Approval by the COTR 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.
- C. Structures Earthwork:
 - 1. Excavation shall be accomplished as required by drawings and specifications.
 - 2. Excavate foundation excavations to solid undisturbed subgrade.
 - 3. Remove loose or soft material to solid bottom.
 - 4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
 - 5. Do not tamp earth for backfilling in footing bottoms, except as specified.
- D. Trench Earthwork:
 - 1. Utility trenches (except sanitary and storm sewer):

- a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COTR.
2. 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.
- E. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the COTR 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 COTR, 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 base course as applicable.
2. Planting and Lawn Areas - as required for the installation of topsoil and decomposed granite to the depths indicated on the drawings and as 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 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 COTR.
- 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 granular fill material completed to mix requirements specified.
- C. Placing: Place material in uniform 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.
- D. 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 COTR. 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 method 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 COTR 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: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by COTR before seeding or sodding operation begins.
- B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 100 mm (4 inches) of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.
- C. Fertilizing: Incorporate fertilizer into the soil to a depth of 100 mm (4 inches) at a rate of 12 kg/100 m² (25 pounds per 1000 square feet).
- D. Seeding: Seed at a rate of 2 kg/100 m² (4 pounds per 1000 square feet) and accomplished only during periods when uniform distribution may be assured. Lightly rake seed into bed immediately after seeding. Roll seeded area immediately with a roller not to exceed 225 kg/m (150 pounds per foot) of roller width.
- E. Sodding: Topsoil shall be firmed by rolling and during periods of high temperature the topsoil shall be watered lightly immediately prior to

laying sod. Sod strips shall be tightly butted at the ends and staggered in a running bond fashion. Placement on slopes shall be from the bottom to top of slope with sod strips running across slope. Secure sodded slopes by pegging or other approved methods. Roll sodded area with a roller not to exceed 225 kg/m (150 pounds per foot) of the roller width to improve contact of sod with the soil.

- F. Watering: The Contractor is responsible for providing adequate water. As sodding is completed in any one section, the entire sodded area shall be thoroughly irrigated by the contractor, to a sufficient depth, that the underside of the new sod pad and soil, immediately below sod, is thoroughly wet.

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 excavated materials suitable for fill and/or backfill on site where required by the drawings and/or as directed by the COTR.
- 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 COTR 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.
- E. No additional payment will be provided for all work associated with the earthwork operations noted above.

3.7 CLEAN-UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove 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. Curb and gutters, flush curbs, etc.
- C. Pedestrian sidewalk pavements
- D. Concrete pads for site furnishings including flower watering stations, trash receptacles, benches, etc.
- E. Concrete bands

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, CAST-IN-PLACE CONCRETE (SHORT FORM).

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 3.4 E., for Cold Weather Placement and Article 3.4 D., for Cold Weather Placement of Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).

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. Hot poured sealing compound
 - 3. Reinforcement
 - 4. Curing materials
- C. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

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
 - 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
 - C979-05.....Pigments for Integrally Colored Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	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: Slump 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 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.
- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.
- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 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.

2.5 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 (Clear) and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

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.

3.3 EQUIPMENT

- A. The Contracting Officer's Technical Representative (COTR) 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 COTR 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 COTR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the COTR 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 PEDESTRIAN PAVEMENTS AND SITE FURNISHING 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 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.

3.8 CONCRETE FINISHING CURB AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain.
- H. Visible surfaces and edges of finished curb, gutter, and combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.9 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Sidewalks, flower/water stations, concrete bands, site furnishing pads:
 - 1. Finish the surfaces to grade and cross section with a metal float, trowled 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 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.

3.11 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Sawcut concrete pavement as shown on the drawings and/or as directed by the COTR.

3.12 EXPANSION 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 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.
 4. All expansion joints shall be sealed.

3.13 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.

3.14 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 COTR.
- 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 clear 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.

3.15 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. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.16 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 COTR, 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 COTR.

3.17 FINAL CLEAN-UP

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

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 11, EARTH MOVING (SHORT FORM).

1.3 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by Oregon State Department of Transportation.
 - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by Arizona State Department of Transportation.
 - 3. Job-mix formula.
- C. Certifications:
 - 1. Asphalt prime and tack coat material certificate of conformance to Arizona State Department of Transportation requirements.
 - 2. Asphalt cement certificate of conformance to Arizona State Department of Transportation requirements.

3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the Arizona State Department of Transportation Specification.

D. One copy of Arizona State Department of Transportation Specifications.

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the Arizona State Department of Transportation Specifications, including amendments, addenda and errata. Where the term "Engineer, Architect, Owner's Representative" is referenced in the Arizona State Department of Transportation Specifications, it shall mean the VA Contracting Officer.

2.2 AGGREGATES

A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.

B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").

C. Base aggregate maximum size:

1. Base course over 152mm(6") thick: 38mm(1-1/2");

2. Other base courses: 19mm(3/4").

D. Asphaltic base course:

1. Maximum particle size not to exceed 25.4mm(1").

2. Where conflicts arise between this specification and the requirements in the latest version of the Arizona State Department of Transportation Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
19mm (3/4")	100
9.5mm (3/8")	67 to 85
6.4mm (1/4")	50 to 65
2.4mm (No. 8 mesh)	37 to 50
600µm (No. 30 mesh)	15 to 25
75µm (No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the Arizona State Department of Transportation Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the Arizona State Department of Transportation Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
 2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.

- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by COTR. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the COTR.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 13 16
INTEGRAL COLOR CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Mix design and installation of integral colored concrete.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
1. C31 - Practice for Making and Curing Concrete Test Specimens in the Field.
 2. C33 - Specification for Concrete Aggregates.
 3. C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 4. ASTM C143 - Test Method for Slump of Hydraulic Cement Concrete.
 5. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 6. ASTM C-309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- B. American Concrete Institute (ACI)
1. ACI 302.IR - Guide for Concrete Floor and Slab Construction.

1.3 SUBMITTALS

- A. Product Data
1. Submit the following for approval:
 - a. Concrete design mixes.
 - b. Curing method and material.
 - c. Joint filler.
 - d. Joint sealer.
 - e. Step-by-step method for installation.
- B. Samples
1. Submit color charts and physical samples of the concrete color admixture.
 2. Submit samples of joint filler.
- C. Test Reports
1. Submit mix proportion and flexural compressive strength test results.

1.4 PROJECT CONDITIONS

- A. Cold Weather Concreting
1. Do not place concrete when the temperature of the surrounding air is expected to be below 4 degrees C (40 degrees F) during placing or

within 24 hours thereafter. Do not allow the temperature of plastic concrete to drop below 12 degrees C (55 degrees F).

B. Hot Weather Protection

1. When the mean daily temperature of the atmosphere is 27 degrees C (80 degrees F) and above, or during hot and dry weather, do not place concrete with a placing temperature which causes difficulty from loss of slump, flash set or cold joints 24 degrees C (75 degrees F) where possible and not more than 32 degrees C (90 degrees F) in any event. Where climatic conditions cause too rapid drying, make arrangements prior to placing concrete for installation of wind breaks, shading, fog spraying, water sprinkling, ponding or wet covering of a light color. Take such protective measures as quickly as concrete hardening and finishing operation allow, and maintain throughout the entire curing period.

1.5 QUALITY ASSURANCE

A. Job Mock-Up

1. Construct a mock-up sample of each color type, 5 feet square minimum, of the concrete, indicate all the typical jointing, score lines, texture or finishes, curing compound and color required in actual construction. Make mock-up samples as required until acceptance by the COTR. The integral color admixture color pigment may be changed at the request of the COTR as part of the mock-up process. Change in color pigment shall be provided by the Contractor at no additional cost to VA. Consider the selected mock-up as a standard of workmanship to be matched throughout the project. Concrete placed on the project site that does not match the color, finish, and quality of the approved mock-up will be rejected. Concrete pavement that is rejected shall be removed and disposed of off-site and replaced at not additional cost to the Owner. **The sample may not be constructed as part of the Project.** Remove samples which fail to meet the COTR's approval. Note: Due to the nature of the specified finish, the sample must be poured a minimum of 30 days prior to commencement of the Work.

PART 2 - MATERIAL

2.1 CONCRETE

- A. Coarse aggregate: ASTM C33, Class Designation 4S, except that the sum of clay lumps, friable particles and chert shall be less than 4 percent.
- B. Proportion ingredients to produce homogeneous concrete that will attain the required strength, durability, resistance to deterioration and abrasion, water tightness, appearance, and other specified properties.
- C. Provide concrete mix as follows:
 - 1. Minimum compressive strength: 4,000 psi.
 - 2. Minimum cement content: 611 lb per cubic yard.
 - 3. Maximum water-cement ratio: 0.44.
 - 4. Air entrainment: 6.5 percent plus-or-minus 1.5 percent.
 - 5. Slump: 4 inches plus-or-minus 1 inch.
- D. Integral color admixture: As manufactured by L.M. Scofield Company, ph. (800) 800-9900 or approved equal. Prior to mix design, consult Scofield Tech-Data Bullentin A-304, current edition, and Guide G-307, current edition.
 - a. Color to be reviewed and approved by the COTR.
- E. Handle, place and test in accordance with current ASTM and ACI standards and recommended practice.
- F. Per ASTM C-94, copy the manufacturer on all test reports.

2.2 FORMWORK

- A. Applicable portion of Section 32 05 23.

2.3 REINFORCEMENT

- A. Applicable portion of Section 32 05 23.

2.4 EXPANSION JOINT MATERIAL

- A. Applicable portion of Section 32 05 23.

2.5 CURING COMPOUND

- A. For integral color concrete use, Lithochrome Colorwax as manufactured by L.M. Scofield Company, ph. (800) 800-9900 or approved equal. Consult Scofield Tech-Data Bulletin A-514, current edition. Color to match admixture.

2.6 JOINT SEALING

- A. Section 32 13 73 Site Joint Sealants.
- B. Color to be approved by COTR.

2.7 BASE COURSE AGGREGATE

A. Applicable portion of Section 32 05 23.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine prepared subgrade for improper grade, poor compaction or other conditions which will adversely affect execution or quality of the work.

B. Do not place concrete until conditions are satisfactory.

3.2 PREPARATION

A. Protection

1. Protect the Work and adjacent work against damage during progress of the Work.
2. Do not use construction equipment which will damage existing or new pavement.

B. Setting Forms

1. Compact subgrade under forms and cut to grade so that form, when set, will be uniformly supported for its entire length.
2. Firmly stake forms to the required line and grade; join forms neatly and in such a manner that joints are free from play or movement in any direction. For sidewalks, arrange forms to provide cross-slope as indicated.
3. Set forms at least one day's construction ahead of the actual placing of concrete. Provide a supply of forms sufficient to permit forms being kept in place for at least 12 hours after concrete has been placed. Clean and oil forms before each use.

C. Before Placing Concrete

1. Maintain finished subgrade in a smooth and compacted condition until concrete has been placed.
2. Do not operate ready-mix trucks or other equipment between forms in paving lane unless job conditions will not permit operation from shoulder or outside lane.
3. If necessary to operate trucks between forms, and trucks cause rutting or displacement of subgrade, provide suitable runways and re-roll or hand-tamp subgrade as required to correct ruts or other irregularities.
4. When the mean daily temperature is less than 2 degrees C (35 degrees F), protect the subgrade from freezing.

5. Immediately prior to placement of concrete, test subgrade for conformity with indicated cross section by means of an approved template riding on side forms. If necessary, remove or add material as required to bring all portions of subgrade to correct elevation. Thoroughly compact subgrade and again test with template. Do not place concrete on any portion of subgrade which has not been tested for correct elevation. Clear subgrade of loose material which may have fallen upon it. Subgrade condition: damp, but not saturated with water.

3.3 INSTALLATION

A. Expansion Joint

1. Install the expansion joint filler strip 1/8 inch below the finish surface of the walk.
2. Provide 1/2-inch-wide expansion joints at points of contact with fixed objects such as building, curbs, pavement, poles, signs and hydrants or as indicated.
3. All expansion joints to be sealed.

B. Placing Concrete

1. Place concrete only on a moist, compacted base.
2. Deposit concrete so as to require as little rehandling as practicable, continuous between transverse joints or in individual sections of the Work.
3. Spade concrete thoroughly along forms and expansion joints, and work carefully into corners and around reinforcement. Tamp and screed to a dense mass.
4. Vibrators may be used provided they are operated under experienced supervision and forms are constructed to withstand their action.
5. Install walks as one-course concrete of widths and depth, and cross-sloped as indicated, continuous between expansion joints.
6. Place wire fabric reinforcement in walks where indicated.
7. After initial placement of concrete, bring surface of concrete to proper section guided by forms.
8. Finish surface of walks and steps to grade and cross section by floating.

C. Control Joints

1. Provide control joints in concrete walks to form panels of sizes indicated, located at right angles to, and parallel to, building lines or to patterns indicated on Drawings.
2. Control joint size: 1/4 inch wide by approximately one-fifth the depth of walk.
3. Joints shall be formed by sawing as soon as the concrete has hardened sufficiently to prevent reveling of the concrete at edges.

3.4 CONCRETE FINISH

A. Broom Finish for integral color concrete

1. After concrete has been brought true to grade and cross section by floating, finish surface of concrete with a coarse hair brush broom drawn over the surface transverse to the line of traffic. Take care that concrete surface does not ravel or ball during brooming.
2. After brooming, re-tool edges and joints with an edging tool having a radius of 1/4 inch and a flat trowel surface approximately 4 inches wide, leaving a smooth margin.

3.5 CURING

A. Integral Color Concrete

1. Apply liquid membrane, color-matched Lithochrome Colorwax curing compound per manufacturer's recommendations for exterior applications.

B. Continue curing until the cumulative number of hours or fractions thereof during which temperature of the air in contact with the concrete is above 50 degrees F has totaled at least 168 hours. Prevent rapid drying at the end of the curing period.

3.6 FIELD QUALITY CONTROL

A. Refer to Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

3.7 CLEANING

- A. Remove concrete spilled on the pavement or structures and thoroughly clean the pavement or structures before the concrete sets. Do not wash spilled concrete into sewers or drains. Restore the site of the Work to a neat and sightly appearance, including removal of excess materials, forms and equipment.

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SECTION 32 13 73
SITE JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes joint sealing for paving and sidewalk joints, and exterior wall joints.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, recommendations and installation and instructions for each type of sealant and associated miscellaneous material required.
- B. Samples: Submit three 12 inch long samples of each color required (except black) for each type of sealant exposed to view. Install sample between two strips of material similar to or representative of typical surfaces where compound will be used, held apart to represent typical joint widths.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms with not less than five years of successful experience in production of types of sealants required for this project. The manufacturer shall, upon request, send a qualified technical representative to the project site for purpose of advising installer on proper procedures for use of products.
- B. Installer: A firm with a minimum of five years of successful experience in application of types of materials required.

1.4 JOB CONDITIONS

- A. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended temperature range for installation. Proceed with the work only when the weather conditions are favorable for proper cure and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of the manufacturer's recommended installation temperature range so that sealant will not be subjected to excessive elongations and bond stress at subsequent low temperatures. Coordinate time schedule with Contractor to avoid delay of project.

1.5 SPECIAL PROJECT WARRANTY

- A. Sealant Warranty: Provide written warranty, signed by manufacturer and installer agreeing to, within warranty period of six years after date

of substantial completion, replace/repair defective materials and workmanship defined to include: instances of leakage of water or air; failures in joint adhesion, material cohesion, abrasion resistance, strain resistance, or general durability; failure to perform as required; and the general appearance of deterioration in any other manner not clearly specified in manufacturer's published product literature as an inherent characteristic of the sealant material.

PART 2 - MATERIALS

2.1 SEALANT MATERIALS FOR VERTICAL SURFACES

- A. Provide manufacturer's standard, non-modified, two-or-more-part, polysulfide-based, elastomeric sealant; complying with either ASTM C 920 Type M Class 25, or FS TT-S-00227E Class A; non-sag grade/type. Color to match adjacent pavement color.
 - 1. Color to be gray. Color to be reviewed and approved by COTR.
- B. Provide products of one of the following manufacturers:
 - 1. Contech/Sonneborn
 - 2. Euclid Chemical Co.
 - 3. W.R. Meadows, Inc.
 - 4. Pecora Corp.
 - 5. Products Research & Chemical Corp.
 - 6. Sika Chemical Corp.
 - 7. Toch/Carboline
 - 8. Tremco, Inc.

2.2 SEALANT MATERIALS FOR HORIZONTAL SURFACES

- A. Provide manufacturer's standard, non-modified, two-or-more-part, polyurethane-based, elastomeric sealant; complying with either ASTM C920 Type M Class 25, or FS TT-S-00227E Class A. Color to match adjacent pavement color.
 - 1. Color to be gray.
- B. Provide product of one of the following manufacturers:
 - 1. Contech/Sonneborn
 - 2. Mameco International
 - 3. W.R. Meadows, Inc.
 - 4. Pecora Corp.
 - 5. Products Research & Chemical Corp.
 - 6. Sika Chemical Corp
 - 7. Tremco, Inc.
 - 8. Toch/Carboline

2.3 MISCELLANEOUS MATERIALS

- A. Joint Cleaner: Provide type of joint cleaning compound recommended by sealant manufacturer for joint surfaces to be cleaned.
- B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.
- D. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam, or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer. Provide size and shape of rod which will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The installer must examine joint surfaces, backing, and anchorage of units forming sealant rabbet, and conditions under which sealant work is to be performed, and notify Contractor in writing of conditions detrimental to proper completion of the work and performance by sealants. Do not proceed with sealant work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 JOINT SURFACE PREPARATION

- A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.
- B. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicated that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution; rinse thoroughly with water and allow to dry before sealant installation.
- C. Roughen joint surfaces in vitreous-coated and similar non-porous

materials where sealant manufacturer's data indicate lower bond strength than for porous surfaces. Rub with fine abrasive to produce a dull sheen.

3.3 INSTALLATION

- A. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.
- B. Prime or seal joint surfaces where shown or recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- C. Install sealant backer rod for liquid sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.
- D. Install bond breaker tape where shown and where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.
- E. Employ only proven installation techniques which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.
- F. Install sealants to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations measured at center (thin) section of bead:
 - 1. For sidewalks, pavements, and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, and neither more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- G. Spillage: Do not allow sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Use masking

tape or other precautionary devices to prevent staining of adjoining surfaces by primer/sealer.

- H. Remove excess and spillage of sealants promptly as the work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes.

3.4 CURE AND PROTECTION

- A. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability. Do not cure in a manner which would significantly alter material's modulus of elasticity or other characteristics.
- B. Installer shall advise Contractor of procedures required for curing and protection of sealants during construction period so that they will be without deterioration or damage (other than normal wear and weathering) at time of Owner's acceptance.

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SECTION 32 14 13
PRECAST CONCRETE UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Aggregate base, setting bed, geotextile and precast concrete unit pavers.

1.2 REFERENCES

- A. ASTM International, as referenced herein as ASTM.
B. Arizona Department of Transportation, Standard Specifications for Construction, latest edition, as referenced herein as ADOT.

1.3 SUBMITTALS

- A. Product Data:
1. Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.
- B. Source Quality Control:
1. Submit 2 samples made up of actual unit pavers for each type, color and texture required. Include in each set of samples the full range of exposed color and texture to be expected in the completed Work.
 2. Submit testing certification showing capability of pavers proposed to comply with the specified strength requirement.
- C. Field Quality Control:
1. During construction, submit field test reports in accordance with Article 3.8.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Engage an installer who has successfully completed within the past 3 years at least three unit paver applications similar in type and size to that of this Project and who will assign installers from these earlier applications to this Project, of which one will serve as lead installer.
- B. Mock-Up:
1. Construct a mock-up sample, 10 feet square minimum, of the paving system, including the materials, pattern and joint treatment required in actual construction. Make mock-up samples as required until acceptance by the COTR. Consider the accepted mock-up as a minimum standard of workmanship to be matched or bettered throughout the Project. The sample may be constructed as part of the Project

and, if approved, will be accepted as part of the Work. Remove samples which fail to meet the COTR's approval.

- C. Engage an independent Testing and Inspection Agency to perform sampling and testing of aggregate base materials proposed for use in the Work as follows: Perform laboratory moisture density test: ASTM D1557.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging, Shipping, Handling and Unloading:

1. Deliver materials to the Project site in their original, unopened containers bearing label clearly identifying manufacturer's name and brand. Store materials under cover, clear of the ground and protected from the weather.
2. Protect unit pavers and aggregate during storage and construction against wetting by rain, snow or groundwater, and against soilage or intermixture with earth or other types of materials.
3. Handle pavers to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges of pavers with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slide.
4. Store pavers on wood skids or pallets. Place and stock skids and pavers to distribute weight evenly and to prevent breakage or cracking. Protect stored pavers from weather with waterproof non-staining covers or enclosures, but allow air to circulate around pavers.

1.6 WARRANTY

- A. Warrant the finished area to be free of bumps and depressions, evenly graded to levels shown, and free of defects in materials and workmanship for a period of 2 years after substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base:

1. Aggregate: Natural or slag aggregate.

B. Sand Setting Bed:

1. Sand: ASTM C33, well graded, washed sharp sand meeting the following sieve analysis gradations:

<u>Sieve</u>	<u>Percent Passing</u>
0.375 inch	100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	20 - 30
No. 200	0 - 5

2. Use of masonry sand will not be permitted.

C. Concrete Pavers:

1. Single layer hydraulic pressed concrete as approved by the COTR.

a. Color and finish to be reviewed and approved by the COTR.

2. Cementitious Materials:

a. Portland cements: ASTM C150.

b. Blended hydraulic cements: ASTM C595.

c. Hydrated lime: ASTM C207, Type S.

d. Pozzolans: ASTM C618 for fly ash and raw or calcined natural pozzolans for use in Portland cement concrete.

3. Aggregates:

a. ASTM C33 for normal weight concrete aggregate.

4. Other Constituents:

a. Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other additives: previously established as suitable for use in concrete and either conforming to ASTM standards where applicable, or shown by test or experience not to be detrimental to the durability of the concrete.

5. Compressive Strength:

a. Average not less than 8,000 psi with no individual unit less than 7,200 psi, as tested per ASTM C140.

6. Absorption:

a. Under freeze/thaw conditions, average no greater than 5%, with no individual unit greater than 7%, as tested per ASTM C936.

7. Proven Field Performance:

a. Satisfactory field performance is indicated when units similar in composition and made with the same manufacturing process as those to be provided for the Work do not exhibit objectionable deterioration after at least 3 years.

b. The units used as the basis for proven field performance have been exposed to the same general type of environment, temperature

range and traffic volume as is contemplated for the units to be provided for the Work.

8. Freeze-Thaw:

- a. No breakage and no greater than 1.0% loss in dry weight of any individual unit when subjected to 50 freeze-thaw cycles, as tested per ASTM C67.

9. Visual Inspection:

- a. Provide units which are sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Cracks or chipping resulting from handling in shipment, delivery and installation are deemed grounds for rejection.

10. Size:

- a. As indicated with a maximum tolerance 0.0625 inch in depth, width or length.

D. Jointing Sand:

1. ASTM C144, clean, fine, sharp, free of organics and soluble salts or other contaminants likely to cause efflorescence, with the following grading limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 8	95 - 100
No. 16	70 - 100
No. 30	40 - 75
No. 50	10 - 35

2. "Unicare Polymeric Sand Max," as manufactured by Unilock, 1-800-864-5625, or approved equal. Polymeric sand shall be in original, unopened packaging. On-site mixing is not permitted. Install per manufacturers recommendations.

E. Geotextile Fabric:

1. Filter Fabric:

- a. Synthetic, non-woven, needle-punched fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel during use and meets the following criteria:

<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Weight	ASTM D3776	4 oz./sq. yd. min.
Grab Tensile Strength	ASTM D4632	100 lbs. min.
Mullen Burst	ASTM D3786	210 psi min.
Puncture Resistance	ASTM D4833	65 lbs. min.
Trapezoidal Tear	ASTM D4533	40 lbs. min.
Coefficient of Permeability	ASTM D4491	0.15 cm/sec. min.

2. Stabilization Fabric:

- a. Synthetic, woven fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel or become clogged during use and meets the following criteria:

<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Weight	ASTM D3776	4.5 oz./sq. yd. min.
Grab Tensile Strength	ASTM D4632	150 lbs. min.
Grab Elongation	ASTM D4632	25% max.
Mullen Burst	ASTM D3786	300 psi min.
Puncture Resistance	ASTM D4833	95 lbs. min.
Trapezoidal Tear	ASTM D4533	65 lbs. min.
Coefficient of Permeability	ASTM D4491	0.01 cm/sec.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:

1. Protect the work and adjacent construction against damage during progress of the Work.
2. Do not use construction equipment which will damage existing or new pavement.

3.2 AGGREGATE BASE COURSES

A. Sub-grade Preparation:

1. Examine sub-grade surfaces for line, grade, and compaction.
2. Bring sub-grade surface found to be unsuitable up to grade and recondition as specified under Section 31 20 00 Site Earthwork, including the necessary fine grading, to ensure that the minimum specified depth of paving will bring the surface to the indicated elevations. If the COTR finds the sub-grade surface unsuitable, such surface shall be struck off with approved graders, scarified and wetted, and finally rolled with the addition of sufficient moisture to prevent drying out prior to the placing of the aggregate material.

B. Equipment:

1. Equipment for construction of aggregate base courses is subject to approval by the COTR and shall be maintained in satisfactory working condition at all times.
2. Place the aggregate base courses by means of a moving vehicle equipped with spreader box, mechanical spreader, or other approved equipment capable of laying the courses so that the finished layer will be of the proper gradation and thickness.
3. Use compaction equipment consisting of self-propelled tamper or pneumatic-tired rollers or vibrating compactors, and three-wheeled or tandem rollers weighing from 6 to 10 tons and having a weight of between 200 lbs. and 325 lbs. per inch-width of roller. Use equipment which is capable of obtaining the required density throughout the entire depth of the layer being compacted.

C. Placing Aggregate:

1. Place aggregate on the sub-grade, using approved placing equipment, in a uniform layer to the required contour and shape and in layers not more than 4 inches (compacted) in thickness. Total thickness after compaction: minimum as indicated. Segregation of large or fine particles will not be acceptable; remove pockets of segregated material and replace with a satisfactory mixture, or remix as directed and approved by the COTR.

D. Compaction:

1. After placing, compact the material by approved means. Begin rolling at edges of the area to be compacted and proceed towards the center. Compact areas not accessible to rollers by mechanical tampers.
2. Compact material to at least 95% of maximum unit weight. Maintain the moisture content within a tolerance of plus or minus 3% of optimum until the prescribed unit weight is obtained, as determined by ASTM D1557.
3. Compact each layer until the maximum unit weight is attained before placing the succeeding layer.

E. Density:

1. During the construction of aggregate base courses, field density tests will be made as specified under Section 31 20 00 Site Earthwork.
2. If density tests indicate that the base course does not comply with specified density requirements, additional wetting, if necessary,

and rolling will be required until the specified density is obtained. Add moisture to the material during compaction only when it is necessary to increase the percentage of moisture to obtain the specified density.

F. Condition of Finished Surfaces:

1. Smooth, even and true to the lines, grades and cross sections indicated. Maximum deviation of finished surface when tested with a 10 foot straight-edge parallel to the center line of the surfaced area: 0.25 inch in 10 feet.

3.3 SAND SETTING BED

A. Moisture Content:

1. In the range of 4 to 8% when installed and uniform when screeded. Protect sand against rain when stockpiled on site prior to screeding.

B. Spreading:

1. Spread the bedding sand loose in a uniform layer to give a depth after compaction of the paving units of a minimum of 0.75 inch thickness and as required to achieve designed grades.

C. Screeding:

1. Carefully maintain the spread sand in a loose condition and protect against pre-compaction by traffic or rain both prior to and following screeding. Lightly screed sand in a loose condition to predetermined depth. Do not screed the sand in advance of the laying face to an extent to which paving will not be completed on that day. Bring screeded sand which is pre-compacted prior to laying of paving unit back to profile in a loose condition. Do not permit pedestrian or vehicular traffic on the screeded sand.
2. Screed the bedding sand using either an approved mechanical spreader or by the use of screed guides and boards.

3.4 SETTING PAVERS

A. General:

1. Do not install pavers with excessive chips, cracks, voids, discolorations or other defects.

B. Pattern:

1. Lay the pavers in the pattern as indicated or as shown on approved Shop Drawings.

C. Color Blending:

1. Install paving units from a minimum of 3 bundles, simultaneously drawing the paver vertically rather than horizontally.

D. Joints:

1. Maintain a consistent joint spacing of approximately 0.125 inch, unless otherwise indicated. Provide this spacing also for the first row abutting the edge restraint. Where pavers have 0.125 inch setting nodes, set nodes tight to adjacent pavers.

E. Alignment:

1. Use string lines or chalk lines on bedding sand to hold pattern lines true.

F. Cutting:

1. Cut paving units only under the written approval of the COTR. Where cutting is approved, fill the gaps at the edge of the paving surface with manufactured edge pavers or with pavers cut to fit. Accomplish cutting to leave a clean edge to the traffic surface using a mechanical hydraulic, or guillotine cutter or masonry saw.
2. The use of infill concrete or discontinuities in patterns will not be permitted. Lay out pavers in all areas so as to eliminate slivers at edges.

G. Sweeping Clean:

1. Upon completion of cutting, sweep the area clean of debris to facilitate inspection and to ensure pavers are not damaged during compaction.

H. Inspection of Installed Pavers:

1. After sweeping and prior to compaction, inspect the paved area to ensure satisfactory color blending. Move pavers as necessary to achieve good color distribution.

I. Compaction:

1. After inspection of the paving unit installation, compact pavers to achieve consolidation of the sand bedding and achieve design levels and profiles by not less than 3 passes of a suitable plate compactor.
2. Accomplish compaction by the use of a plate compactor capable of a 5,000 pound compaction force.
3. Proceed with initial compaction as closely as possible following installation of the paving units and prior to acceptance of any traffic or application of sweeping sand.
4. Do not attempt compaction within 3 feet of the laying edge.

J. Paver Replacement:

1. Immediately remove and replace units which are structurally damaged during compaction.

K. Jointing Sand:

1. Spread the jointing sand over the pavement as soon as is practical after initial compaction and prior to the termination of Work on that day. Do not use wet sand.
2. Broom the jointing sand to fill the joints. Remove excess sand from the pavement surface and compact the pavers again to settle the jointing sand.

L. Final Compaction of Pavers:

1. After jointing sand has been installed and the pavement surface swept clean, accomplish final compaction by not less than two passes of the plate compactor.
2. Proceed with final compaction as closely as possible following installation of jointing sand and prior to the acceptance of any traffic.
3. Inspection by the Owner or his consultant will determine whether a second application or partial application of jointing sand is required.

3.5 PROOF ROLL

- A. Proof roll the completed installation with pneumatic tire equipment which replicates anticipated service traffic. Subject each individual paver to at least one passage of load.
- B. Proof roll plaza areas with the equivalent of a 2,000 pound wheel load with a tire pressure of 50 psi.
- C. Proof roll road areas with the equivalent of a 5,000 pound wheel load with a tire pressure of 100 psi.
- D. Equipment and procedures are subject to approval by the COTR. Notify the COTR when proof rolling will be conducted.
- E. Remove and replace units which are cracked or otherwise damaged by proof rolling. Inspect and repair setting bed.
- F. ALLOWABLE TOLERANCE
- G. Finished surface: smooth, even, and true to the lines, grades and cross section indicated.
- H. Maximum deviation of finished surface when tested with a 10 foot straight-edge parallel to the centerline of the surfaced area: 0.5 inch in 10 feet.

- I. Maximum offset from flush from paver surface to paver surface or from paver surface to a fixed flush edge: 0.0625 inch.

3.6 REPAIR/RESTORATION

- A. Remove and replace pavers which are chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.
- B. Clean concrete pavers after setting is complete; use procedures recommended by producer for types of application indicated.

3.7 FIELD QUALITY CONTROL

- A. Testing:
1. Engage and independent Testing and Inspection Agency to perform field testing for quality control during construction as follows:
 - a. Field gradation analysis for setting bed and joint sand: ASTM D422.
 - b. Field density-in-place tests for aggregate base course. Make at least 4 tests in accordance with ASTM D2167 or other method approved by the COTR. Testing Agency report shall indicate location of each test.

3.8 CLEANING

- A. Sweep clean paved areas of excess sand and dirt.
- B. Pick up and remove from the site surplus materials, equipment and debris resulting from the work of this Section.

3.9 PROTECTION

- A. Provide final protection and maintain conditions which ensure paver work being without damage or deterioration at time of substantial completion.

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SECTION 32 16 13
CONCRETE CURBS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Concrete curbs, and concrete curb and gutter to line grade and profile as indicated.

1.2 REFERENCES

- A. Reference Specifications: As herein noted, the work shall comply with requirements of:
1. The current American Society of Testing Materials series of Standard Specifications, referred to as ASTM; and,
 2. The current American Association of State Highway and Transportation Officials, referred to as AASHTO; and
 3. Standard Specifications of Oregon State Department of Transportation, latest revision.
 - a. 2002 Oregon Standard Specifications of Construction.
 - b. January 2006 Supplemental Oregon Standard Specifications for Construction.

1.3 QUALITY CONTROL

- A. Field Quality Control Testing
1. Perform slump measurement according to ASTM C143.
 2. Perform air content according to ASTM C231.
 3. Perform compressive strength tests according to ASTM C31 and C39.
- B. Workmanship
1. The Contractor is responsible for correction of concrete work which does not conform to the specified strength, tolerance or finish.

1.04 JOB CONDITIONS

- A. Environmental Conditions
1. Refer to Section 03 30 53, CAST-IN-PLACE CONCRETE, for placing concrete in either cold or hot weather.

1.05 SITE CONDITIONS

- A. Existing Conditions
1. Examine work in place upon which this work is dependent. Defects which may influence satisfactory completion and performance of this work shall be corrected in accordance with the requirements of the applicable section of work prior to commencement of the work.

Commencement shall be construed as work in place being acceptable for satisfying the conditions of this section.

B. Protection

1. Protect the work and adjacent work against damage during progress of the work.
2. Construction equipment which will damage existing or new curbs shall not be used.

PART 2 - MATERIALS

2.1 CONCRETE

- A. All concrete shall conform to Section 03 30 53, CAST-IN-PLACE CONCRETE.
- B. Coarse aggregate shall comply with ASTM C33 Class Designation 4S except that the sum of clay lumps, friable particles and chert shall be less than 4 percent.
- C. Ingredients shall be proportioned to produce homogeneous concrete which will attain the required strength, durability, resistance to deterioration and abrasion, water tightness, appearance, and other specified properties.
- D. Minimum compressive strength shall be 4,000 psi.
- E. Entrained air content shall be within a range of 4 to 7 percent.
- F. Maximum slump shall be 3 inches.

2.02 REINFORCEMENT

- A. All reinforcement shall be Grade 60 deformed bars conforming to ASTM A615 or A617.

2.03 EXPANSION JOINT

- A. Provide expansion joints at a maximum spacing of 60 ft.
- B. All expansion joints shall be sealed.
- C. Refer to Joint Sealants 07 92 00.

2.04 CURING COMPOUND

- A. Curing compound shall be Type 1, clear, conforming to ASTM C309.2.2

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine subgrade for improper grade, poor compaction or other conditions which will adversely affect execution or quality of the work.
- B. Do not place concrete until conditions are satisfactory.

3.02 FORMWORK

- A. Forms shall be of wood or metal, straight and free from distortion and of sufficient strength to resist springing during the process of depositing concrete against them. They shall be of an approved section with a flat surface on top. When the curb radius is less than 200 feet, the curbed alignment shall be provided for by either standard steel forms equipped with flexible liners, by flexible forms, or by 3/4 inch oiled sheeting forms. Use snap-ties, spacers and braces as required to secure forms.
- B. Slip-forming curbs will not be accepted.

3.03 SETTING FORMS

- A. Compact subgrade under forms and cut to grade so that form, when set, will be uniformly supported for its entire length.
- B. Forms shall be firmly staked to the required line and approved grade. Join forms neatly and in such a manner that joints are free from play or movement in any direction.
- C. Supply of forms shall be sufficient to permit forms being kept in place for at least 12 hours after concrete has been placed. Clean and oil forms before each use.
- D. Grade and alignment of forms shall be checked by the Resident Engineer and necessary corrections made immediately before placing concrete.

3.04 JOINTS

- A. Provide control joints in curbs in such a manner as to align with control joints in adjacent work. Control joints shall be formed by 1/4 inch thick steel template of a width equal to that of curb and depth at least 2 inches greater than required curb depth, set vertically within the curb forms and at right angles to curb face.
- B. Provide 1/2 inch thick expansion joint opposite expansion joint in adjacent walk at the tangent points of all curb returns, at intersections between the walk and curb where the walk is parallel and adjacent to the curb, and elsewhere at intervals not exceeding 60 feet. The expansion joints shall be established by means of placing prepared strips of 1/2 inch thick fiber matrix, cut to conform to the shape of the curb and gutter and shall extend the full depth of the concrete and set below the top of curb to allow for the installation of sealant.

3.05 PLACING CONCRETE

- A. Concrete shall be so placed as to provide one course monolithic structure. Concrete shall be deposited in such a consistency as to prevent sagging of the curb during finishing process. Concrete shall be consolidated by vibration, tamping or spading to eliminate voids and honeycomb.

3.06 FINISHES

- A. All surfaces exposed to view shall be finished smooth and even by means of a moistened wood float followed by a light brushing, using either a broom brush or burlap. All corners, edges and joints shall be edged and troweled with 1/8 inch radius, except as noted on drawings.
- B. Top of curb shall not vary more than 3/16 inch in 10 feet when checked with a 10 foot straight-edge.
- C. After the forms have been removed and prior to final finishing, repair all honeycomb and minor defects with mortar composed of one part Portland cement and two parts sand.

3.07 CURING AND PROTECTION

- A. Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and shall be maintained without drying at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Apply curing according to manufacturer's recommendations.
- B. Barricade against pedestrians for 24 hours and against vehicular traffic for 14 days. Backfill behind curb shall be placed and thoroughly tamped in layers not exceeding 6 inches in depth and left in a neat and workmanlike condition.

3.08 CLEAN UP

- A. Concrete spilled on the pavement or structures shall be removed and the pavement or structures thoroughly cleaned before the concrete sets. Spilled concrete shall not be washed into sewers or drains. Restore the site of the work to a neat and sightly appearance, including removal of excess materials, forms and equipment.

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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. Furnish and install benches at the specified locations.
 3. Flagpole 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 03 30 53: 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

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

- B. American Society for Testing and Materials (ASTM):
B221-08Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes
- C. American Welding Society (AWS):
D1.2-97..... Structural Welding Code Aluminum
- D. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.1 FLOWER WATERING STATIONS: GENERAL

Flower watering station materials, finishes and colors shall be as shown on the drawings and as approved by the COTR or be deemed as approved equal.

2.2 TRASH RECEPTACLE

- A. Trash receptacles shall 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 specifications and Contract Drawings 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 specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, 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 Glossy Black
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.
2. The thickness of the resulting finish averages 8-10 mils (200-250 microns).

2.3 FLOWER VASE RECEPTACLE

A. Flower vase receptacles shall 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 specifications and Contract Drawings 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 specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, 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 be regularly produced by the manufacturer for use at VA Cemeteries, with a special light weight hinged lid designed for the VA Cemeteries. 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.

2.4 WATER SPIGOT ASSEMBLIES

Water spigots shall match existing 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 Gloss Black. 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 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 final approved configuration, including the mounting method, shall be as approved during the submittal process.

2.5 BENCHES

- A. To establish an acceptable level of quality for the bench materials and fabrication process, the following manufacturing features are listed and required for the purpose of identifying manufacturers that provide work and materials generally complying with these specifications. Their selection for this work shall not relieve them from performing the work as specified.
- B. Manufacturing Features: Front welds are to be ground and polished until they form a continuous surface from the top tubular section to each vertical steel slat. Steel seat members shall be gently reverse contoured for maximum comfort. The end sections shall be solid steel

bar, welded and ground, structurally adequate for the maximum loads, including an industry standard or greater design load safety factor. End arm rests are required and shall be standard integral welded configuration, with no center arm rests. All fabricated metal components are to be steel shotblasted, etched, phosphatized, preheated and electrostatically powder-coated with TGIC polyester powder coatings.

- C. Benches shall be at the locations, sizes and in the quantities indicated on the Contract drawings.
- D. Bench color shall be Victor Stanley Black, as approved during the submittal process.
- E. All mounting hardware shall be stainless steel. Use of acorn nuts is required; exposed bolt ends or flat bolt heads are not acceptable. Apply medium strength (blue) thread-locking fluid to fastener threads.
- F. WARRANTY:
 - 1. All benches shall be free from defects in material and/or workmanship for a minimum period of three years, from final acceptance. Warranty shall not apply to damage resulting from accident, alteration, misuse, tampering, negligence or abuse.

2.6 FLAG SLEEVES

- A. Furnish flag sleeves at the locations and following the details in the Contract Drawings.
- 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 COTR.
- C. Flag sleeve locations shall be marked along the adjoining roadway, by installing a 1" round bronze marker perpendicular to the road centerline on the top of the curb at the flag sleeve location. Confirm location, installation, and detail of the bronze marker with COTR prior to installation. The flag sleeve locations shall 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

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 Contracting Officer's Technical Representative (COTR).

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by COTR. 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

- A. Flower Watering Stations:
 - 1. Stake location of flower watering stations and obtain approval from COTR prior to forming concrete pad. Install concrete pad in accordance with 03 30 53 - CAST-IN-PLACE CONCRETE (SHORT FORM).
 - 2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions.
 - 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.
- B. Benches:
 - 1. Benches shall be shipped assembled. Mount benches as recommended and as specified on the drawings. Apply medium strength (blue) thread-locking fluid to fastener threads.
- 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

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 31 53
PERIMETER SECURITY FENCES AND GATES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work consists of all labor, materials, and equipment necessary for furnishing and installing perimeter security fences, gates and accessories in conformance with the lines, grades, and details as shown.

1.2 RELATED WORK

- A. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.
B. Finish Grading: Sections 31 20 11, EARTH MOVING and 32 90 00, PLANTING.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Fence, gates, and accessories shall be products of manufacturers regularly engaged in manufacturing items of type specified.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Fencing, gates and all accessories.
 2. Manufacturer's Certificates:
 - a. Zinc-coating complies with specifications.
 - b. Structural characteristics comply with indicated and criteria.
 - c. Connections comply with requirements indicated.
 3. Samples: color chips for selected fence and accessories.
- B. Shop Drawings for layout of fence and gates with dimensions, details and finishes of component accessories and post foundations. .
- C. Certification that fence alignment meets requirements of contract documents. Alignment certification shall include reference to property lines.

1.5 APPLICABLE PUBLICATIONS

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.

- A. American Society for Testing and Materials (ASTM):
A653/A653M.....Steel Sheet, Zinc Coated (Galvanized) or Zinc
Iron Alloy-Coated.....(Galvannealed) by the Hot-dip Process
A853-04.....Steel Wire, Carbon, for General Use

A924/A924M:Steel Sheet, Metallic-Coated by the Hot-Dip
Process.

A1011/A1011M:Steel, Sheet and Strip, Hot-Rolled, Carbon,
Structural, High-Strength Low-Alloy and High-
Strength Low-Alloy with Improved Formability

B117:Practice for Operating Salt-Spray (Fog)
Apparatus

C94/C94M-07.....Ready-Mixed Concrete

F626-96a(2003).....Fence Fittings

F1083-06.....Pipe, Steel, Hot-Dipped Zinc-Coated
(Galvanized) Welded, for Fence Structures.

F2408Ornamental Fences Employing Galvanized Steel
Tubular Pickets

1.6 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials shall conform to ASTM F1083 ferrous metals, zinc-coated; and detailed specifications forming the various parts thereto; and other requirements specified herein. Zinc-coat metal members (including fabric, gates, posts, rails, hardware and other ferrous metal items) after fabrication shall be reasonably free of excessive roughness, blisters, flaking, bare spots, sal-ammoniac spots, and other obvious imperfections.

2.2 PERIMETER SECURITY FENCE

- A. The perimeter security fence shall be a zinc (hot-dip galvanized) coating steel metal palisade style fence system with 3 rails. The system shall include all components such as pickets, pales, mesh, fabric, rails, posts, post caps, brackets, gates and hardware required.
- B. Material:
1. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz./sq.ft. (276 g/m²). The manufactured panels and posts shall be multi-stage pretreatment/wash (with zinc phosphate),

followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm).

- a. The color and finish for all fence components to match Ameristar Black.
 - b. All fence materials and components shall have a electrode coating process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm).
 - c. Coating performance for all fence components shall meet the requirements identified in Table 2 below and coating performance criteria of ASTM F2408.
2. Pickets: Galvanized 1" square steel tubular members min. gauge wall thickness 14 gauge manufactured per ASTM A924/A924M, having a 45,000 psi (310 MPa) yield strength and hot dipped galvanized per ASTM A653/A653M with a coating weight of 0.90 oz./sq.ft. (276 g/m²)
 3. Rails: 1 3/4" (45mm) x 1 3/4" (45mm), 12 gauge [0.105" (2.67mm)] thick galvanized steel "U" channel per ASTM A-653/A-653M, having a 45,000 psi (310 MPa) yield strength and hot dipped galvanized per ASTM A653/A653M with a coating weight of 0.90 oz./sq.ft. (276 g/m²). Pre-punched holes in the rails shall be aligned to provide a maximum opening between pickets of 3 15/16" and shall have the pickets fusion welded to the rails creating a seamless, spatter-free, rigid panel assembly.
 4. Posts: Galvanized square steel tubular members manufactured per ASTM A-653/A-653M having a 45,000 psi (310 MPa) yield strength and hot dipped galvanized per ASTM A653/A653M with a coating weight of 0.90 oz./sq.ft. (276 g/ m²) Zinc coating is inside and outside. Minimum post size 2 1/2 inches, having 12 gauge wall thickness.
 5. Panels shall be biasable to a 25% change in grade. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

Table 2 - Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 - Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

C. Heights:

1. Fence to be a nominal 6 ft. 0 inches in height.
2. Extend fence posts min. of 3'-3" below grade into concrete footings per drawings.

D. Framework:

1. Fence shall withstand the wind load requirements per ANSI/ASCE 7-02 "American Society of Civil Engineers Minimum Design Loads for Buildings and other Structures" for the State of Oregon.
2. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Gates:

1. Gates shall be designed to meet the same materials and design characteristics as the other portions of the fence.
 - a. The color and finish for all fence components to match Ameristar Black.

2. Provide manually operated swing gates for vehicle and pedestrian access as shown on drawings.
3. Gate Frames: Fabricate ornamental picket swing gate using galvanized steel members, ASTM A78, structural quality steel, 45,000 psi (310 MPa) tensile strength, with a coating weight of 0.90 oz./sq.ft. (276 g/ m²) Zinc coating inside and outside. Frame members welded using stainless steel welded to form rigid one-piece unit. (no substitution) Minimum size vertical uprights, 2 1/2" (63.5 mm) square 12 gauge [0.105" (2.67 mm) wall thicknesses.
4. Bracing: Provide diagonal adjustable length truss rods on gates to prevent sag.
5. Hardware Materials: Galvanized steel with a coating weight of 0.90 oz./sq.ft. (276 g/ m²) or malleable iron shapes to suit gate size.
6. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° (3.14 rad).
7. Fulcrum Latch: Capable of retaining gate in closed position and have provision for padlock.
 - a. Provide industrial grade exterior rated weatherproof padlock with vinyl cover- provide keys (three sets) to COTR.
8. Keeper: Provide keeper for each gate leaf over 4' (1524 mm) wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
9. Double Gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe encased in concrete to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
10. Gate Posts: Square members, ASTM A787, structural quality steel 45,000 psi (310 MPa) tensile strength, with a galvanized coating weight of 0.90 oz./sq.ft. (276 g/ m²); size as indicated below:
 - a. Gate Width Post Size
 - 4 ft. 3" min. (12 gauge)
 - 8 ft. 4" min. (11 gauge)
 - 12 ft. 4" min. (11 gauge)

2.3 ACCESSORIES

- A. Accessories as necessary caps, rail and brace ends, clips, braces, truss rods, and miscellaneous accessories conforming to ASTM F626

2.4 CONCRETE

- A. ASTM C94/C94M, using 3/4 inch (19 mm) maximum-size aggregate, and having minimum compressive strength of 4,000 psi at 28 days.

Non-shrinking grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

2.5 WARRANTY

- A. Provide manufacturer's warranty that its ornamental fence system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of **10 years** from the date of purchase.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fence by properly trained crew, on previously prepared surfaces, to line and grade as shown. Install fence in accordance with the manufacturer's printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project in sufficient quantities and capacities for proper installation of posts, pickets, rails, pales, and accessories.
- B. Engage the services of a Registered Professional Land Surveyor or Registered Civil Engineer specified in Section 01 00 00, GENERAL REQUIREMENTS, to stake out and certify that the fence alignment meets the requirements as shown.

3.2 EXCAVATION

- A. Excavation for concrete-embedded items shall be of the dimensions shown, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth shown or 18 inches (450 mm) into the bedrock, whichever is less, and provide a minimum of 2 inches (50 mm) larger diameter than the outside diameter of the post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the COTR.

3.3 POST SETTING

- A. Install posts plumb and in alignment. Set post in concrete footings of dimensions as shown, except in bedrock. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing. Install posts in

bedrock with a minimum of one inch (25 mm) of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids and finished in a slope or dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

1. Concrete shall be a minimum 28 day compressive strength of 4,000 psi per section 03 30 53, Cast-in-Place Concrete.

3.4 POST CAPS

- A. Fit all exposed ends of post with Flat top style caps. Provide caps that fit snugly and are weathertight. Post cap materials to be the same as the other railing components. Install post caps as recommended by the manufacturer and as shown. Caps to match Ameristar Black in color and finish.

3.5 SUPPORTING ARMS

- A. Design supporting arms, when required, to be weathertight. Where top rail is used, provide arms to accommodate the top rail. Install supporting arms as recommended by the manufacturer and as shown.

3.6 ACCESSORIES

- A. Supply accessories (post braces, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to ensure complete installation.

3.7 GATES

- A. Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as required by the manufacturer and as shown. Test gates, hardware, locking mechanisms and releases for proper operation. Adjust and lubricate as necessary.

3.8 REPAIR OF GALVANIZED SURFACES

- A. Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

3.9 FINAL CLEAN-UP

- A. Remove all debris, rubbish and excess material from the station.

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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 ("Call Before You Dig").
3. Maintenance period.
4. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK

A. 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 pipe (6-inch and larger), electrically operated remote control valves, and large radius rotary sprinklers (minimum 1-inch inlet with swing joint).

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 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. 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's Technical 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. 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. 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.
- E. Testing: 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.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. 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):
 - 1. A21.4-Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings
 - 2. B40.1-91Gauges-Pressure Indicating Dial Type Elastic Element
- D. American Society of Agricultural Engineers (ASAE):
 - 1. S398 Sprinkler Testing and Performance Reporting.
- E. American Society for Testing and Materials (ASTM):
 - 1. B61-93 Steam or Valve Bronze Castings
 - 2. B62-93 Composition Bronze or Ounce Metal Castings

3. C857 Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 4. C858 Specification for Underground Precast Concrete Utility Structures
 5. C891 Practice for Installation of Underground Precast Concrete Utility Structures
 6. D1785-91 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 7. D2241-89 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
 8. D2287-81 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
 9. D2464-91 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 10. D2466-90 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 11. D2564-94 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings
 12. D2855-90 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
 13. F477-90 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 14. F656-08 Primers for Use In Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- F. American Water Works Association (AWWA):
1. C104 Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings
 2. C110-93 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids
 3. C111-90 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
 4. C115-94 Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges
 5. C151-93 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
 6. C153-94 Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.
 7. C500-93 Gate Valves for Water and Sewerage Systems
 8. C504-87 Rubber Sealed Butterfly Valves
 9. C600-93 Installation for Ductile-Iron water Mains and Their Appurtenances
 10. C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service
- G. Manufacturers Standardization Society (MSS):

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

H. National Electrical Manufacturers Association (NEMA):

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

I. National Electric Code: (latest edition)

J. 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 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the irrigation system or completion of portions thereof, the contractor through the connection of the new irrigation system to the potable water system, shall be provided water for flushing and testing of the new irrigation system. Once the system is deemed operable and approved, and prior to the final inspection, 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 COTR, 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.

1.8 TESTING

- A. Notify the Contracting Officer's Technical Representative five working days in advance of testing.
- B. Subject pipelines jointed with rubber gaskets or threaded connections to a pressure test after partial completion of backfill. 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's Technical Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:
 - 1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure for 30 minutes.
 - 2. Cap all risers.
 - 3. Backfill to prevent pipe from moving under pressure. Expose all joints, 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's Technical 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.
- F. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:
 - 1. Activate each remote control valve in sequence from each controller. Manual operation of the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The Contracting Officer's Technical 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 passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

G. 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 via a written report.
4. A written report of the test data listing controller number or location, 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's Technical Representative.

H. 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's Technical 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 72 hours of notification from Contracting Officer's Technical 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's Technical Representative to schedule Final Inspection.

1.9 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer's Technical 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's Technical 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 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 Final Inspection by Contracting Officer's Technical Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 72 hours of notification from Contracting Officer's Technical 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.

1.11 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Contracting Officer's Technical Representative and Cemetery Staff. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.
- B. Control of Excavations: See Section 3.3 for safety and access directions.

- C. Install mainline and wiring sleeving under new roads prior to installation of road base.
- D. Install irrigation components in landscaped areas only.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the Contracting Officer's Technical Representative.

PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Contracting Officer's Technical 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 responsibility.
- B. Pipe sizes referenced in the construction documents are minimum sizes, 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. Mainline and lateral pipe sleeves are as shown on the drawings.
- E. Install separate control wiring sleeves. 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 Sch 40, conforming to dimensions and tolerances established by ASTM Standard D1785.

3. Use solvent weld pipe for mainline pipe under 3". Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Primer for use with solvent cement to conform to ASTM F656. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
4. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe 3" and larger. 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.
5. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length. Acceptable manufacturer for casing spacers is Ford Meter Box Company or approved equal.

B. Lateral Pipe and Fittings:

1. 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 Sch 40, conforming to dimensions and tolerances established by ASTM Standard D1785.
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. Primer for use with solvent cement to conform to ASTM F656. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Ductile Iron Pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use minimum of Class 53 thickness pipe for flanged piping. Use cement-mortar lining conforming to ANSI/AWWA C104/A21.4
2. Copper pipe: Use Type "K" rigid pipe conforming to ASTM Standard B88.
3. 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#).
4. 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.

D. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.
2. Use 3,000-PSI concrete.
3. Use 2-mil plastic.
4. Use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating.

E. Joint Restraint Harness:

1. Use a joint restraint harness as presented in the installation details and wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
3. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Use retainer conforming to ASTM A536. Use high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.
4. Acceptable manufacturer is Uni-Flange, or approved equal.

2.5 MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure. AWWA C509. Acceptable manufacturers are Clow, Kennedy, Mueller, Waterous or approved equal.
3. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Brooks Products or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

B. Air-Vacuum Relief Valve Assembly:

1. As presented in the installation details.
2. Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 2 PSI to 230 PSI. Use a continuous acting combination air and vacuum and air release valve. Acceptable manufacturer is Bermad, Crispin, Fresno, Waterman or approved equal.
3. PVC Ball Valve: Use a true union ball rated to 235 PSI. Use valve with safe-t-blocked seal carrier (full rated pressured) safe-t-shear

stem, and self adjusting floating seat. Acceptable manufacturer is Spears or approved equal.

4. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Brooks Products or approved equal.
5. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking rubber or vinyl cover. Acceptable manufacturer and model is Hunter QCV, Rain Bird 5LRC, Toro 100-SLVLC or approved.
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. Acceptable manufacturer is Harco or approved equal.
5. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Brooks Products or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

D. Flower Water Station Hydrant Connection Assembly:

1. As presented in the installation details.
2. Yard Hydrant: Self-closing plain end bib faucet with rough brass finish and a special extended lever handle that is locked to valve. Acceptable manufacturer and model is Haws 6252EHLF to match existing.
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. Inline pressure regulator: 40-45 PSI, 1-inch inlet and outlet. Acceptable manufacturers and models are Rain Bird PSI-M40X-100 and Senniger Model PSR-40 or approved equal.
5. Copper Pipe: Use Type "K" rigid pipe conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered or push-fit mechanical connection. Use a 95% tin and 5% antimony solder.
6. Valve Box: Use F8 concrete curb valve box with cast iron lid sized 8" ID x 12". Valve box must be capable of being face anchored in concrete. Acceptable manufacturer is Christy Concrete Products or approved equal.

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 brass and have stainless steel studs and flange nuts. 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 have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture Superior to match existing.
3. PVC Ball Valve: Use a compact ball valve rated to 235 PSI. Use valve with safe-t-shear stem, and self adjusting floating seat. Acceptable manufacturer is Spears or approved equal.
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) standard valve box with black lid. Acceptable manufacturer is Brooks Products 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 Spray Sprinkler Assembly:

1. As presented in the installation details.
2. 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 30 PSI pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Hunter Pro-Spray Series, Rain Bird 1800 Series, or approved equal.
3. Low Density Polyethylene Hose (Swing Pipe): Use pipe specifically intended for use as flexible swing joint. Use spiral barb fittings supplied by the same manufacturer as hose. Acceptable manufacturer is Rain Bird or approved equal.

C. Below Grade Tree Bubbler Assembly:

1. As presented in the installation details.
2. Use a prefabricated root watering system complete with bubbler, minimum 3-inch diameter semi-rigid mesh tube with retaining cap and vandal resistant locking grate, and swing joint. Furnish assembly with sand sock. Minimum height is 36-inches. Acceptable manufacturer and model is Hunter RZWS-36-25 or Rain Bird RWS-B-1401 or approved equal.
3. Low Density Polyethylene Hose (Swing Pipe): Use pipe specifically intended for use as flexible swing joint. Use spiral barb fittings supplied by the same manufacturer as hose. Acceptable manufacturer is Rain Bird to match existing equipment or approved equal.

2.7 POINT SOURCE DRIP IRRIGATION COMPONENTS

A. Drip 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 brass and have stainless steel studs and flange nuts. 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 have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture Superior to match existing.
3. PVC Ball Valve: Use a true union ball rated to 235 PSI. Use valve with safe-t-blocked seal carrier (full rated pressured) safe-t-shear stem, and self adjusting floating seat. Acceptable manufacturer is Spears or approved equal.
4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
5. Pressure Regulator: Use a normally-open pressure regulating device with preset outlet pressure of approximately 40 PSI. Body is to be constructed of glass filled, UV-resistant polypropylene, with a 120 PSI operating pressure rating. Acceptable manufacturer is Rain Bird or approved equal.
6. Compact Y filter: Use y-style filter with removable screen. Body is to be constructed of glass filled, UV-resistant polypropylene, with 120 PSI operating pressure rating. Screen is to be 200 mesh constructed of durable polyester fabric attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap form

filter body and removing filter element. Acceptable manufacturer is Rain Bird or approved equal.

7. Valve Boxes: Use plastic (ABS) standard valve boxes with black lid. Acceptable manufacturer is Brooks Products or approved equal.
8. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
9. Install assembly over gravel sump as presented in the installation details.
10. Wire connectors: Use 3M DBR/Y-6.
11. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

B. Drip Emission device

1. As presented in the installation details.
2. Single-outlet emitters: Use ½" treaded inlet emitter. Emitter to be constructed of UV resistant acetyl materials. Self-flushing with consistent flow rate of 0.6 GPH, 1.0 GPH, or 2.0 GPH (depending on model. Acceptable manufacture is Bowsmith to match existing.
3. Multiple-outlet emitters: Use ½" treaded inlet emitter with 6 barbed outlet ports. Emitter to be constructed of UV resistant acetyl materials. Self-flushing with consistent flow rate of 0.6 GPH, 1.0 GPH, or 2.0 GPH (depending on model. Acceptable manufacture is Bowsmith to match existing.

2.8 CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Description: Stand alone, pedestal mount, 8 station controller. Acceptable manufacturer is Calsense ET2000e to match existing.
2. Basic Capabilities:
 - a 100% solid state electrical components with heavy duty electrical surge protection for input and output circuits.
 - b 24 VAC transformer.
 - c Built in lightning and surge protection.
 - d Battery backup of at least 14 days.
 - e Manual activation of remote control valves from hand held radio.
 - f Minimum number of stations as shown on the drawings. Maximum number of stations is 48.
 - g Use pedestal mount configuration.
3. Rain Sensor: Use rain sensor that is compatible with control unit and can automatically shut down controller operation in a rain event.
4. 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.

5. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
6. Lightning protection: Provide one ground plate, earth contact enhancement material, one copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, 6-inch plastic round valve box and CADWELD connectors at each control unit per installation detail.

B. Controller Wire:

1. Use American Wire Gauge (AWG) #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.
2. Use American Wire Gauge (AWG) #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.
3. Color: Wire color must be continuous over its entire length.
4. Splices: Use 3M DBR/Y-6 splices.
5. Valve Box: Use plastic (ABS) standard rectangular valve with black lid. Acceptable manufacturer is Brooks Products or approved equal.
6. 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.

2.9 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's Technical 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's Technical Representative one week in advance of review. The Contracting Officer's Technical Representative will identify modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of alley and sprinklers in burial sections using a licensed surveyor. 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's Technical 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. 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. Minimum cover:
 1. 24-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
 2. 18-inches over irrigation lateral pipe in landscaped areas (distance from top of pipe to finish grade)
 3. 18-inches over control wire conduit when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 4. 10-inches vertical separation between lateral and mainline pipe installed in a common trench.
 5. 2-inches minimum horizontal separation between pipes and wiring in a common trench.

6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
- D. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer's Technical Representative.
- E. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- F. 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's Technical Representative.
- G. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, 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.
- H. 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.
- I. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 1. Backfill the trench 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.
- J. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves.
- K. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer's Technical Representative.
- L. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer's Technical 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 with restrained casing spacers are larger than twice the diameter of the pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"

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. 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.
 - 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. Ductile Iron Pipe: Install in accordance with accepted industry practices.
 - 2. Copper Pipe:
 - a Use flux and solder. Join pipe in manner recommended by manufacturer and in accordance with local codes and accepted industry practices.
 - b Solder so that continuous bead shows around the joint circumference.
 - 3. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
 - 4. 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. Thrust Blocks:
 - 1. Use cast-in-place concrete bearing against undisturbed soil.
 - 2. Size, orientation and placement will be as shown on the installation details.
 - 3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
 - 4. Install rebar with mastic coating as shown on the installation details.
- F. 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. Isolation Gate Valve Assembly:

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

B. Air/Vacuum Relief Valve Assembly:

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

C. Quick Coupling Valve Assembly:

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

D. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Sequence of construction:
 - a Coordinate exact location with Contractor Officer Technical Representative.
 - b Components up to and including copper pipe are to be installed before concrete components. After concrete components is finished, complete installation of remaining components. Coordinate installation with concrete contractor.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS.

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a Thoroughly flush mainline before installation of Remote Control Valve Assemblies.

- b Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c 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.
 - d Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e Multiple points may be flushed simultaneously.
 - f Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g Contracting Officer's Technical Representative will review the flushing operation and clarity of water before stopping the flushing operation.
 - h Disconnect pipe from service tee(s) and install remote control valve(s).
- 2. Install per manufacturer's recommendations where indicated on the drawings.
 - 3. Adjust valve to regulate the downstream operating pressure to 35 PSI for spray sprinklers.
 - 4. Use wire connectors and waterproof sealant to connect control and common wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
 - 5. 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.
 - 6. Attach ID tag with controller station number to control wiring at solenoid.
 - 7. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.
- B. 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. Allow 3-inch separation between side of spray sprinkler and adjacent edges of paved areas, walls or fences.
 - 4. Install sprinklers perpendicular to the finish grade.
 - 5. Install swing pipe and fittings per manufacturer's recommendations.
 - 6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.

7. Adjust the radius of throw of each sprinkler for best performance.

C. Below Grade Tree Bubbler Assembly:

1. Thoroughly flush lateral pipe before installing assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings. Supply appropriate bubbler.
3. Install assembly perpendicular to the finish grade.

D. Install swing pipe per the installation details. Use spiral barb fittings. Install pipe and fittings as recommended by manufacturer.

3.8 INSTALLATION OF POINT SOURCE DRIP IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. Mainline Flushing:

- a Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c 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.
 - d Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e Multiple points may be flushed simultaneously.
 - f Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g Contracting Officer's Technical Representative will review the flushing operation and clarity of water before stopping the flushing operation.
 - h Disconnect pipe from service tee(s) and install remote control valve(s).
2. Install per manufacturer's recommendations where indicated on the drawings.
 3. Use wire connectors and waterproof sealant to connect control and common wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
 4. Install only one remote control valve or wye strainer/pressure reducer to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas.
 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.
7. Install per the installation details at locations shown on the drawings.

B. Point Source Drip Emission Device Assembly:

1. Lateral Flushing:

- a Thoroughly flush laterals before installation of emitters.
 - b Utilize specified flush valves and additional open emitter risers as needed to completely purge laterals of debris.
 - c 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.
 - d Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e Multiple points may be flushed simultaneously.
 - f Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g Contracting Officer's Technical Representative will review the flushing operation and clarity of water before stopping the flushing operation.
2. Install per manufacturer's recommendations where indicated on the drawings.

3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control unit at location shown in construction documents. Control unit to be installed in pedestal mounted outdoor enclosure per installation detail.
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: Install per installation detail. Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections. Connect to control unit dedicated ground terminal.
4. Connect control wire to the corresponding control unit terminals.

B. Control Wire:

1. 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.
2. If a cable must be spliced, use waterproof wire 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.
 3. Unless noted on plans, install wire parallel with and below mainline pipe.
 4. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

3.10 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.

3.11 MAINTENANCE AND OPERATION INSTRUCTIONS

- A. Irrigation System Maintenance:
 1. Prior to Final Inspection, provide one-day training session to operating personnel on proper operation and maintenance of the irrigation system. Training session should be for a period of not less than 8-hours and cover aspects of maintaining, operating and repairing the new irrigation system components.
 2. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - a Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - b Manufacturer's Operation and Maintenance manuals.
 - c Manufacturer's Technical Service Bulletins.
 - d Manufacturer's Warranty Documentation.

- e Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
 - 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's Technical Representative. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Contractor to verify or enter historic ET rate data for irrigation season.
2. Contractor responsible to program each controller with a peak season irrigation schedule for the areas being irrigated by the controller.
3. Using the precipitation rate results of the Distribution Uniformity tests calculate the peak season run time for each station.
4. Verify operation of program.
5. Prepare a memorandum documenting the details and assumptions of the programming. Turn over memorandum to Contracting Officer's Technical Representative. Completion of the memorandum is a prerequisite for final inspection and operational testing of the irrigation system.
6. Program must be created by manufacturer's training personnel or an individual with documented experience in programming the control system. Provide documentation of programming experience if requested by the Contracting Officer's Technical Representative.

3.12 Colored Controller Charts:

1. Draft using a CADD program. Each type of sprinkler to have a unique color. All pipe within a zone, and the control valve for that zone are to be of a single color, distinguished from the colors of adjacent zones.
2. On this drawing include a table that lists for each zone:
 - a Zone number, coordinated with indication on as-built drawing
 - b Remote control valve size
 - c Sprinkler complement (model, quantity, nozzle)
 - d Regulated discharge pressure of remote control valve
 - e Flow
 - f Precipitation rate, inches per hour
 - g Initial schedule (minutes per cycle, days/week, and application depth per cycle)
3. Draft of chart to be submitted prior to the request for final inspection. Correct all missing or incorrect information on charts

during final inspection. Submit for final approval subsequent to final inspection. Upon approval by Contracting Officer's Technical Representative, deliver laminated chart and PDF of chart to Contracting Officer's Technical Representative for cemetery use.

3.13 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 irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
- C. Prior to project completion label each sheet of the project drawings (redlines) as "Record Drawing" and turn over to Contracting Officer's Technical Representative for delivery to Engineer. Completion of the Record Drawings is a prerequisite for Final Inspection.

3.14 MAINTENANCE

- A. Operate and maintain irrigation system for a duration of 30 calendar days from Final Inspection. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

3.15 CLEANUP

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

- - - END - - -

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 Technical Representative (COTR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.
- B. Agronomic consultation on the appropriateness of all plant materials proposed for installation during this project must be obtained from the MSN Agronomist and/or NCA Chief Agronomist via coordination through the COTR prior to project initiation and actual plant installation. In general, all plant material must be regionally adapted to the climate of the site, be of appropriate mature dimensions to fit the planting location and be low maintenance species. This requirement will generally exclude or severely limit the use of rose plants, wild flowers and ground covers.
- C. Any exceptions to these species exclusions must be approved by the MSN Agronomist and/or NCA Chief Agronomist via coordination through the COTR prior to project initiation.

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 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
- B. Section 31 20 11, EARTH MOVING (SHORT FORM), rough grading.
- C. Section 32 84 00, PLANTING IRRIGATION.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Section 32 30 00, SITE FURNISHINGS
- F. Section 32 95 16, STONE TOPDRESS, Decomposed Granite Mulch
- G. Section 32 14 13, PRECAST CONCRETE UNIT PAVING

1.4 SUBMITTALS

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

1. Plant Materials: Plant material: Sources and nursery purchase order agreements for each specified plant. Inspection and tagging may be completed by the COTR.
 2. In addition, plant samples or digital photos of plants may be requested in lieu of inspection. Digital photos must have, included in the image, a visual reference relative to the landscape subject.
 3. Decomposed Granite topdress: 2 pound sample.
 4. Staking and guying material.
 5. For all pesticides required such as preemergence or post emergence herbicides, insecticides, or fungicides EPA approved labeling and MSDS sheet for each such product selected for use must be submitted.
 6. Topsoil: see paragraph 1.4.E.
- B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the COTR for approval:
1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease). Submit vendor invoice for each plant shipment showing sizes, quantities and root treatment.
 2. Fertilizers.
 3. Lime
 4. Peat
 5. Seed
 6. Membranes
- C. Manufacturer's Literature and Data:
1. Metal edging Antidesiccant
 2. Erosion control materials
 3. Pre-emergent herbicide
- D. Licenses: Licenses of Arborist shall be submitted (one copy), to the COTR.
- E. Soil laboratory testing results and any soil amendment recommendations from the Contractor. Submit soil test results for each variable soil type and condition that exists on the construction site.
1. Imported Topsoil for Planting Soil Mixture: The Contractor shall provide a 5 pound representative sample from each proposed source for testing, analysis, and approval. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the COTR. Testing reports shall include the following tests and recommendations.

- a. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) 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. A hydrometer shall be used to determine percent of clay and silt.
 - b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
 - c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and acidity (pH).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH shall be performed by a testing laboratory retained by the Department of Veterans Affairs as described in Section 01410, TESTING LABORATORY SERVICES.
 - e. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful turfgrass growth.
 - f. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
2. Seed: Submit a manufacturer's Certificate of Compliance to the Specifications with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, 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 the certificates.
 3. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.
 4. Hydro Mulching: Prior to the start of hydro mulching, submit a certified statement for approval as to the number of pounds of materials to be used per gallon of water.
- F. Schedules:
1. Upon authorization to proceed with the work, submit a project work schedule indicating the dates of each of the following items:
 - a. Tagging of plants in nurseries
 - b. Delivery of other materials to the site
 - c. Staking of plant locations on the site
 - d. Delivery of plant material to the site
 - e. Planting
 - f. Substantial completion of the work.

G. Maintenance Instructions:

1. Prior to the end of the Warranty Period, submit three copies of typewritten instructions for annual maintenance of the landscape including cultivation, irrigation, fertilization, pest and weed control, and pruning.
2. Submit Maintenance Report Forms immediately following completion of each maintenance visit for items outlined in Part 3.3 of this Section. The form shall cross-reference the maintenance schedule. Payment for maintenance visits will not be made without submission of report forms.

1.5 QUALITY CONTROL

A. Qualifications

1. The Contractor shall be a company specializing in landscape installation, having experience in projects of the scope and scale being specified.

B. All materials and work shall comply with applicable sections of the following references:

1. American Association of Nurserymen, Inc. (AAN) Standard: American Standard for Nursery Stock (ANSI Z60.1-2004)
2. Hortus Third, Cornell University, 1976
3. Federal Specifications (Fed. Spec.)
 - a. A-A-1909 - Fertilizer.

C. Source Quality Control

1. Certification: All plant materials shall be inspected and certified by authorized governmental agencies and shall comply with regulations prevailing at both the source and the project site.
2. Plant material selection: Tag and request plant material inspection and approval by the COTR at least four weeks prior to digging.
3. Analysis and standards: Products in sealed containers shall be labeled with manufacturer's certified analysis. Bulk materials shall be tested by an approved laboratory in accordance with Association of Official Agricultural Chemists procedures, or as specified by product specifications referenced herein.

D. Substitutions

1. If specified landscape material cannot be located, the COTR in coordination with the MSN Agronomist will identify alternate sources or substitutions. Plants of larger size may be used if approved and if root balls meet ANA standards for the increased size. Adjustments will be made at no additional cost to the VA, except if downsized, credits to the VA will be based on comparable industry costs.

2. Container plants may be substituted for those designated "B&B" if approved by the COTR.

1.6 DELIVERY AND STORAGE

A. Delivery:

1. Notify the COTR 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.
3. Labels: Prior to shipping, each plant or bundle of like variety and size shall be labeled with legible weatherproof tags indicating the correct name and size of plant.
4. 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.
5. If plant material is delayed more than six hours after delivery, store plants in the shade, protect from the weather and mechanical damage, and keep them moist and cool. All plant material should be planted within 24 hours of delivery.
6. 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.
7. Handle plants at all times in accordance with the best horticultural practices. Lift B&B materials from the bottom of the ball only. Plants handled otherwise will be subject to rejection. Balled and burlapped plants which have cracked or broken balls are not acceptable and shall not be planted. Plants with mechanical damage, deformation or breakage will not be accepted and are to be replaced at the Contractor's expense.

B. Storage:

1. Store materials only in locations approved by the COTR.
2. Keep 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.

1.7 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From February 15 to May 31 for spring and from September 1 to November 15 for fall, but not before irrigation system installed, tested, and approved.
- B. 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 COTR stating the special conditions and proposal variance for approval.

1.8 LANDSCAPE PLANT ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the COTR 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 COTR.
 - 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 COTR 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 COTR 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 COTR in consultation with the MSN Agronomist to ensure plant and turfgrass survival.

10. Repair damage caused while making plant or turfgrass replacements.

1.9 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, guys, and turnbuckles 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 COTR to ensure plant material survival and promote healthy growth have been completed.
- C. Reinstall shrubs for all bare areas greater than 8 feet in diameter during the next appropriate planting schedule.
- D. 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.

1.10 PLANT AND TURFGRASS WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of Section 00 72 00, 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 COTR in consultation with the MSN Agronomist.

1.11 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. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- 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
 - D1557-09.....Test Methods for Laboratory Compaction of Soil
 - 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 Hortus Third.

2.2 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. 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.
- C. 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 COTR, 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.

- D. 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.
- E. 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.
- F. Bare-root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.
- 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 COTR 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.

2.3 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.

2.4 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. All topsoil shall be imported from off-site sources.
- C. At least 10 days prior to topsoil delivery, notify the COTR 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 Part 1.4.E and Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.5 LIME

Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such fineness that not less than 90% must pass No. 8 mesh and not less than 25% must pass No. 100 mesh. Moisture is not to exceed 10%.

2.6 SOIL CONDITIONERS

- A. Peat shall be a milled sphagnum or reed sedge product having at least 95 percent organic content, pH range of 4.0 to 5.5, free of sticks, wood or other debris. Peat shall be a natural product derived from a fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Peat shall be shredded and granulated to pass through a 13 mm (1/2 inch) mesh screen and conditioned in storage piles for at least six months after excavation.
- B. Coarse Sand: Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, and free of limestone, shale and slate particles and of toxic materials.
- C. Perlite shall conform to ASTM C549.
- D. Vermiculite shall be horticultural grade and free of any toxic materials and conform to ASTM C516.
- E. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.
- F. Elemental sulfur shall be finely ground horticultural grade material containing at least 95 percent purity.

2.7 PLANTING SOIL MIXTURE

- A. The planting soil mixture shall be composed of 3 parts topsoil, and 1 part peat moss or organic matter.
- B. Planting mix will be utilized for backfill mixture and planting bed mixture.

2.8 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.

2.9 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.

2.10 MEMBRANES

Landscape Fabric shall be a woven needle-punched polypropylene weighing 113 grams per square meter (4.8 oz. per sq. yd.) And a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.)

2.11 MULCH

See Section 32 95 16, STONE TOPDRESS

2.12 EROSION CONTROL

- A. Erosion control net material shall be heavy, twisted jute mesh weighing 25 g/m² (pounds per square yard). Openings between strands approximately 12 mm square (inches square). Openings between strands shall be approximately 13 mm square (1/2 inch square). Material will be secured with 150 mm (6 inch) wire staples made by the same manufacturer as the netting. All erosion control material is to be installed according to the respective manufacturer's recommendations.
- B. Erosion control blanket material shall be cellulose fiber blanket bonded to 6 mm (1/4 inch) square plastic net weighing 10 kg/100 m² (20 pounds per 1000 square feet) in 1250 mm (50 inch) wide rolls.

2.13 TREE WRAP

- A. Crinkle Paper Tree wrap shall be two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material shall be a minimum of 100 mm (4 inches) in width and have a stretch factor of 33-1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.
- B. Breathable synthetic fabric tree wrap. White in color, delivered in 75 mm (3 in.) wide rolls, specifically manufactured for tree wrapping. Tree

wrap shall be "Breathable Fabric Tree Wrap" as manufactured by the Dewitt Company, Inc., Sikeston, MO, or approved equal. Submit manufacturer literature for approval.

2.14 STAKES AND GUYING STRAPS

- A. Provide stakes for tree support of rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be a minimum of 50 mm by 50 mm (2 inches by 2 inches), or 65 mm (2-1/2 inches) in diameter, by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1 ¼ in.) x 3000 mm (10') with cap, primed with 2 coats flat black exterior enamel.
- B. Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose of all the same color on the project.
- C. Flags to be fastened to guys shall be surveyor's plastic tape, white in color and 150 mm (6 inches) in length.
- D. Guying straps shall be a fabric material designed specifically to guy newly planted trees. No wire should ever be used for this purpose.
- E. Turnbuckles shall be galvanized or cadmium-plated and have a 75 mm (3 inch) minimum lengthwise opening fitted with screw eyes.
- F. Eye bolts shall be galvanized or cadmium plated having a 50 mm (one inch) diameter eye with a minimum screw length of 40 mm (1-1/2 inches).
- G. Deadmen shall be 100 mm by 200 mm (4 inch by 8 inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.
- H. Arrow shaped or auger iron anchors shall be noncorrosive, and sized according to the manufacturer's recommendation.

2.15 EDGING

See Section 32 14 13, PRECAST CONCRETE UNIT PAVING, for stabilized decomposed granite path and gravel flower strip edging.

2.16 WATER

Water shall not contain elements toxic to plant life. It shall be obtained as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services at the Contractor's expense. .

2.17 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.

2.18 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 COTR. 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 of an almost endless list of acceptable seed mixtures that roughly approximate these guidelines.

Warm Season Turfgrass Seed Mixtures: Seed is % by weight**

Preferred mixture, sunny locations - Hybrid bermudagrass cultivars available as seed. Use a blend that contains a minimum of 2 cultivars in roughly equal proportion from this list - Sunsport, Princess, Riviera, Southern Star, Blackjack, Savannah, Primo Blend.

SEEDING RATE = 2 lb/1000 sq.ft.

Preferred species, shady locations: St. Augustinegrass - sod only

Secondary species, low visibility areas - centipedegrass or bahiagrass

SEEDING RATE = 8 lb/1000 sq.ft Bahiagrass or 2 lb/1000 sq.ft.

Centipedegrass

- ** Zoysiagrass is not generally an acceptable turfgrass species for NCA cemetery use due to its extremely slow rate of growth and high maintenance costs. If unique environmental and growing conditions exist at a NCA construction site suggest that Zoysiagrass should be considered as the recommended turfgrass species, a special waiver endorsed by the NCA Chief Agronomist and appropriate MSN Agronomist must be obtained in writing before approval of the planting plan.

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 COTR.

2.19 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.

2.20 TOPDRESS MATERIALS

- A. Decomposed Granite in Planting areas: "Brick Red" 2" minus from A&A Materials (or approved equal). 2" minimum depth.
- B. Decomposed Granite in Stabilized areas: "Brick Red" ¼" minus from A&A Materials (or approved equal). 3" minimum depth.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations and bed outlines on project site for approval by the COTR before any plant pits or beds are dug. The COTR may approve adjustments to plant material locations to meet field conditions. If layouts are not understood or if surface or subsurface obstructions are encountered that are not indicated, do not proceed with planting operations until alternative plant locations have been selected and approved in writing by the COTR.

3.2 EXCAVATION FOR PLANTING

- A. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. 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 COTR may select other locations for plant material.
- C. Dig plant pits by any approved method so that they have vertical sides and flat bottoms. When pits are dug with an auger or other mechanical diggers and the sides of the pits become glazed, scarify the glazed surface.
- D. Excavate planting beds to the depth shown on the drawings and replace with specified planting soil mixture, bringing the grades to a smooth and even surface which, when settled, will conform to established grades. Remove excavated material to an off-site location or area on-site designated by the COTR.
- E. Where poor soil percolation is probable, test drainage by filling planting pits with 12 inches of water. Record the drainage time for each pit and if, in the opinion of the COTR, the water does not adequately drain off within 24 hours, drill and shatter the substrate to a minimum depth of 3 feet below the bottom of the pit. Retest the drainage. If poor drainage persists, install drains as directed.

- F. In areas of new grading where existing soil is being replaced for the construction of new plant beds, remove 300 mm (12 inches) of existing soil and replace with planting mix unless otherwise noted. Plant beds shall be brought to a smooth and even surface conforming to established grades.

3.3 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 the plant to the grade indicated on the details and face to give the best appearance or relationship to one another and views from the roads and plazas.
- B. For balled and burlapped plants, carefully fold back the top half of the burlap and remove tying materials. Any wire caging or similar material, must be completely removed from pit. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Backfill planting pit approximately two-thirds full, add water and allow planting mixture to settle. After the water has been absorbed, complete backfilling and tamp lightly to grade, and form a watering basin of the size indicated.
- C. Container-grown stock: Plant as specified above for balled and burlapped plants, and as modified herein. Remove containers and make at least five vertical cuts 1 inch deep around the root ball; thoroughly loosen the roots on the outside of the ball.
- D. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2" high for shrubs and 4" high for trees.
- E. Treat plant saucers, shrub, and ground cover bed areas, after mulching, with 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.

3.4 TRUNK WRAPPING

Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, 40 mm (1-1/2 inches) or greater in caliber with the specified material beginning at the base and extending to the first branches. Remove wrapping after one year. When using Crinkled Paper Wrap, securely tie wrapping at the top and bottom and at 450 mm (18 inch) maximum intervals with twine.

3.5 STAKING AND GUYING

- A. Stake and guy plants as shown on the drawings and as specified.

- B. Drive stakes vertically into the ground to a depth of 800 to 900 mm (2-1/2 to 3 feet) in such a manner as not to injure the ball or roots, unless otherwise shown on the drawings.
- C. Place deadmen not less than 450 mm (18 inches) below the surface of the ground, unless otherwise shown on the drawings.
- D. Install iron anchors according to manufacturer's recommendations.
- E. Fasten flags securely on each guy strap approximately 2/3 of the distance up from ground level.
- F. Remove stakes and guy straps after one year.

3.6 MULCHING PLANTS

See Section 32 95 16, STONE TOPDRESS

3.7 PRUNING

- A. Prune new plant material 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. Employ workers experienced in this type of work.

3.8 FINISH GRADING

See Section 32 95 16, STONE TOPDRESS

3.9 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Prior to or during planting, amend all backfill and bed mixes at rates specified under Parts 2.1 and 2.2. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft. In addition, adjust soil acidity as recommended by soil test results and add any soil conditioners as specified herein for suitable topsoil under PART 2, Paragraph 2.2A and B, and 2.5 TOPSOIL.
- B. Spread lime as recommended by the soil test results.
- C. Incorporate lime into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation. Starter fertilizer should be lightly mixed with the top 1/2 inch of soil. Immediately restore the soil to an even condition before any seeding or sod placement.

3.10 MECHANICAL SEEDING

- A. Broadcast seed by approved application equipment at the rate as outlined in section 2.20C in this spec above. 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.

3.11 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.

3.12 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 COTR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.13 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.

3.14 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.

- B. For waterways, unroll the material in the direction of water flow. When two or more strips are required to cover a ditch area, they shall overlap at least 100 mm (4 inches). In case a strip is to be spliced lengthwise, the ends of the strips shall overlap at least 150 mm (6 inches) with the upgrade section on top.
- 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.

3.15 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.

3.15 ENVIRONMENTAL PROTECTION

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

- - - E N D - - -

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing water supply.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, 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 FORMT).

1.3 DEFINITIONS

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout building areas and other areas of water use, including valves, and other appurtenances used to supply water for domestic purposes.
- B. Water Service Line: Pipe line 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 Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.
- C. Comply with all rules and regulations of Federal, State, and Local Department of Environmental Quality having jurisdiction over the design, construction, and operation of potable water systems.
- D. 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):
(Polyvinyl Chloride (PVC) shall be in accordance with C605 PVC; and shall be provided to COTR for approval.)
 - 1. Piping.
 - 2. Gaskets.
 - 3. Valves.
 - 4. Street washer.
 - 5. Meter.
 - 6. Vaults, frames and covers.
 - 7. Valve boxes.
 - 8. Corporation and curb stops.
 - 9. Curb stop boxes.
 - 10. Joint restraint.
 - 11. Disinfection products.
 - 12. Link/sleeve seals.
- C. Testing Certifications:
 - 1. Certification of Backflow Devices.
 - 2. Hydrostatic Testing.
 - 3. 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):
 - B40.100-98.....Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
 - C32-04.....Sewer and Manhole Brick (Made from Clay or Shale)
 - C139-03.....Concrete Masonry Units for Construction of Catch Basins and Manholes
 - D1784-03.....Standard Specifications for Rigid PVC Compounds and CPVC Compounds
 - D2464-99.....Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80

- D2467-02.....Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D3139-98.....Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- C32-04.....Standard Specifications for Sewer Manhole Brick
- D. American Water Works Association (AWWA):
- B300-04.....Hypochlorites
- B301-04.....Liquid Chlorine
- C500-02.....Gate Valves for Water and Sewerage Systems
- C508-01.....Swing Check Valves for Waterworks Service, 2 Inches (50 mm) Through 24 Inches (600mm) NPS
- C509-01.....Resilient Seated Gate Valve for Water and Sewage System
- C510-97.....Double Check Valve Back-Flow Prevention Assembly
- C511-97.....Reduced Pressure Principle Back-Flow Prevention Assembly
- C550-01.....Protective Epoxy Interior Coatings for Valves and Hydrants
- C605-94.....Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
- C651-92.....Disinfecting Water Mains
- C800-01.....Underground Service Line Valves and Fittings
- C900-97.....Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Thru 12 Inches, for Water
- E. NSF International:
- 14-03.....Plastics Piping Components and Related Materials
- 61-02.....Drinking Water System Components-Health Effects (Sections 1-9)
- F. American Welding Society (AWS):
- A5.8-04.....Brazing Filler Metal
- G. Foundation for Cross-Connection Control and Hydraulic Research-2005

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Class-Rated Polyvinyl Chloride (PVC) Pipe:

1. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D-1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

1. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.2 COPPER PIPE AND TUBING

Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP.

2.3 VALVES

A. Asbestos packing is not allowed.

B. Gate:

1. Operator:

- a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation. Post indicator shall comply with the requirements of NFPA 24 and shall be fully compatible with the valve provided.
- b. Above Ground and in Pits: Hand wheels.

2. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

C. Check: Swing.

1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 1375 kPa (200 pound) WOG.

D. Corporation stops and saddles shall conform to AWWA C800.

E. Curb Stop: Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1375 kPa (200 pound) WOG per AWWA C800.

2.4 VALVE BOX

Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide 2 "T" handle socket wrenches of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

2.5 PIPE SLEEVES

Ductile iron or zinc coated steel.

2.6 BACKFLOW PREVENTER

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 100 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- C. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.
- D. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.
- E. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- F. Backflow preventer shall be accessed and have clearance for the required testing, maintenance and repair. Access and clearance shall require a minimum of one (1) foot (305 mm) between the lowest portion of the assembly and grade, floor or platform. Installations elevated more than five (5) feet (1524 mm) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.7 WATER METER

Furnish and install meter approved by Water Service Utility. Forward approval.

2.8 VAULTS (BACKFLOW PREVENTER OR METER)

- A. Top and base shall be reinforced concrete.
- B. Walls shall be reinforced concrete, precast concrete, or segmental block (ASTM C139).

2.9 CAST IRON FRAME AND COVER, STEPS, ETC.

Cast iron frame and cover, steps, etc. shall comply with State Department of Transportation standard details. Identify cover as "WATER".

2.10 POTABLE WATER

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

2.11 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.12 WARNING TAPE

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, non-detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES

Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.2 REGRADING

Raise or lower existing valve and curb stop boxes to finish grade in areas being graded.

3.3 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 directed by the COTR.
- 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 on pipe installed underground shall be anchored. See section 3.7 "PIPE SUPPORTS".
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.
- M. Warning tape shall be continuously placed 300 mm (12 inches) above buried water pipes.

3.4 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation

from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (1000 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

- C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 6 m (20 foot) centers. If pipe is in a congested piping area, install on 3 m (10 foot) centers. Prepare as-built drawing indicating exact location of magnetic markers.

3.5 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.

3.6 PIPE SUPPORTS

A. Supports:

1. All piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on centers and at each fitting.
2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

3.7 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 "Flex-Ring", "Lok-Ring", or mechanical joint coupled as manufactured by American Cast Iron Pipe Company, "Mega-Lug" or approved equal.
- D. Thrust blocks shall not be permitted.
- E. PVC pipe bell and spigot joints shall be restrained with the Uni-Flange Corp. Series 1350 Restrainer or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.
- F. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with UNI-Flange Corp. Series 1300 Restrainer, EBBA Iron, Inc, Series 2000PV Mechanical Joint Restrainer Gland, or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

3.8 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
 - 1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.
 - 2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:

- a. Local conditions prevent a lateral separation of 3 m (10 feet);
and
 - b. The water main invert is at least 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).

3.9 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 450 by 450 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.10 PIPE SLEEVES

Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.11 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 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 2.5 ft/sec (approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. in. (mm)			
				1 (25)	1 ½ (38)	2 (51)	2 1/2-in (64 mm)
In	(mm)	gpm	(L/sec)	Number of taps on pipe			
4	(100)	100	(6.3)	1	--	--	1
6	(150)	200	(12.6)	--	1	--	1
8	(200)	400	(25.2)	--	2	1	1
10	(250)	600	(37.9)	--	3	2	1
12	(300)	900	(56.8)	--	--	3	2
16	(400)	1,600	(100.9)	--	--	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 Oregon Department of Environmental Quality. 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.

3.12 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 (200 psi). Leakage shall not exceed the following requirements.
 - 1. Copper Tubing: No leaks.
 - 2. Ductile Iron Pipe: AWWA C600. Provide to COTR office.
 - 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COTR office.

3.13 BACKFLOW PREVENTOR TESTING

- A. All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COTR.

- - - E N D - - -

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING.
- C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 53, CAST-IN-PLACE CONCRETE.
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: 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 Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Piping.

2. Jointing material.
 3. Manhole, inlet and catch basin material.
 4. Frames and covers.
 5. Steps.
 6. Resilient connectors and downspout boots.
- C. One copy of Oregon Department of Transportation standard details of MANHOLES, INLETS and catch basins.
- D. One copy of Oregon Department of Transportation specification.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A48-03/A48M-03.....Gray Iron Castings
 - A536-84(2004).....Ductile Iron Castings
 - A615-05/A615M-05.....Deformed and Plain-Billet Steel Bars for
Concrete Reinforcement
 - A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain
and Sewer Pipe
 - C76-05a/C76M-05a.....Reinforced Concrete Culvert, Storm Drain and
Sewer Pipe
 - C150-04ae1.....Portland Cement
 - C443-05/C443M-05.....Joints for Concrete Pipe and Manholes, Using
Rubber Gaskets
 - C857-95(2001).....Minimum Structural Design Loading for
Underground Precast Concrete Utility Structures
 - C923-02/C923M-02.....Resilient Connectors between Reinforced
Concrete Manhole Structures, Pipes and
Materials
 - C924-02/C924M-02.....Testing Concrete Pipe Sewer Lines by Low
Pressure Air Test Method
 - C1103-03/C1103M-03.....Joint Acceptance Testing of Installed Precast
Concrete Pipe Sewer Lines
 - D698-00ae1.....Laboratory Compaction Characteristics of Soil
Using Standard Effort (12,400 ft-lbf/ft³ (600
kN-m/m³))
 - D1056-00.....Flexible Cellular Materials-Sponge or Expanded
Rubber

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

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

M198-05.....Joints for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

1. Concrete:

a. Reinforced pipe, ASTM C76. Class IV. Reinforced arch culvert and storm drainpipe shall comply with ASTM C506, Class A-IV. Joints shall be watertight flexible joints made with rubber-type gaskets conforming to ASTM C443.

2.2 JOINTING MATERIAL:

A. Concrete Pipe: Rubber gasket ASTM C443.

2.3 MANHOLES, INLETS AND CATCH BASINS:

A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:

1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall

- shall be in the same plane from bottom of structure to manhole cover.
3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
 5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
 6. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-1/2 gallons) per sack of cement.
 7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.
 8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "storm sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.

10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

D. Frame and Cover for Gratings: Frame and cover for gratings shall be in accordance with Oregon Department of Transportation standard details. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 HEADWALLS:

A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 CONCRETE:

Concrete shall be in accordance with State Department of Transportation standard specification 02001. For concrete not specified in above standards, concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.6 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.7 FLARED END SECTIONS:

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.8 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.9 WARNING TAPE:

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 11, EARTH MOVING.

3.2 PIPE BEDDING:

The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Bedding, haunching and initial backfill shall be either Class IB or Class II material.

3.3 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.

- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations with gasketed joints.
- J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

3.4 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 MANHOLES, INLETS AND CATCH BASINS:

- A. General:
 - 1. Circular Structures:
 - a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
 - b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material

specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.

- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
2. Rectangular Structures:
- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
 - b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
- a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed.

In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame.

Slope the top of the collar away from the frame.

3.7 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

Reinforced concrete as shown or precast concrete.

3.8 INSPECTION OF SEWERS:

Inspect and obtain the COTR's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.10 TESTING OF STORM SEWERS:

A. Gravity Sewers (Select one of the following):

1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

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SECTION 33 46 13
SUBDRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies subdrainage system, including installation, backfill, and cleanout extensions, to place of connection to storm sewer.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: For each type of filter fabric, pipe, and fitting indicated
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- HB17-02.....Standard Spec for Highway Bridges, Div II,
Section 36.4.2.4, Joint Properties.
- M6-03.....Fine Aggregate for Portland Cement Concrete
- M86/M86M-06.....Concrete Sewer, Storm Drain, and Culvert Pipe
- M288-06.....Geotextile Specification for Highway
Applications
- C. American Society for Testing and Materials (ASTM):
- D448-03a.....Standard Classification for Sizes of Aggregate
for Road and Bridge Construction

- D2321-05.....Standard Practice for Underground Installation
of Thermoplastic Pipe for Sewers and Other
Gravity-Flow Applications
- D2737-03.....Standard Specification for Polyethylene (PE)
Plastic Tubing
- F477-02e1.....Standard Specification for Elastomeric Seals
(Gaskets) for Joining Plastic Pipe

PART 2 - PRODUCTS

2.1 MATERIALS

A. Underslab Header:

1. PE drainage tubing and fittings with smooth interior and annular exterior corrugations, per AASHTO M252, Type S, in NPS 4 to NPS 10 (DN 100 to DN 250). Joints shall be coupling type.
2. PE pipe and fittings with smooth interior and annular exterior corrugations, per AASHTO M294, in NPS 12 to NPS 36 (DN 300 to DN 900). Joints shall be coupling type.

B. Perforated Drainage Pipe:

1. Perforated, PE pipe and fittings with smooth interior and annular exterior corrugations, per AASHTO M252, in NPS 4 to NPS 6 (DN 100 to DN 150). Joints shall be coupling type. Perforation Pattern shall be AASHTO Class II.
 - a. Pipe shall be wrapped in filter sock, per ASTM D6707.
2. Perforated, PE pipe and fittings with smooth interior and annular exterior corrugations, per AASHTO M294, in NPS 8 to NPS 24 (DN 200 to DN 600). Joints shall be coupling type. Perforation Pattern shall be AASHTO Class II.
 - a. Pipe shall be wrapped in filter sock, per ASTM D6707.

C. Cleanout Extension: Gravity Sewer pipes shall have a neoprene gasket joints and long sweep elbow fittings.

D. Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:

1. Apparent Opening Size, 0.150mm (Sieve #100), per ASTM D4751.
2. Permittivity, 0.70 Sec⁻¹, per ASTM D4491.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Laying: Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the COTR. Install nonwoven geotextile adjacent to bottom and side of trench as indicated on the drawings. Lay drain lines and firmly bed in granular material a minimum of 75 mm (3 inches) below invert to top of pipe to true grades and alignment with bells facing upgrade, and to slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed to 300 mm (1 foot) above top of pipe, unless otherwise noted.
1. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standard:
 - a. PE pipe installation shall be per ASTM D2321 and ASTM F758.
 - b. PE joint construction shall be per ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, "Joint Properties."
 2. Lay perforated pipe with perforations down. Lay plain end pipe with closed joints held in place with two No. 9 spring steel wire clips at each joint or by standard clay collars.
 3. For crypt field subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 900 mm (3 feet), unless otherwise indicated.
 4. For underslab subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
 5. Install cleanout extensions where shown on the Contract Documents.
 6. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.
- B. Backfilling: Place a minimum of 300 mm (12 inches) of granular material, hand tamped, extending in width a minimum of 600 mm (2 feet) from building wall. Then place a minimum of 150 mm (6 inches) of torpedo sand, well tamped. Continue backfill with drainage material from site excavation to within 900 mm (3 feet) of finished grade in planting areas. Remainder of backfill shall be comparable to existing adjacent soils. In bituminous and concrete paving areas, backfill to the bottom of the base course with pervious material. Where foundation drain is within 600 mm (2 feet) of finished grade, one-half of fill shall be made with crushed stone.

C. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed and their location marked with wooden stakes.

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APPENDIX A
PRELIMINARY GEOTECHNICAL INVESTIGATION

**REPORT ON GEOTECHNICAL
INVESTIGATION**



DESIGNATION: Prescott National Cemetery

LOCATION: 500 N. Highway 89
Prescott, Arizona

CLIENT: JJR, LLC

PROJECT NO: 111204SA

DATE: November 11, 2011

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APPENDIX



1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of the proposed improvements at the south east corner of the Prescott National Cemetery. The site is located at 500 N. Highway 89 in Prescott, Arizona.

Preliminary information calls for the construction of a 575 square foot committal shelter that will be about 15 ft high and a 10 to 15 ft high unit-block or concrete retaining wall. The building is expected to be a steel framed open structure. Structural loads are expected to be light and no special considerations regarding settlement tolerances or other construction details are known at this time. Adjacent areas will be landscaped or paved to support low volume passenger, delivery truck, and cemetery maintenance vehicles. Landscaped areas will be utilized for storm water retention and disposal.

2.0 GENERAL SITE AND SOIL CONDITIONS

2.1 Site Conditions

The site is located at the south east end of the cemetery. The site is currently a fully functioning cemetery with several small structures, asphalt roads and grave sites. There was no evidence of mass fill placement, however, with the existing structures it is possible that there is some fill on site.

2.2 Seismic Design Parameters

The project area is located in a seismic zone that is considered to have moderate seismic potential. The Big Chino Fault is located approximately many miles to the north of the site and is considered one of the most active faults in the state; however the recurrence intervals are on the order of 20,000 to 30,000 years. Liquefaction is not considered a concern as groundwater was not encountered above the bedrock.

Although borings were not advanced to 100 feet, based on the nature of the subsoils encountered in the borings and geology in the area, Site Class Definition, Class B (Table 1613.5.2, 2006 IBC) may be used for design of the structures. In addition, the following seismic parameters may be used for design (based on 2002 USGS maps adopted by 2006 IBC):

Table 2.3.1 Seismic Parameters

MCE ¹ spectral response acceleration for 0.2 second period, S_S :	0.345g
MCE ¹ spectral response acceleration for 1.0 second period, S_1 :	0.101g
Site coefficient, F_a :	1.0
Site coefficient, F_v :	1.0
MCE ¹ spectral response acceleration adjusted for site class, S_{MS} :	0.345g
MCE ¹ spectral response acceleration adjusted for site class, S_{M1} :	0.101g
5% Damped spectral response acceleration, S_{DS} :	0.230g
5% Damped spectral response acceleration, S_{D1} :	0.067g
1. NOTES: MCE = maximum considered earthquake	

2.3 General Subsurface Conditions

Subsoil conditions at the site comprise predominantly of clayey sand and silty sand underlain by weathered bedrock to the termination depths of the borings at 6 to 16.5 feet. Various amounts of gravel were also noted in the profile. Boring location SB-5 indicated a pocket of elastic silt from 2 to 6 feet below grade. The standard penetration resistance test (SPT) values range from 11 to 50+ blows per foot. No groundwater was encountered during this investigation. Based on visual and tactile observation, the soils were in a 'dry' state at the time of investigation.

Laboratory testing indicates in-situ dry densities of the upper soils on the order of 81 to 113 pcf and water contents on the order of 16 to 30 percent at the time of investigation. Liquid limits range from 39 to 78 percent. Plasticity indices are on the order of 14 to 34 percent. The upper clayey soils exhibit volume increase (swell) due to wetting of approximately 1.9 percent when compacted to moisture and density levels normally expected during construction. An undisturbed sample displayed limited additional compression due to inundation under a maximum confining load of 3,200 psf.

3.0 ANALYSIS AND RECOMMENDATIONS

3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are favorable for the support of the proposed structures, on medium to very dense native soils or weathered bedrock material. The pockets of moist elastic silt are a concern as they are likely highly compressible. If the elastic silt is encountered within the building footprint, foundation elements will need to be extended through the elastic

silt layers to contact dense native soil or weathered bedrock. This can be accomplished by over-excavating the planned footing width to the contact layer and backfill with lean concrete slurry to the required bottom of footing depth.

The swell potential of the fine portion of the upper clayey soils is a minor concern. The potential is usually strong enough to cause differential movements of slabs-on-grade such as floors and sidewalks and lightly loaded foundation but not enough to cause damage to heavier structures. Accordingly, it is paramount to provide proper drainage to limit the potential for water infiltrating under slabs. Typical recommendations to reduce the swell potential include reducing the compaction requirements and requiring higher moisture contents during pad preparation and requiring at least **12-inches of non-expansive material** to be placed directly beneath the building slabs and slabs contiguous to the structure such as sidewalks

For standard foundations to perform as expected, attention must be paid to provide proper drainage to limit the potential for water infiltration of deeper soils. It is preferred to keep irrigated plants at least 5 feet away from structures with irrigation schedules set and maintained to run intermittently. **Unpaved planter areas should be sloped at least 5 percent for a distance of at least 10 feet away from the building.** Sidewalks should not be placed (or planters graded) that could create a "pond" adjacent to the building. Roof drainage should also be directed away from the building in paved scuppers. Pre-cast loose splash blocks should not be used as they can be dislodged and/or eroded. Roof drains should not be allowed to discharge into planters adjacent to the structure. It is preferred that they be directed to discharge to pavement, retention basins or discharge points located at least 10 feet away from the building.

Excavation operations should be relatively straightforward although the presence of cobbles and shallow weathered bedrock may impede progress and possibly require the use of heavier equipment. Perched groundwater is expected to be a factor in the design or construction of foundations and underground utilities. Depending on the time of year, saturated soil conditions and shallow perched water may impact construction. Additionally, perched water may sometimes be found at the interface of unconsolidated sediment and bedrock formations during high rainfall events. Any water present in new footing bottoms excavations will need to be pumped during construction or the concrete will need to be placed using a tremie to displace the water.

The potential for perched groundwater combined with poor drainage behind any proposed retaining walls will increase the active pressure acting on the backside of the wall. Weep holes and/or other drainage system should be incorporated into the wall design to prevent the build up of hydrostatic pressure behind the wall. The wall design may need to account for full hydrostatic load in the event the drainage is impeded.

For exterior slabs on grade, frequent jointing is recommended to control cracking and reduce tripping hazards should differential movement occur. It is also recommended to pin the landing slab to the building floor/stem wall. This will reduce the potential for the exterior slab lifting and blocking the operation of out-swinging doors. Pinning typically consists of 24 inch long No. 4 reinforcing steel dowels placed at 12-inch centers.

3.2 Site Preparation

The entire area to be occupied by the proposed construction should be stripped of all vegetation, debris, rubble and obviously loose surface soils. If the existing structures and any foundation elements are to be removed, they should be removed in their entirety along with soil disturbed by this activity. Carefully remove all concrete and other elements as well as any deleterious materials that may be encountered. A representative of the geotechnical engineer should examine the subgrade once sub-excavation is complete to verify contact zone and to ensure removal of deleterious materials, including any elastic silts.

It is not known whether underground services related to the existing facility will be altered or removed. If any utility is located within 5 feet of any proposed foundation, relocation of the utility should be considered. This office should be contacted for further recommendations on a case-by-case basis.

If grading plans require placing structural fill below footing bottom elevation, the exposed grade should be scarified to a depth of 8 inches, moisture-conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698. Pavement areas should be scarified, moisture- conditioned and compacted in a similar manner.

All cut areas and areas above footing bottom elevation that are to receive floor slab only fill should be scarified 8 inches, moisture conditioned to at least optimum to 3 percent above optimum and lightly but uniformly compacted to 90 but not more than 95 percent of maximum dry density as determined by ASTM D-698.

3.3 Permanent Cut/Fill Slope Limitations

Generally, permanent cut or fill slopes should be no steeper than 2-horizontal to 1-vertical (2:1). Where particular conditions make it appropriate to vary from these slopes, these must be addressed on a case by case basis by this office. Steeper cut slopes in stable rock may be possible (depending on geology). Determination of acceptable steeper slope ratios is predicated on a stability analysis of the specific geometry, determinations of soil and groundwater characteristics, structure set backs, surcharge loads and slope stabilization.

Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified deeply or where the slope ratio of the original ground is steeper than 5 horizontal to 1 vertical (5:1), the bank shall be stepped or benched to remove all loose soils and to provide a level surface for placement of fill. Ground slopes which are flatter than 5 to 1 may require benching when considered necessary by a representative of this office. The benches should be cut wide enough to remove loose surface soils and allow proper compaction of fills. A minimum bench width of 8 feet is typically recommended for the first lift (toe) of any fill placed on a slope. This width may be reduced at the direction of the field engineer depending on the presence of loose soils, slope steepness, exposed rock and lift thickness.

3.4 Foundation Design

It is recommended that the structure be founded on shallow spread footings bearing on dense native soil or weathered bedrock at a minimum depth of **30 inches** below lowest finished exterior grade within 5 feet of the structure. If site preparation is carried out as set forth herein, a recommended safe allowable bearing capacity of **3,000 psf** can be utilized for design. The depth to the require contact zone varies across the site along with pockets of elastic silt. Where deeper excavations are required, it may be possible to excavate the neat footing width to the dense native or weathered bedrock interface and backfill with 500 psi slurry to the planned bottom of footing elevation. This bearing capacity refers to the total of all loads, dead and live, and is a net pressure. It may be increased one-third for wind, seismic or other loads of short duration. All footing excavations should be level and cleaned of all loose or disturbed materials. **Positive drainage away from the proposed building must be maintained at all times.**

Estimated settlements of spread foundations under design loads are on the order of ½ to ¾ - inch, virtually all of which will occur during construction. Post-construction differential settlements will be on the order of one-half total settlement, under existing and compacted moisture contents. Additional localized settlements of the same magnitude could occur if native supporting soils were to experience a significant increase in moisture content. Positive drainage away from structures and controlled routing of roof runoff must be provided to prevent ponding adjacent to perimeter walls. Planters requiring heavy watering should be considered with caution. Care should be taken in design and construction to insure that domestic and interior storm drain water is contained to prevent seepage.

Continuous footings and stem walls should be reinforced to distribute stresses arising from small differential movements, and long walls should be provided with control joints to accommodate these movements. Reinforcement and control joints are suggested to allow slight movement and prevent minor floor slab cracking.

3.5 Lateral Pressures

The following ultimate lateral (equivalent fluid) pressure values may be utilized for the proposed construction assuming drained conditions. Increase to full saturated values for wall backfill that is not drained.

Active Pressures (wall allowed to rotate 0.2% of wall height for loose backfill)	
Unrestrained Walls (Free Draining)	25 pcf
At-Rest Pressures	
Restrained Walls (Free Draining)	40 pcf
Passive Pressures	
Continuous Footings	350 pcf
Coefficient of Friction (w/ passive pressure)	0.40
Coefficient of Friction (w/out passive pressure)	0.50
Coefficient of Friction on Weathered Rock	0.60

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. Expansive soils should not be used as retaining wall backfill, except as a surface seal to limit infiltration of storm/irrigation water. The expansive pressures could greatly increase active pressures.

3.6 Fill And Backfill

Native soils with USC Classification MH or CH should only be used in landscaped areas, they should not be used within the building pad or as retaining wall backfill. All other native soils are considered suitable for use in general grading fills, engineered pad fill, and retaining wall backfill provided particles greater than 3 inches in size are first removed. In special cases, it may be allowable to use up to 6-inch rock provided that the contractor can demonstrate proper compaction and sufficient fines in the matrix to limit voids.

The silty fine sand soils may be sensitive to excessive moisture content and will become unstable at elevated moisture content. Accordingly, it may be necessary to compact soils on the dry side of optimum, especially in asphalt pavement areas. The reduced moisture content under slabs-on-grade should only be used upon approval of the engineer in the field.

Successful backfill of retaining walls can be difficult to achieve in tight access conditions. Placement and compaction must be carefully controlled in order to minimize the potential for post construction settlement should the backfill zone be subjected to water infiltration. Even the most well

controlled granular fills could experience additional settlement on the order of one or more inches if subjected to significant moisture increases. Non-granular fills could be subject to greater water induced settlement, on the order of several percent of the wall height.

If imported common fill for use in site grading is required, it should be examined by a Soils Engineer to ensure that it is of low swell potential and free of organic or otherwise deleterious material. In general, the fill should have 100 percent passing the 3-inch sieve and no more than 60 percent passing the 200 sieve. For the fine fraction (passing the 40 sieve), the liquid limit and plasticity index should not exceed 30 percent and 10 percent, respectively. It should exhibit less than 1.5 percent swell potential when compacted to 95 percent of maximum dry density (ASTM D-698) at a moisture content of 2 percent below optimum, confined under a 100 psf surcharge, and inundated.

Fill should be placed on subgrade which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content, ± 2 percent. Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows:

A.	Building and Wall Areas	
1.	Below footing level	n/a (or 500 psi Slurry)
2.	Below slabs-on-grade (non-expansive soils)	95
3.	Below slabs-on-grade (expansive soils)	90-95 (max)
B.	Pavement Subgrade or Fill	95
C.	Utility Trench Backfill	95
D.	Aggregate Base Course	
1.	Below floor slabs	95
2.	Below asphalt paving	100
E.	Landscape Areas	90

3.7 Utilities Installation

Trench excavations for shallow utilities can be accomplished by conventional trenching equipment, although deeper trench excavations may encounter weathered bedrock and more aggressive means may be necessary. Trench walls may not stand near-vertical for the periods of time required to install utilities. Trenches penetrating looser sandy deposits may experience sloughing of side walls and necessitating cutting back of side slopes and/or shoring. Adequate precautions must be taken to protect workmen in accordance with all current governmental regulations.

Backfill of trenches may be carried out with native excavated material provided particles in excess of 3 inches are first removed. Material with particle sizes larger than 1.5 inches should not be used around the pipe. Water settling is not recommended. Compaction requirements are summarized in the "Fill And Backfill" section of this report.

3.8 Slabs-On-Grade

To facilitate fine grading operations and aid in concrete curing, a 4-inch thick layer of granular material conforming to the gradation for aggregate base (A.B.) as per M.A.G. Specification Section 702 should be utilized beneath the slab. Dried subgrade soils **must** be re-moistened prior to placing the aggregate base if allowed to dry out, especially if fine-grained soils are used in the top 12-inches of the pad.

3.9 Asphalt/Concrete Pavement Design

If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements. The location designation is for reference only. The designer/owner should choose the appropriate sections to meet the anticipated traffic volume and life expectancy. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESALs per truck depending on load. It takes approximately 1200 passenger cars to impart 1 ESAL.

Pavement Design Parameters:

Assume:	One 18 kip Equivalent Single Axle Load(ESAL)/Truck
Life:	20 years
Subgrade Soil Profile:	
% Passing #200 sieve:	31%
Plasticity Index:	21%
SVF:	3.2
k:	150 pci (assumed)
R value:	35 (per ADOT tables)
M _R :	10,700 (per AASHTO design)

Table 3.9.1 Pavement Sections

Area of Placement	Daily 18-kip ESALs		Flexible		Rigid
	AC	PCCP	AC (0.39)	ABC (0.12)	PCCP
Auto Parking	2	9	2.0"	6.0"	5.0"
Truck Parking/Drives	7	23	3.0"	6.0"	6.0"
	13	51	3.5"	6.0"	7.0"

Notes:

1. Designs are based on AASHTO design equations and ADOT correlated R-values.
2. The PCCP thickness is increased to provide better load transfer, and reduce potential for joint and edge failures. Design PCCP per ACI 330R-87.
3. Full depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 3 inches of base course replaced.

These designs assume that all subgrades are prepared in accordance with the recommendations contained in the "Site Preparation" and "Fill and Backfill" sections of this report, and paving operations carried out in a proper manner. If pavement subgrade preparation is not carried out immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

Pavement base course material should be aggregate base per M.A.G. Section 702 Specifications. Asphalt concrete materials and mix design should conform to M.A.G. 710 using the Marshall mix design criteria for low volume traffic and PG 64-16 for the asphalt grade. Reducing the air void content to 3 percent will aid in reducing the thermal cracking typical in the area. It is recommended that a ½ inch or ¾ inch mix designation be used for the pavements. While a ¾ inch mix may have a somewhat rougher texture, it offers more stability and resistance to scuffing, particularly in truck turning areas. Pavement installation should be carried out under applicable portions of M.A.G. Section 321 and municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer M.A.G. mixes are very coarse and could cause placing and finish problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

For sidewalks and other areas not subjective to vehicular traffic a 4-inch section of concrete will be sufficient. For trash and dumpster enclosures a thicker section of 6 inches of concrete is recommended.

Portland Cement Concrete Pavement must air entrained and have a minimum 28-day flexural strength 550 psi (compressive strength of approximately 3,700 psi). It may be cast directly on the prepared subgrade with proper compaction (reduced) and the elevated moisture content as recommended in the report. Lacking an aggregate base course, attention must be paid to using low slump concrete and proper curing, especially on the thinner sections. No reinforcing is necessary. Joint design and spacing should be in accordance with ACI recommendations. Construction joints should contain dowels or be tongue and grooved to provide load transfer. Tie bars are recommended on the joints adjacent to unsupported edges. Maximum joint spacing in feet should not exceed 2 to 3 times the thickness in inches. Joint sealing with a quality silicone sealer is recommended to prevent water from entering the subgrade allowing pumping and loss of support.

Proper subgrade preparation and joint sealing will reduce (but not eliminate) the potential for slab movements (thus cracking) on the expansive native soils. Frequent jointing will reduce uncontrolled cracking and increase the efficiency of aggregate interlock joint transfer.

4.0 GENERAL

The scope of this investigation and report includes only regional published considerations for seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, not any site specific studies. The scope does not include any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Soils Engineer observe and test the earthwork and foundation portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.


Respectfully submitted,
SPEEDIE & ASSOCIATES, INC.



Timothy J. Rheinschmidt, R.G.



Keith R. Gravel, P.E. Expires 03/31/14



Gregg A. Creaser, P.E.

APPENDIX

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLAN

SOIL LEGEND

LOG OF TEST BORINGS

TABULATION OF TEST DATA

CONSOLIDATION TEST

MOISTURE-DENSITY RELATIONS


SWELL TEST DATA

FIELD AND LABORATORY INVESTIGATION

On October 4, 2011, soil test borings were drilled at the approximate locations shown on the attached Soil Boring Location Plan. All exploration work was carried out under the full-time supervision of our senior soils technician, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with a truck-mounted CME-75 drill rig utilizing 7-inch diameter hollow stem flight augers. Detailed information regarding the borings and samples obtained can be found on an individual Log of Test Boring prepared for each drilling location.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests for classification and pavement design parameters. Remolded swell tests were performed on samples compacted to densities and moisture contents expected during construction. Compression tests were performed on a selected ring sample in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.



 - APPROXIMATE BORING LOCATIONS

DRAWING COURTESY OF: JJR, LLC








SOIL BORING LOCATION PLAN

PRESCOTT NATIONAL CEMETERY
 500 N. HIGHWAY 89
 PRESCOTT, ARIZONA

**SPEEDIE
AND ASSOCIATES**
 GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS
 3331 E. WOOD ST. PHOENIX, ARIZONA 85040 (602) 997-6391

DR: BJA	CHK:	REV:	DATE: 10/17/2011	PROJECT NO. 111204SA
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SOIL LEGEND

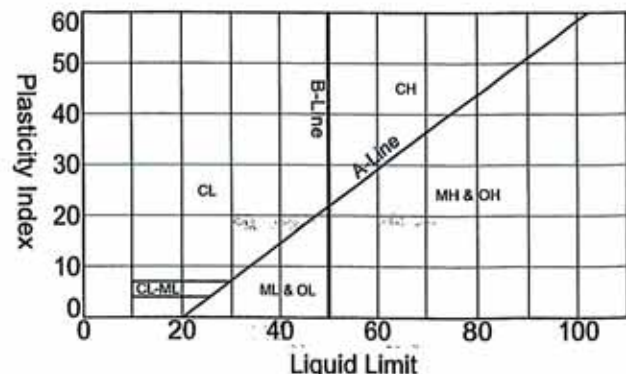
SAMPLE DESIGNATION		DESCRIPTION	
	AS	Auger Sample	A grab sample taken directly from auger flights.
	BS	Large Bulk Sample	A grab sample taken from auger spoils or from bucket of backhoe.
	S	Spoon Sample	Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance.
	RS	Ring Sample	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch inside diameter, 1-inch long brass rings, into undisturbed soil for one 12-inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
	LS	Liner Sample	Standard Penetration Test driving a 2.0-inch outside diameter split spoon equipped with two 3-inch long, 3/8-inch inside diameter brass liners, separated by a 1-inch long spacer, into undisturbed soil by the same means of the Spoon Sample.
	ST	Shelby Tube	A 3.0-inch outside diameter thin-walled tube continuously pushed into the undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587).
	--	Continuous Penetration Resistance	Driving a 2.0-inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12-inch increment are recorded.

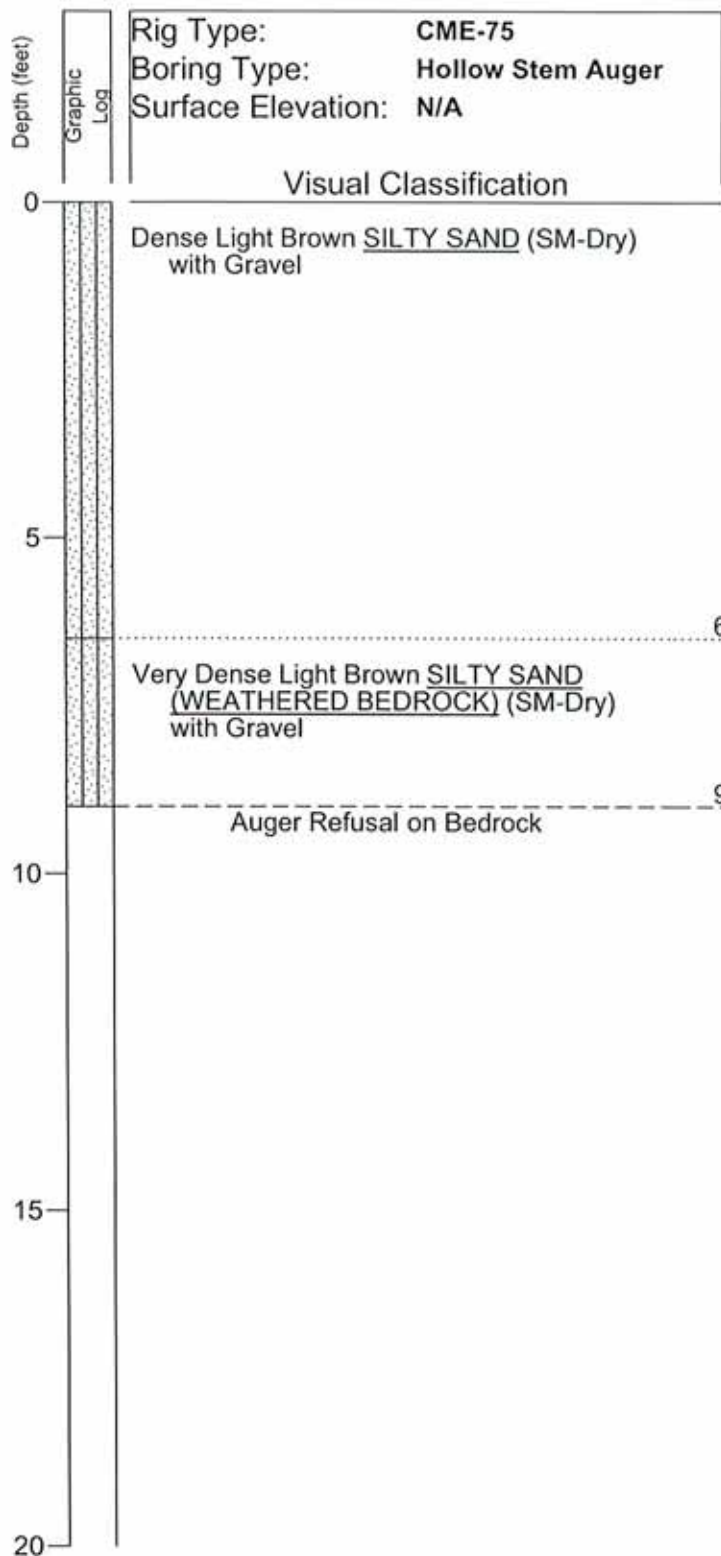
CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot	Strength (tons/sq ft)	Sands & Gravels	Blows/Foot
Very Soft	0 - 2	0 - 0.25	Very Loose	0 - 4
Soft	2 - 4	0.25 - 0.5	Loose	5 - 10
Firm	5 - 8	0.5 - 1.0	Medium Dense	11 - 30
Stiff	9 - 15	1 - 2	Dense	31 - 50
Very Stiff	16 - 30	2 - 4	Very Dense	> 50
Hard	> 30	> 4		

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		LIQUID LIMIT LESS THAN 50		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		LIQUID LIMIT LESS THAN 50		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
		LIQUID LIMIT GREATER THAN 50		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		LIQUID LIMIT GREATER THAN 50		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL.

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size *	mm	Sieve Size *
SANDS				
	0.075	#200	0.42	#40
	0.420	#40	2.00	#10
GRAVELS				
	2.000	#10	4.75	#4
COBBLES				
	4.75	#4	19	3/4"
BOULDERS				
	19	3/4"	75	3"
COBBLES	75	3" x	300	12" x
BOULDERS	300	12" x	900	36" x
*U.S. Standard		*Clear Square Openings		





Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
RS-1	3.0	19.2	97.5	
S-2	6.5	NT	NT	
S-3	8.3	NT	NT	50/3"

Boring Date: 10-4-11
Field Engineer/Technician: K. Euge II
Driller: C. Riley
Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

**SPEEDIE
AND ASSOCIATES**

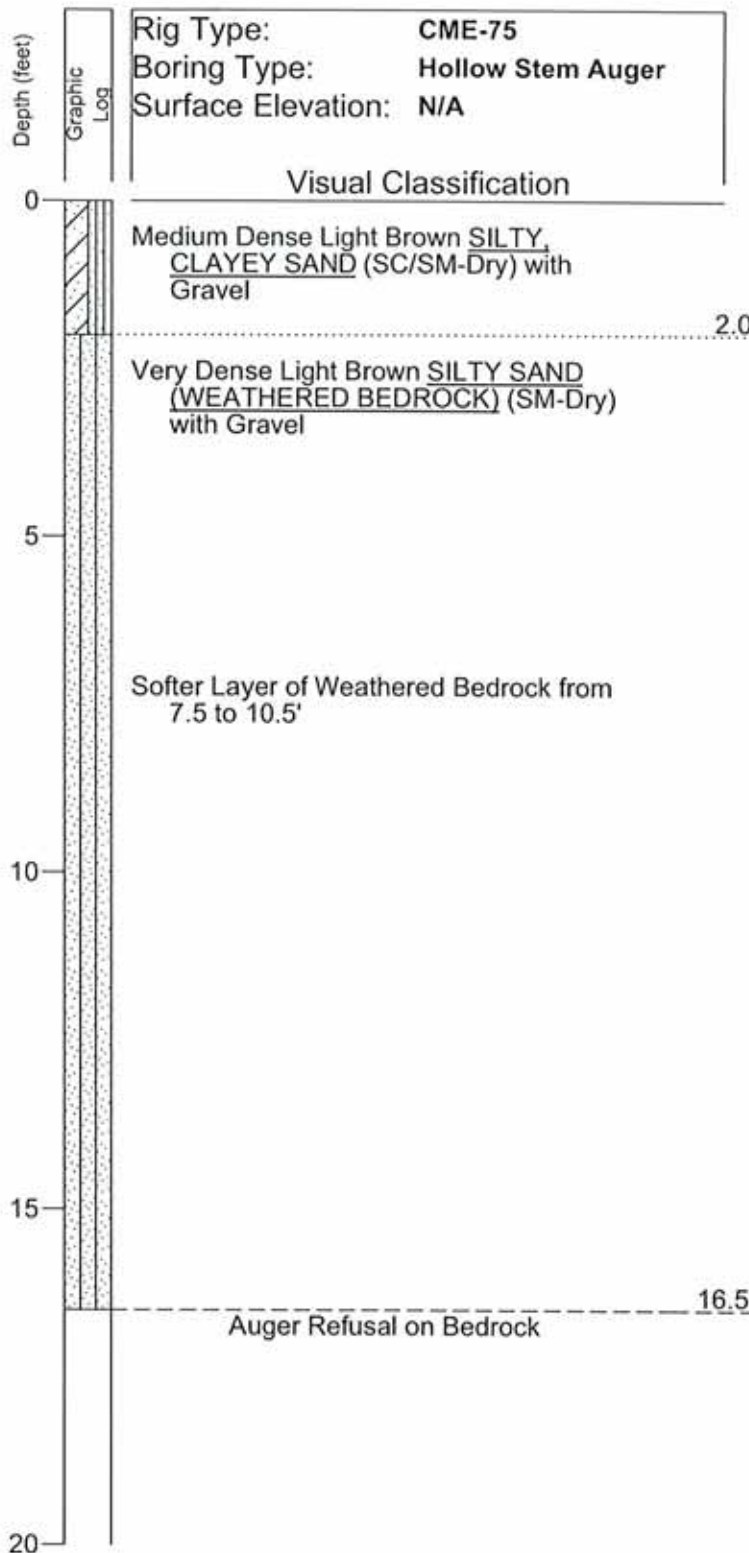
Log of Test Boring Number: SB-1

Prescott National Cemetery

500 N. Highway 89

Prescott, Arizona

Project No.: 111204SA



Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	1.5	NT	NT	
RS-2	3.5	15.8	113.2	63/12"
S-3	6.5	NT	NT	59/12"
S-4	9.0	NT	NT	
S-5	11.5	NT	NT	81/12"
S-6	15.5	NT	NT	50/5"

Boring Date: 10-4-11
Field Engineer/Technician: K. Euge II
Driller: C. Riley
Contractor: Geomechanics SW

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: SB-2

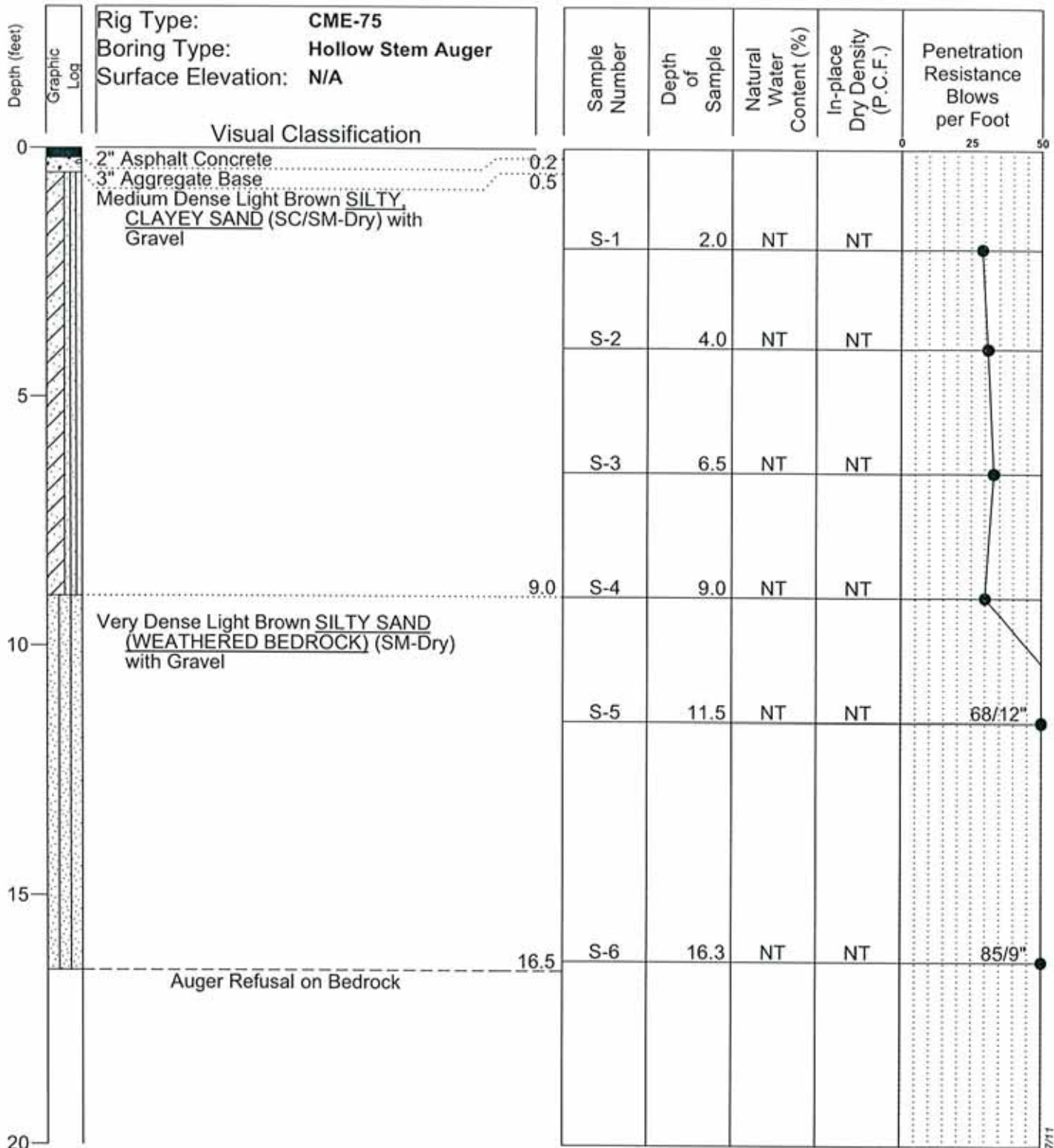
Prescott National Cemetery

500 N. Highway 89

Prescott, Arizona

Project No.: 111204SA

111204SA.GPJ GENOEO.GDT 10/17/11



Boring Date: **10-4-11**
 Field Engineer/Technician: **K. Euge II**
 Driller: **C. Riley**
 Contractor: **Geomechanics SW**

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

**SPEEDIE
AND ASSOCIATES**

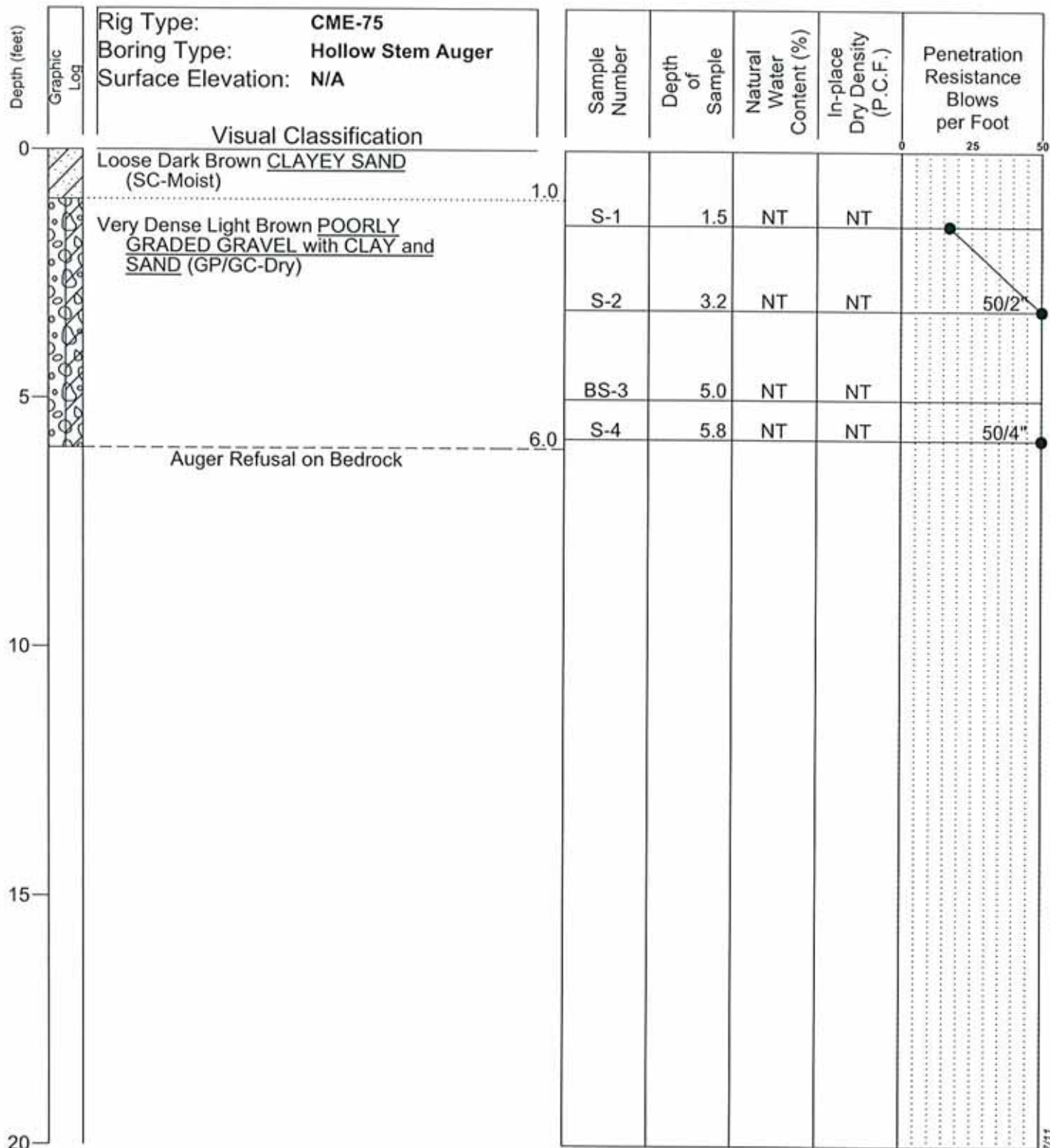
Log of Test Boring Number: **SB-3**

Prescott National Cemetery

500 N. Highway 89

Prescott, Arizona

Project No.: **111204SA**



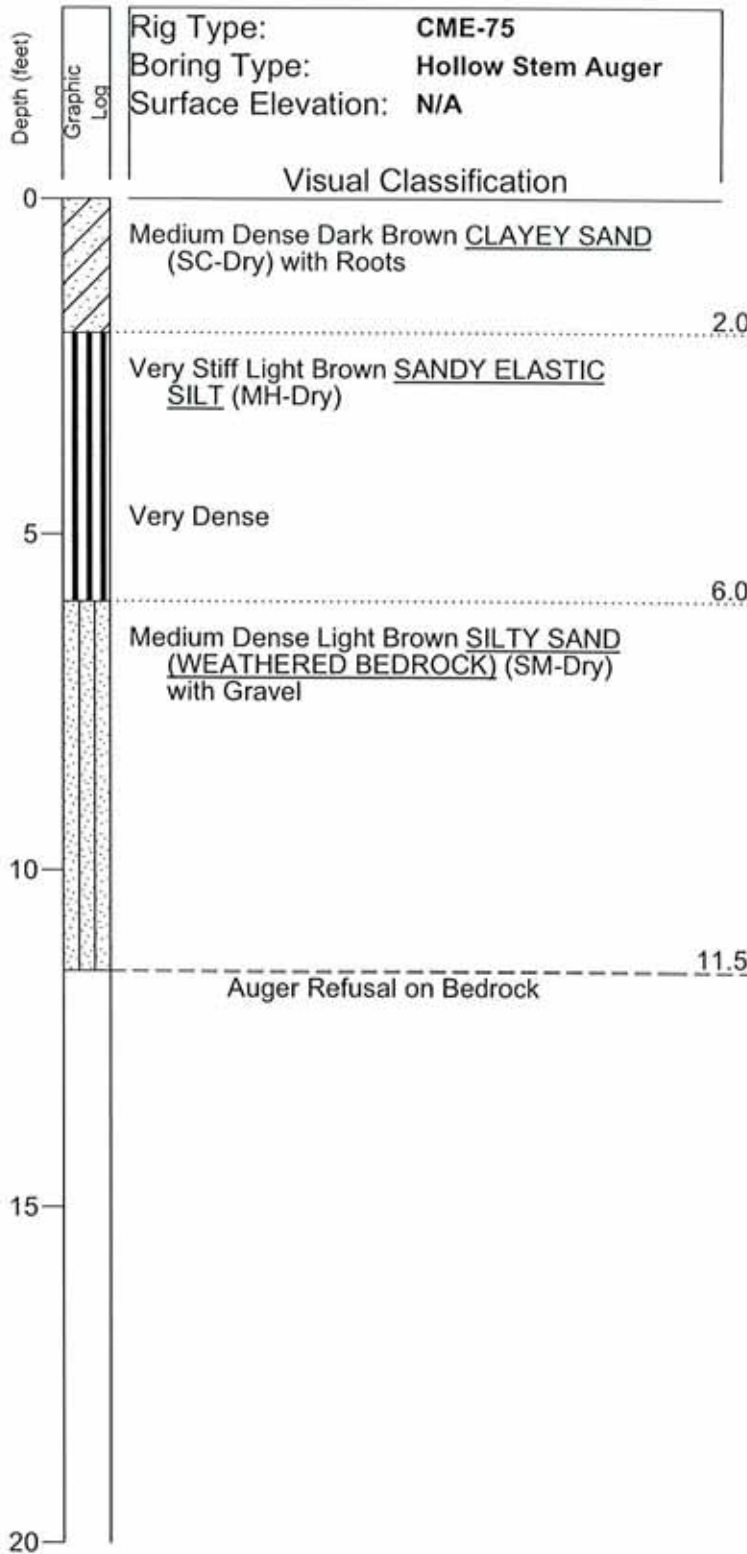
Boring Date: 10-4-11
 Field Engineer/Technician: K. Euge II
 Driller: C. Riley
 Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES	
Log of Test Boring Number: SB-4	
Prescott National Cemetery 500 N. Highway 89 Prescott, Arizona	
Project No.: 111204SA	

SPEEDIE 111204SA.GPJ GENSEO.GDT 10/17/11



Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	1.5	NT	NT	
S-2	4.0	NT	NT	
RS-3	6.0	29.5	81.3	63/12"
S-4	7.9	NT	NT	50/5"
S-5	10.3	NT	NT	50/3"

Boring Date: 10-4-11
Field Engineer/Technician: K. Euge II
Driller: C. Riley
Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **SB-5**

Prescott National Cemetery

500 N. Highway 89

Prescott, Arizona

Project No.: 111204SA

111204SA.GPJ GENGEO.GDT 10/17/11

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
SB-1	RS-1	RING	2.0 - 3.0	19.2	97.5	17	35	49	60	100	50	35	15	SM	SILTY SAND with GRAVEL
SB-2	RS-2	RING	2.5 - 3.5	15.8	113.2	NT	NT	NT	NT	NT	NT	NT	NT		
SB-4	BS-3	BULK	0.1 - 5.0	NT	NT	7	12	20	25	100	39	25	14	GP-GC	POORLY GRADED GRAVEL with CLAY and SAND
SB-5	RS-3	RING	5.0 - 6.0	29.5	81.3	69	94	99	100	100	78	44	34	MH	SANDY ELASTIC SILT

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

NT=Not Tested

Sheet 1 of 1

Prescott National Cemetery
500 N. Highway 89
Prescott, Arizona
Project No. 111204SA

**SPEEDIE
AND ASSOCIATES**

CONSOLIDATION TEST

PROJECT: Prescott National Cemetery

PROJECT NO.: 111204SA

LOCATION: 500 N. Highway 89

DATE: 10/4/11

BORING NO.: SB-1

SAMPLE NO.: RS-1

SAMPLE DEPTH: 2 to 3

LABORATORY NO.:

LIQUID LIMIT: 50

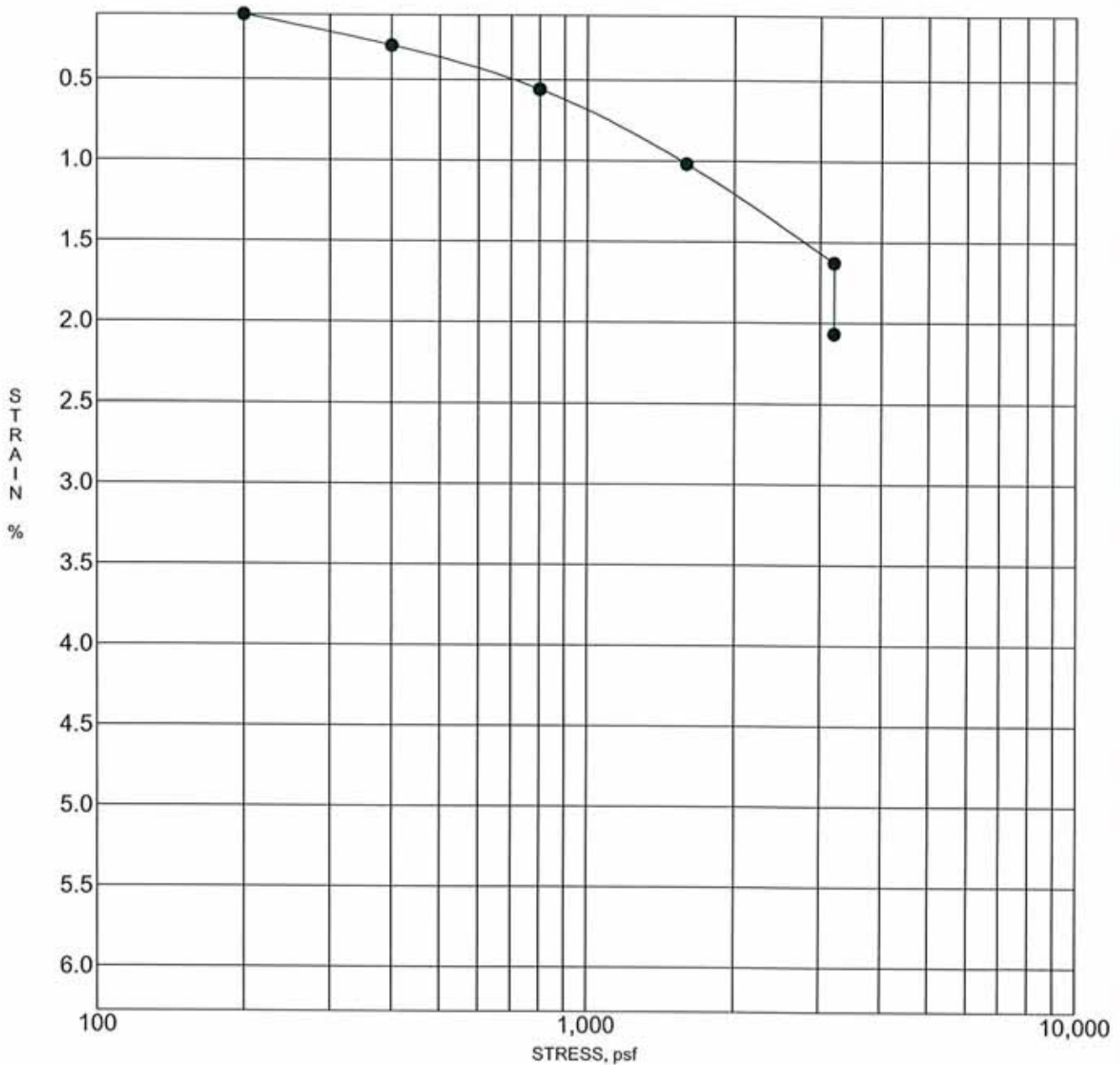
PLASTIC LIMIT: 35

PLASTICITY INDEX: 14

CLASSIFICATION: SM

ASTM SOIL DESCRIPTION:

SILTY SAND with GRAVEL



Sample inundated at end of test at 3200 psf

**SPEEDIE
AND ASSOCIATES**

MOISTURE-DENSITY RELATIONS

PROJECT: Prescott National Cemetery

PROJECT NO.: 111204SA

LOCATION: 500 N. Highway 89

DATE: 10/4/11

BORING NO.: SB-4

SAMPLE NO.: BS-3

SAMPLE DEPTH: 0.1 to 5

LABORATORY NO.:

METHOD OF COMPACTION: D698A

LIQUID LIMIT: 39

PLASTIC LIMIT: 25

PLASTICITY INDEX: 14

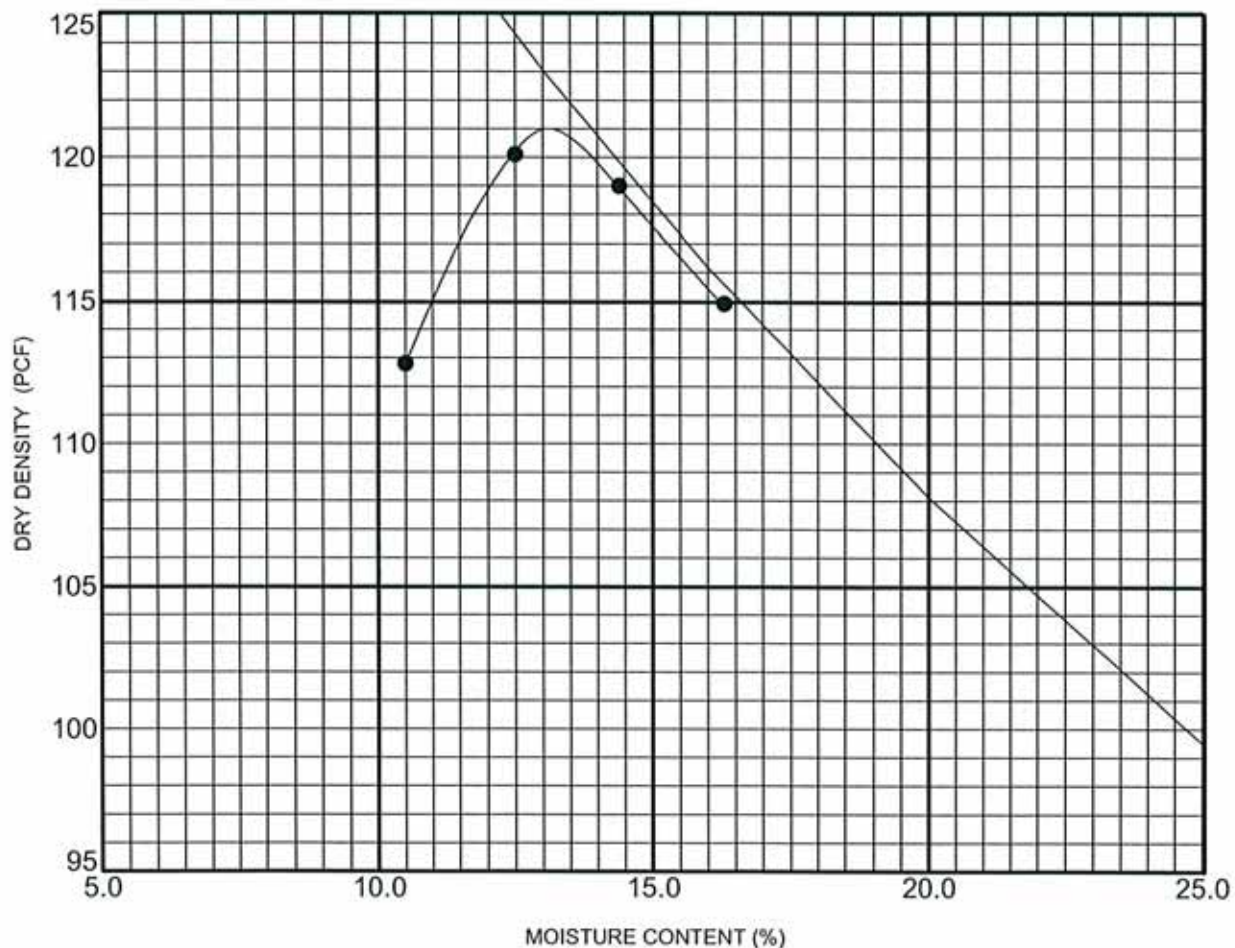
CLASSIFICATION: GP-GC

ASTM SOIL DESCRIPTION:

POORLY GRADED GRAVEL with CLAY and SAND

MAXIMUM DRY DENSITY: 121.0 PCF

OPTIMUM MOISTURE CONTENT: 13.1%



SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	PERCENT COMPACTION	FINAL MOISTURE CONTENT (%)	CONFINING LOAD (psf)	TOTAL SWELL (%)
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SB-4, BS-3	5.0	121.0	13.1	114.7	11.5	94.8	17.4	100	1.9
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