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SECTION 00 01 15
LIST OF DRAWINGS

The drawings listed below accompany the Specifications and form a part of the contract.

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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 construction operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for the Cemetery Improvements at the Fort Smith National Cemetery as required by the Drawings and Specifications.
- B. Before placement and installation of work subject to tests by testing laboratory retained and paid for by the Contractor, the contractor shall notify the COTR in sufficient 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.
- C. All employees of general contractor and subcontractors shall comply with VA security management program.
- D. 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.

1.2 STATEMENT OF BID ITEM(S)

- A. ITEM I, GENERAL CONSTRUCTION: Contractor shall completely prepare site for construction operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for the Cemetery Improvements at the Fort Smith National Cemetery as required by the Drawings and Specifications.

PROJECT DESCRIPTION

- 1. The replacement of 10 pre-placed crypts.
Crypts number 2 - 11 located in section 27 are to be replaced under this contract. This project includes removal and the disposal of the damaged crypts and installation of 10 new crypts that meet the drawings and specifications in the original project. One of the 10 crypts is a perimeter crypt. It shall include testing, erosion control, excavation, removal, and installation, grading, surface runoff control, protection and or restoration of existing irrigation and turf for the replacement of the 10 damaged crypts.
Note: Crypt testing may be avoided by the contractor if the crypt manufacturer has a minimum 8 years in the manufacturing of crypts for the National Cemetery Administration.
- 2. Manufacture and deliver ten (10) pre-placed crypts.

3. The contractor shall replace 320 Lf. of the wind damaged fencing and the damaged gate installed in project 847CM3016. This includes the necessary components and appurtenances. This shall include the replacement of any brace rails, top rails, tension bars, truss rods, turnbuckles, corner end post, line post, locking bars, privacy slats, and footing replacements. The fence and gate replacements shall match the existing fencing installed in project 847CM3016 in color and finish and be free from all bends, leans.
4. The contractor shall replace 1,728 Sf. of the damaged asphalt paving with concrete. The new concrete shall be pitched to drain effectively. The AE shall demolish and remove 1,728 Sf. of the existing asphalt and base material. The contractor shall excavate to the depth necessary to install the new heavy duty 6" reinforced concrete over 4" base material. The finished paving shall be at the same grade as the existing paving and shall be pitched to drain. The contractor shall investigate the soils report furnished in the addendum and verify that the new paving and base material meets and or exceeds the recommendations.
5. The contractor shall replace 435 Lf. of precast concrete caps with limestone stone caps. The fence post shall not be removed and the new cap joints shall align with the existing fence post. The dimensions and installation of the caps shall comply with the drawings and specifications. (see 847CM3016 D/L-23). The contractor shall install new wall caps to match the desired condition. The existing caps shall not be reused. The existing fencing is to be reused. Any additional damage caused to the fence by the contractor shall be borne by the contractor.
6. The contractor shall install six new burial section markers. The section markers shall adhere to the drawings and specifications (see Appendix 847CM3016 L-18). The section markers shall be installed two markers for each of the following sections: Section 30, Sections MA-1, and MA-2.
7. The contractor shall design and construct a (one) shelter to be used for the protection of heavy equipment from the environmental elements. The desired location is identified on the plan. The final location is to be adjusted so as not to interfere with manholes or other existing utilities. The contractor will locate any known utilities and provide us a shop drawing of the shelter in the proposed location. The shelter shall be a minimum of 24' width x 84' length. The shelter shall be installed on a heavy duty concrete slab, pitched to drain, with a concrete ramp at the entrance and downspouts and gutters (the gutters do not have to be tied to the storm drainage system). The structure shall be identical to Polygon REK or approved equal product readily available on the open market. The columns shall be approximately 20' O.C. with a minimum height of 16' to 18'. Each column shall have a yellow pipe bollard for protection on the entrance side of the shelter. Water will not be allowed to puddle on the slab or at the base of the structure. The roof of the structure shall be a standing seam metal gable roof and be pitched 12:4. The steel columns and frame members shall have a powder coat finish. The cemetery director shall sign off on the color

scheme of the structure. A GFI and a ¾" ADA water hydrant with freeze protection will be furnished on one of the columns of the structure.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, three (3) sets of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

1.4 FIRE SAFETY

- A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.
 - 1. ASTM International (ASTM):
 - E84-2008..... Surface Burning Characteristics of Building Materials
 - 2. National Fire Protection Association (NFPA):
 - 10-2006 Standard for Portable Fire Extinguishers
 - 30-2007 Flammable and Combustible Liquids Code
 - 51B-2003..... Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 70-2007 National Electrical Code
 - 241-2004 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. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- D. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- E. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with the COTR.
- F. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the COTR.

- G. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- H. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- I. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B.
- J. Fire Hazard Prevention and Safety Inspections: Inspect construction areas daily. Any findings and corrections shall be indicated on the daily construction progress report. If required, coordinate with the cemetery director or local authority, report findings and corrective actions to the COTR as soon as practical.
- K. Smoking: Smoking is prohibited within cemetery property.
- L. Dispose of waste and debris in accordance with NFPA 241. Remove from the cemetery property daily.
- M. Perform other construction and demolition operations in accordance with 29 CFR 1926.

1.5 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall take full responsibility and shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the CO or 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 sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the CO 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. With the written consent of the CO, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the CO, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the CO/COTR. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads to owner's satisfaction.
- D. Working space and space available for storing materials shall be as designated by the COTR.
- E. Workmen are subject to rules of 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.
- G. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, seven feet minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to one inch above grade. Remove the fence when directed by the COTR.
- H. Utilities Services: Maintain existing utility services for Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by the COTR.
 - 1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of the COTR.
 - 2. Contractor shall submit a request to interrupt any such services to the COTR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 - 3. 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 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 the COTR. Such approval will be confirmed in writing as soon as practical.
 - 6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer,

electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

- I. 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.
- J. 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. Avoid/eliminate any potential safety and health hazards to the general public who visit or work at the cemetery.
 3. Check in with the Cemetery Director for burial service schedules when on-site before commencement of work each day.

1.6 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 1. Reserved items which are to remain property of the Government are identified by listing and location 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 Cemetery.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. Proper arrangement shall be coordinated and made between the contractor and COTR in advance of work to avoid interfering with Contractor's operation.
4. PCB Transformers and Capacitors Removal (if applicable): The Contractor shall be responsible for proper handling and disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors in accordance with the procedures and requirement of all applicable Federal, State and local rules and regulations. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the CO and a copy to the COTR and the Cemetery Director for their records.
 - a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:
 - 40 CFR 261 Identification and Listing of Hazardous Waste
 - 40 CFR 262 Standards Applicable to Generators of Hazardous Waste
 - 40 CFR 263 Standards Applicable to Transporters of Hazardous Waste
 - 40 CFR 761 PCB Manufacturing, Processing, Distribution in
Commerce, and use Prohibitions
 - 49 CFR 172 Hazardous Material tables and Hazardous Material
Communications Regulations
 - 49 CFR 173 Shippers - General Requirements for Shipments and
Packaging
 - 49 CRR 173 Subpart A General
 - 49 CFR 173 Subpart B Preparation of Hazardous Material for
Transportation
 - 49 CFR 173 Subpart J Other Regulated Material; Definitions and
Preparation
 - TSCA Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

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

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which is not to be removed and which does 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 CO.
- 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 CO may have the necessary work performed and charge the cost to the Contractor.
- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "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 contract will apply for and obtain required permit. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. The contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. The Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
 - Designating areas for equipment maintenance and repair;
 - Providing waste receptacles at convenient locations and provide regular collection of wastes;

- Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
- Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
- Providing adequately maintained sanitary facilities.

1.8 RESTORATION

- A. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- B. Any unknown site conditions 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).

1.9 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 MACTEC Engineering and Consulting Inc.
- B. A copy of the investigation report will be made available for inspection by bidders upon request to the CO.
- C. 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 the above referenced report. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.10 PROFESSIONAL SURVEYING OR ENGINEERING SERVICES LICENSED BY THE STATE OF ARKANSAS

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.

1.11 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 Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the CO. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the CO until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the CO may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.
- B. Establish and plainly mark corner points and survey controls for each building and other structures, 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 new structure, roads, walkways, parking lots, gravesite control monuments, and other required construction 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. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, crypt fields, under drains elevations, 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 of compliance 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, 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 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 of each building and other structures.
 2. Elevations of bottoms of footings and tops of floors of each building.
 3. Lines and elevations of storm drainage pipelines, catch basins, and other drainage structures.
 4. Lines of grave plot documentation.
 5. Lines and elevations of roads, parking lots, and walkways.
 6. Elevations of all graded areas.
 7. Lines and elevations of crypt under drains, and grading.
 8. Locations of irrigations lines, control valves and irrigation heads.
- E. Upon completion of the work, the Contractor shall furnish the CO reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments, irrigation system, roads and fifty foot stationing along new road centerlines. 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".

1.12 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, to 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 and are subject to inspection verifications upon Inspector's site visits.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the COTR within 15 calendar days after each completed phase and after the acceptance of the project by the COTR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.
- E. Contractor shall also deliver, on a Compact Disc (CD), one electronic copy of the as-built drawings in PDF and AutoCAD format to the COTR.

1.13 USE OF ROADWAYS

- A. 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 Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate construction operations. These roads may be used by all who have business thereon within zone of construction operations.

1.14 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations. All connections and appliances connected therewith are to be removed prior to completion of contract, and premises left clean. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen.

1.15 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make NO utilities available to the contractor. It is contractor's responsibility to make any necessary connections and pay for such connections and services. If such connections are thru the system the government is using, the amount to be paid by the Contractor for chargeable utility services shall be the prevailing rates charged to the Government.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the CO, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of utility 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. Water (for Construction and Testing): The Contractor shall furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery water distribution system. Provide reduced pressure backflow preventer at each connection.
 - 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 the COTR's discretion) of use of water from Cemetery's system.

1.16 TESTS

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

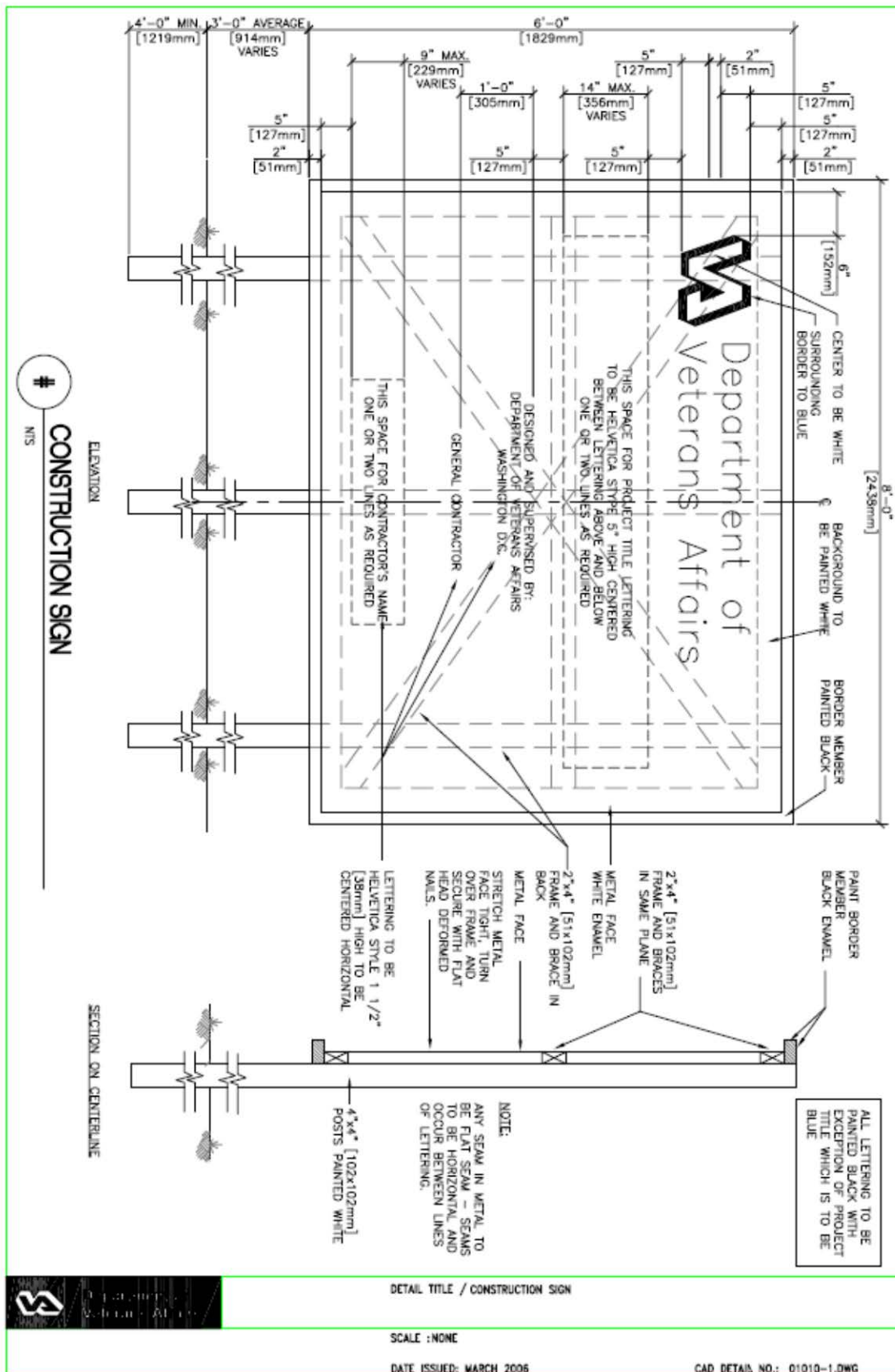
1.17 INSTRUCTIONS

- A. 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(4) 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: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions, each training session shall be a minimum

of 4 hours to a maximum of 24 working hours 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 CONSTRUCTION SIGN

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



1.19 SAFETY SIGN (NOT USED)

1.20 CONSTRUCTION PROGRESS PICTURES

The Contractor shall provide daily construction progress pictures in electronic form (.jpg) and select representative pictures with explanations send thru e-mail to COTR. At the end of construction prior to requesting final inspection, the Contractor shall provide all pictures taken in disc or device of USB port and deliver to COTR.

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.

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**SECTION 01 32 16.15
PROJECT SCHEDULES
(SMALL PROJECTS)**

PART 1- GENERAL

1.1 DESCRIPTION:

- A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule using Microsoft Project program to demonstrate fulfillment of the contract requirements (Project Schedule) within 10-day of issuing of Notice to Proceed, and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting to the Contractor's Representative (CR).
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.
- C. The Contractor's representative shall have the option of developing the project schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.3 of this specification will apply.

1.3 CONTRACTOR'S CONSULTANT:

- A. The Contractor shall submit a qualification proposal to the VA Contracting Officer and Contracting Officer's Technical Representative (COTR,) within 10 days of bid acceptance. The qualification proposal shall include:
1. The name and address of the proposed consultant.
 2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.

3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
- B. The COTR has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

- A. The contractor will provide and update the schedule as needed base.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 30 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review: color coded schedules on sheets of paper 30 x 42 inches and an electronic file in the previously approved schedule program as base line schedule. 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.
- B. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the process of consultation/discussion/negotiation with VA in compliance with all applicable federal acquisition codes for contract change.

1.6 WORK ACTIVITY/EVENT COST DATA

- A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

- B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).
- C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 – 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.
- D. The Contractor shall cost load work activities/events for all BID ITEMS including ASBESTOS ABATEMENT. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

- A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:
 - 1. 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's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
 - e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
 - 2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area or building to another area or building.

3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, 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 COTR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.
 4. 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.
 5. The schedule shall be generally numbered in such a way to reflect discipline, phase or location of the work.
- B. The Contractor shall submit the following supporting data in addition to the project schedule:
1. The appropriate project calendar including working days and holidays.
Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.
- C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COTR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COTR's approval of the Project Schedule.
- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION

CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.

- B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory updated project schedule.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Schedule progress meetings will be held on dates mutually agreed to by the COTR and the Contractor. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COTR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
 - 1. Actual start and/or finish dates for updated/completed activities/events.
 - 2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
 - 3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
 - 4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
 - 5. Completion percentage for all completed and partially completed activities/events.
 - 6. Logic and duration revisions required by this section of the specifications.
 - 7. Activity/event duration and percent complete shall be updated independently.
- B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.
- C. **Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress.**
- D. Following approval of the construction schedule, the VA, the General Contractor, its approved CPM Consultant, and all subcontractors needed, as determined by the COTR,

shall meet to discuss the 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. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised progress schedule that 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 COTR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events, 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 CPM 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 regardless of the cause for these revisions.
- B. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all sections and any other previous agreements by the Contracting Officer or COTR.
- D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 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, CPM data and supporting evidence as the COTR 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. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer- produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

- 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 FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic 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 case by case basis in a timely manner.

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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 Specifications, 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 CO (CO) or CO's Technical Representative (COTR,) 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 all submittals in sufficient time to allow proper consideration and approval by Government. Timely submission should be observed to assure adequate lead time for procurement of contract required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- 1.5 Submittals will be reviewed for compliance with contract requirements by the COTR, and action thereon will be taken by the COTR on behalf of the CO.
- 1.6 The contractor will submit all submittals along with a submittal registry with assigned identifiable section with sequential numbers for tracking. 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 by CO, 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 the COTR. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The CO and the COTR assume 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. CO 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. A PDF format submittal with electronic signature can be accepted at the COTR's discretion.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by the Contractor. Submittal shall be sent via FedEx package prepaid by the contractor 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 the Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by CO.
1. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 2. Contractor shall forward a copy of transmittal letter to the COTR simultaneously with submission to a commercial testing laboratory.
 3. Laboratory test reports shall be sent directly to the COTR for appropriate action.
 4. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 5. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the Construction Inspector and by the contractor at the site until completion of contract, at which time such samples will be kept as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 4. A space 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 the COTR 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 the COTR.

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SECTION 01 45 29 TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T27-06..... Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006)..... Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-01 (R2004)..... The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2003)..... Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-01 (R2004)..... Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02(R2006)..... Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
- 506.4R-94 (R2004)..... Guide for the Evaluation of Shotcrete
- D. ASTM International (ASTM):
- A325..... Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A490..... Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M..... Standard Practice for Making and Curing Concrete Test Specimens in the Field

C39/C39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
C140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M	Standard Test Method for Slump of Hydraulic Cement Concrete
C172	Standard Practice for Sampling Freshly Mixed Concrete
C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C780	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019.....	Standard Test Method for Sampling and Testing Grout
C1064/C1064M	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
C1077.....	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314.....	Standard Test Method for Compressive Strength of Masonry Prisms
D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
D1188.....	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
D1556.....	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557.....	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
D2937.....	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

- D2974..... Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
- D3666..... Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
- D3740..... Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D6938..... Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- E164..... Standard Practice for Contact Ultrasonic Testing of Weldments
- E329..... Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
- E543..... Standard Specification for Agencies Performing Nondestructive Testing
- E709..... Standard Guide for Magnetic Particle Testing
- E1155..... Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
- E. American Welding Society (AWS):
 - D1.1-07 Structural Welding Code-Steel

1.3 REQUIREMENTS

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by the COTR. When it

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

- C. Written Reports: Testing laboratory shall submit test reports to the 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 the COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: Unless otherwise directed by the Contracting Officer, the Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed 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 and grading to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COTR regarding suitability or unsuitability of graded areas. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to the COTR the extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 - 2. Provide full time observation of fill placement and compaction and field density testing in building areas and pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
 - 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
 - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698.
 - 2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 or ASTM D2937 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 2000 square feet of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 2000 square feet of overlaying building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: One test per 100 feet of each layer of compacted fill but in no case fewer than two tests.
 - c. Pavement Subgrade: One test for each 400 square yards, but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 300 feet, but in no case fewer than two tests.
 - e. Trenches: One test at maximum 100 foot intervals per 2 feet of vertical lift and at changes in required density, but in no case fewer than two tests.
 - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to Resident Engineer. In each compacted fill layer below wall footings, perform one field density test for every 100 feet of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by the COTR.

3.2 LANDSCAPING

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
 1. Test for organic material by using ASTM D2974.
 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to the 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 AASHTO T180 or 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 AASHTO T191 or ASTM D1556.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the AHTD Standard 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 of asphalt base and surface course in accordance with ASTM D1188 for each day's paving operation.

3.4 SITE WORK CONCRETE

Test site work concrete including materials for concrete as required in subsection 3.5 of this section.

3.5 CONCRETE

A. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least four cylinders for each 100 cubic yards or less of each concrete type, and at least

- four cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. The 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 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 40 degrees F, record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 85 degrees F, record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
 13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 14. Observe curing procedures for conformance with specifications, and record dates of concrete placement, start of preliminary curing, start of final curing, and 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 two cylinders at 28 days. Use remaining cylinder as a spare tested as directed by the COTR.

2. Furnish certified compression test reports (duplicate) to the 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 psi.
 - e. Weather conditions during placing.
 - f. Temperature of concrete in each test cylinder when test cylinder was molded.
 - g. Maximum and minimum ambient temperature during placing.
 - h. Ambient temperature when concrete sample in test cylinder was taken.
 - i. Date delivered to laboratory and date tested.

3.6 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 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.

3.7 MASONRY

- A. Mortar Tests:
 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 2 inch, 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 2500 square feet of masonry.

C. Masonry Unit Tests:

1. Laboratory Compressive Strength Test:

- a. Comply with ASTM C140.
- b. Test 3 samples for each 5000 square feet of wall area.

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

3.8 STRUCTURAL STEEL

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. 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 Resident Engineer.

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SECTION 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS

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, solid waste, radiant energy, and radioactive materials, 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, or;
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
 - 1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
 - 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 - 3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
 - 4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 - 5. 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 "water of the United States" and would require a permit to discharge water from the governing agency.

6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
 - a. Sewage: Domestic sanitary sewage and human and animal waste.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 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

1.4 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, 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) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
 - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
 - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

- d. Description of the Contractor's environmental protection personnel training program.
 - e. 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.
 - f. 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.
 - g. Procedures to provide the environmental protection that comply 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.
 - h. Permits, licenses, and the location of the solid waste disposal area.
 - i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
 - k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas.
- B. 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.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by 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, and land forms without permission from the COTR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
 - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
 - b. Immediately repair all damage to existing trees and shrubs 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 in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
 - a. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
 - b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls installed and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown on the Drawings or as otherwise approved by the COTR. 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 borrow areas on Government property to minimize erosion and to prevent 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 public water areas.
 2. Monitor public water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Arkansas 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 (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 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. Reduction of Noise: 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 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the COTR, and as discussed in Section 01 00 00, GENERAL REQUIREMENTS. 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		
GENERATORS	75	SAWS	75
COMPRESSOR S	75	VIBRATORS	75

- b. Use shields or other physical barriers to restrict noise transmission.
 - c. Provide soundproof housings or enclosures for noise-producing machinery.
 - d. Use efficient silencers on equipment air intakes.
 - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - f. Line hoppers and storage bins with sound deadening material.
 - g. 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 55 dB(A) noise level. Measure noise exposure at the property line or 50 feet from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 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 satisfactory to the COTR. Cleaning shall include off the station 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.

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SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for submittals.

1.3 QUALITY ASSURANCE

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

- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

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

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

1.5 SUBMITTALS

- A. Conform to the requirements of Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for submittals.
- B. Prepare and submit a written Waste Management Plan. The plan shall include, but shall not be limited to, the following information:
 1. Procedures to be used for debris management.
 2. Techniques to be used to minimize waste generation.
 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
 4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.

- 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Submit name of Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Submit monthly summaries of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 RECORDS

- A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COLLECTION

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

3.2 DISPOSAL

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

3.3 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, and invoices. Include the net total costs for each disposal.

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SECTION 02 41 00 DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies demolition and removal of buildings, portions of buildings, utilities, and other structures. The Work includes, but is not limited to, demolition and removal of the following as indicated on the Drawings:
 - 1. Concrete block building (2-story)
 - 2. Concrete bleachers
 - 3. Ball fields
 - 4. Wooden concession stands
 - 5. Restrooms, dugouts, pavilions
 - 6. Light poles
 - 7. Fences, gates, and walls
 - 8. Roads, walks, curbs, and on-grade concrete slabs
 - 9. Other structures
 - 10. Site utilities
 - 11. Drawings may not be all inclusive. Any related items that need to be removed from the area for gravesite expansion shall be removed under this section.

1.2 RELATED WORK:

- A. Section 31 20 00, EARTH MOVING.
- B. Section 01 00 00, GENERAL REQUIREMENTS.
- C. 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 1.7 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. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
 - 3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. 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 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 cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal

works. Repairs, reinforcement, or structural replacement must have the COTR's approval.

- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 UTILITY SERVICES:

- A. Demolish and remove outside utility service lines need to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new utility service lines.
 - 2. To full depth within an area defined by hypothetical lines located 5 feet outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas approved by the COTR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 24 inches square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- 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 and utility owner. When utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area.
- E. Protect any adjacent roadways, properties that are not within the demolition zone.

3.2 CLEAN-UP:

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

Property) disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES:

- A. Formwork, Reinforcement Fabricating and Placing, and Cross-Sectional Dimension: ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 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):
 - 117-06..... Standard Specifications for Tolerances for Concrete Construction and Materials
 - 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
 - 211.2-98(R2004) Standard Practice for Proportions for Structural Lightweight Concrete
 - 301-05..... Specifications for Structural Concrete
 - 305.1-06..... Specification for Hot Weather Concreting
 - 306.1-90(R2002) Standard Specification for Cold Weather Concreting

SP-66(04)	ACI Detailing Manual
318-08	Building Code Requirements for Reinforced Concrete
347-04	Guide to Formwork for Concrete

C. ASTM International:

A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
C33	Standard Specification for Concrete Aggregates
C39/C39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C94/C94M	Standard Specification for Ready-Mixed Concrete
C143/C143M	Standard Test Method for Slump of Hydraulic Cement Concrete
C150	Standard Specification for Portland Cement
C171	Standard Specification for Sheet Materials for Curing Concrete
C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
C231	Standard Test method for Air Content of Freshly Mixed Concrete by the Pressure Method
C260	Standard Specification for Air-Entraining Admixtures for Concrete
C330	Standard Specification for Lightweight Aggregates for Structural Concrete
C494/C494M	Standard Specification for Chemical Admixtures for Concrete
C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

D1751.....	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D4397.....	Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
E1155.....	Standard Test Method for 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 the 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 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, 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. 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 2500 psi at 3 days and 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 as specified in individual specification sections.
- 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 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 Compressive Strength psi	Min. Cement lbs/c. yd	Max. Water Cement Ratio	Min. Cement lbs/c. yd	Max. Water Cement Ratio
5000 ^{1,3}	630	0.45	650	0.40
4000 ^{1,3}	550	0.55	570	0.50
3000 ^{1,3}	470	0.65	490	0.55
3000 ^{1,2}	500	*	520	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi in excess of f'c. For concrete strengths above 5000 psi, the proposed mix design shall achieve a compressive strength 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 Table II. Determine air content by either ASTM C173 or ASTM C231.

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

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
3/8 in	6 to 10
1/2 in	5 to 9
3/4 in	4 to 8
1 in	3 1/2 to 6 1/2
1 1/2 in	3 to 6

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
 - 1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 - 2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation shall conform to ACI 301 and as recommended in ACI 347. Formwork shall be 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:

- A. Details of concrete reinforcement, unless otherwise shown, shall be 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.
 - 1. Place 4 inches of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
 - 2. Lap joints 6 inches and seal with a compatible pressure-sensitive tape.
 - 3. 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 the 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 5 feet in unexposed work nor more than 3 feet in exposed work. Place and consolidate concrete in horizontal layers not exceeding 12 inches in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305.1 to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306.1, to prevent freezing of thin sections less than 12 inches and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from the COTR.

3.5 PROTECTION AND CURING:

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

3.6 FORM REMOVAL:

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

3.7 SURFACE PREPARATION:

- A. Immediately after forms have been removed and work has been examined and approved by the 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 the 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 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.
- B. 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 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.

3.11 PRECAST CONCRETE ITEMS:

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

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**SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE**

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This Section specifies site architectural precast concrete work shown on the Contract Drawings. The work includes furnishing all labor materials manpower and equipment required to complete the manufacturer, assembly, transportation delivery and installation of the site architectural precast concrete elements, which include:

1. Capstones for the cemetery stone walls and columns

1.2 RELATED WORK

- A. Section 01 45 29, TESTING LABORATORY SERVICES.
B. Section 07 92 00, SEALANTS AND CAULKING.

1.3 REFERENCES

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
- ACI 211.1 Standard Practice for Selecting Proportions for Normal,
Heavyweight and Mass Concrete
- ACI 318-08 Building Code Requirements for Reinforced Concrete
- ACI 533.1R-02 Design Responsibilities for Architectural Precast Concrete
Projects
- C. ASTM International (ASTM):
- A185 Standard Specification for Steel Welded Wire Fabric, Plain,
for Concrete
- A416/A416M Standard Specification for Steel Strand, Uncoated Seven-
Wire for Prestressed Concrete
- A615/A615M Standard Specification for Deformed and Plain Carbon-
Steel Bars for Concrete Reinforcement
- A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel
Bars for Concrete Reinforcement
- A934/A934M Standard Specification for Epoxy-Coated Prefabricated
Steel Reinforcing Bars
- C33 Standard Specification for Concrete Aggregates

- C39/C39M Standard Test Method for Compressive Strength of
Cylindrical Concrete Specimens
 - C150..... Standard Specification for Portland Cement
 - C260..... Standard Specification for Air-Entraining Admixtures for
Concrete
 - C494/C494M Standard Specification for Chemical Admixtures for
Concrete
 - C642..... Standard Test Method for Density, Absorption, and Voids
in Hardened Concrete
 - C979..... Standard Specification for Pigments for Integrally Colored
Concrete
 - C1107 Standard Specification for Packaged Dry, Hydraulic-
Cement Grout (Nonshrink)
 - C1240..... Standard Specification for Silica Fume Used in
Cementitious Mixtures
- D. Concrete Reinforcing Steel Institute (CRSI):
- 1. "Manual of Standard Practice."
- E. Precast/Prestressed Concrete Institute (PCI)
- 1. MNL 117 – "Manual for Quality Control."
 - 2. MNL 120 – "Design Handbook."

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Comply with Uniform Building Code, (UBC), municipal building codes and regulations or other governing agencies having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: Submit product data for manufactured materials and products.
- B. Shop Drawing:
- 1. Show in-place location, fabrication details, plans, elevations, anchorages, reinforcement, connection details and methods, dimensions, finishes, relationships to adjacent materials, and erection and placement. Provide details of how and where the pieces should be held and lifted. Engineering design of the elements shall include thickness of the elements needed to meet the structural loads imposed during fabrication, handling, transportation, erection and in place conditions. Should thickness of elements be required to be larger than shown, the Contractor shall coordinate with the COTR during the submittal process.

2. Show identification marks, coordinated to Shop Drawings, and date of manufacture on all units to facilitate hauling and erection.
 3. Setting diagrams, templates, instructions and directions as required for installation.
- C. Engineering Calculations: Engineering calculations sealed by a licensed Professional Engineer in the State of Arkansas.
- D. Samples: Provide samples to the COTR at the site. Samples shall be for the purpose of establishing the acceptable level of quality, finish and color variation for Architectural Precast Concrete pieces for this project. Color for Architectural Precast elements shall be light grey.
1. Capstones for columns:
 - a. Provide at least one full-sized capstone. The two sides with drips and one end shall be directly from the casting and one end can be cut to reduce to overall size of the sample. Multiple samples are recommended so as to be able to clearly depict the acceptable quality of work that will be allowed for the manufacturer of the units. The accepted sample units will be to establish the lowest level of workmanship and product construction, to be allowed to be delivered to the site.
 - b. The same types of samples shall be provided for the wall capstones. The sample shall be at least 12 inches long, with drip edges.
- E. Quality: The samples and submittal materials shall clearly identify the proposed allowable variances in color, texture, alignment, physical dimensioning, drips, and allowable size and distribution of the various typical imperfections from the casting operations. The submittal process should result in a clear understanding of the acceptable quality of the products that must be obtained at the manufacturer, before the products can be shipped to the site. Patching and repair work shall generally be limited to allowable repairs caused during the transportation, delivery and installation of the pieces.
- Submittal materials with the samples shall include sufficient information to clearly indicate the measurement criteria to be utilized at the site to either accept or reject the units, before installation. Minimal or no patching of the products once set in place is the desired effect.
- F. Mix Design(s): Proposed concrete mix design for each type and color of concrete mix required including backup mix.
- G. Certifications:
1. Fabricator's certification from APA, PCI, or applicable municipal certifications.

- H. Repairing criteria and procedures, along with samples of acceptable repair samples shall be provided as part of the submittal process.

1.6 QUALITY ASSURANCE

- A. Fabricator's Qualifications: Firm shall have a minimum of five (5) years experience in producing units similar to those required for this Project, with sufficient production capacity to produce and deliver required units without causing delay in Work.
 - 1. Fabricating plant shall be certified by one of the following:
 - a) Architectural Precast Association (APA).
 - b) Precast/Prestressed Concrete Institute (PCI), Group A1.
 - c) Applicable municipal building department.
 - d) Firms not certified by APA or PCI shall submit a written Quality Assurance/Quality Control program for approval.
- B. Installer's Qualifications: Installer shall have a record of at least five (5) years of successful installation of units similar to those required for this Project.
- C. Production Samples:
 - 1. Provide color and texture range samples for approval prior to production start

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units to the Project site in such quantities and at such times to ensure continuity of installation.
- B. Avoid job site storage. When job site storage is required store in a manner to prevent physical damage and so that markings are visible.
- C. Lift and support only at designated lifting or supporting points as shown on reviewed Shop Drawings.
- D. Provide 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.

1.8 WARRANTY

- A. Manufacturer shall submit a written warranty for precast products for a period of two years upon final acceptance of products.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Approved Fabricators are those manufacturer's that are, no later than at the time of submittals, members of the Architectural Precast Association. Fabricators that are members of this organization will be eligible as firms meeting the quality and

experience requirements needed to produce products meeting the standards for this project.

- B. Alternative manufacturer's may be considered if they can demonstrate that they have the experience, and manufacturing capabilities equivalent to those of the APA members and have the capability to produce products for this project that meet the approved manufacturing standards established during the submittal process. Only manufacturer's that are very close to fully complying with the requirements for membership to the APA as approved manufacturers of Architectural Precast Concrete products for application similar to or equal to those required for this project will be considered, as determined by the COTR.

2.2 MATERIALS

A. Concrete Materials:

1. Portland Cement: ASTM C150, Type I or III, white or gray colors to achieve desired finish colors. Use only one brand, type, and color from the same mill. Gray cement may be used for non-exposed backup mixes.
2. Aggregates: ASTM C33, gradation may differ to achieve desired finish characteristics. Select coarse and fine aggregate colors and screen sizes to match approved sample(s). Verify that adequate supply, from one pit or quarry, for each type of aggregate is available for the entire Project. If possible obtain entire aggregate supply prior to starting Work, or have aggregate supply held in reserve by aggregate supplier.
3. Water: Potable. Clean, clear, and free from deleterious amounts of salts, acids, alkalies, organic materials, oils, detergents, or other matter that may interfere with color, curing, or strength of concrete.
4. Admixtures: Select to be compatible in specified mix.
 - a) Air Entraining: ASTM C260.
 - b) Water Reducing: ASTM C494, Type A,B,C,F, or G.
 - c) Silica Fume: ASTM C1240, for cement replacement for high performance concrete.
 - d) Coloring Agent: ASTM C979, compatible with other concrete materials.
 - e) Other constituents: Integral water repellents and other chemicals for which no ASTM standard exists, shall be previously established as suitable for use in concrete or shall be shown by test or experience not to be detrimental to the concrete.

B. Formwork:

1. Provide forms with acceptable form facing materials that are non-reactive with concrete or form release agents and will produce required finish surfaces.
2. Construct and maintain forms to produce precast concrete units of shapes, lines, and dimensions indicated, within specified tolerances.

C. Reinforcing Materials:

1. Reinforcing Bars: ASTM A615, Grade 40 or 60, unless otherwise required to meet structural requirements. Use galvanized reinforcing bars; ASTM A767, hot-dip galvanized where concrete cover is less than 1-1/2 inches. Epoxy coated reinforcing bars, ASTM A934, may be used in special applications; timely availability may be a problem).
2. Steel Welded Wire Fabric: ASTM A185, plain, cold drawn.
3. Pre-Stressing Tendons: ASTM A416, Grade 250 or 270, un-coated, 7 wire, low relaxation strand.

D. Grout Materials:

1. Cement Grout: Cement ASTM C150; sand ASTM C 404; proportions 1:2.5 by volume, minimum water for placement and hydration.
2. Non-Shrink Grout: ASTM C1107.
3. Epoxy Grout: Consult Suppliers.

2.3 MIXES

- A. Design mixes for each type of concrete specified may be prepared by an independent testing agency or by architectural precast manufacturing plant personnel at precast fabricator's option.
- B. Proportion mixes by either testing agency trial batch or field test data methods in accordance with ACI 211.1, using materials to be used on the project, to provide normal weight concrete with properties as follows:
 1. Compressive Strength: 5,000 psi when tested in accordance with ASTM C39.
 2. Maximum water cement ratio 0.40 at point of placement.
 3. Add air-entrainment admixture to result in air content at point of placement complying with ACI 533.1R requirements.
 4. List other admixtures and recommended quantities.
 5. Water absorption maximum 6% (by weight) when tested in accordance with ASTM C642.

2.4 FABRICATION

A. General:

1. Fabricate precast concrete units with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances as specified in ACI 533.1R, unless more stringent requirements are shown or specified.
2. Fabricate units straight, smooth and true to size and shape, with exposed edges and corners precise and square, unless otherwise indicated.

B. Cast openings larger than 3 inches in any dimension according to locations shown on Shop Drawings. Smaller holes may be field cut when approved by the COTR.

C. Reinforcement: Comply with CRSI "Manual of Standard Practice" and ACI 318 recommendations. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses, and to comply with specified performance criteria.

D. Cast-in Items: Provide embedded anchors, inserts, steel shapes, and lifting devices as shown on reviewed Shop Drawings. Firmly hold cast items in place by jigs, strongbacks, or other approved means.

E. Comply with ACI 533.1R requirements for measuring, mixing, transporting, and placing concrete. Place facing mix to a thickness of the greater of 1 inch or 1.5 times the maximum aggregate size. Place back-up concrete to ensure bond with face concrete.

F. Consolidate concrete using equipment and procedures complying with ACI 533.1R.

G. Permanently mark units with pick-up points as shown on reviewed Shop Drawings. Imprint casting date and piece mark on a surface to be concealed from view in the finished structure.

H. Cure concrete in accordance with ACI 533.1R requirements.

I. Discard units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by the the COTR and meet specified requirements. Refer to ACI 533.1R for product finish requirements unless otherwise shown or specified.

J. Fabrication Tolerances: Fabricate to tolerances listed in ACI 533.1R, or to tolerances required to meet the finish standards described herein and/or approved during submittal review and approval, whichever produces the higher quality product.

2.5 FINISHES

A. Finish exposed surfaces or units to match approved design reference sample and as follows:

1. Smooth surface finish free from pockets, sand streaks, honeycomb, with uniform color and texture. Bugholes are not acceptable.

- B. Finish unexposed surfaces of units by float finish or as-cast form finish.

2.6 SOURCE QUALITY CONTROL

- A. Inspect and test architectural precast concrete in accordance with ACI 533.1R.
- B. Defective Work: Discard units that do not conform to requirements as shown or specified. Replace with units that meet requirements. Units shall be inspected for compliance with the accepted standards, as agreed to through the submittal process, and shall be rejected as defective and removed from shipment to the site at the manufacturer's facility.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation, tolerances, true and level bearing surfaces, and other conditions affecting performance of architectural precast concrete units. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Do not install units until supporting structure has been completed (has attained minimum allowable design compressive strength).

3.2 ERECTION

- A. Erection shall be by persons experienced and trained in placement and securing of architectural precast concrete units.
- B. Erect level, plumb, and true to line. Do not allow cumulative dimensional errors to develop. Adjustments such as shimming, which would place additional stress on units, will not be permitted. Adhere to dimensional tolerances in accordance with ACI recommendations. Erect and secure in a manner to prevent damage to unit or units in place. Replace any damaged units.
- C. Lift and handle precast using lift points and embeds as shown on precast shop drawings.
- D. Erection Tolerances:
 - 1. Erect within tolerances listed in ACI 533.1R.
 - 2. Erect to conform with structure tolerances listed in ACI 533.1R.
 - 3. Where two stage joint seal is required, sequence with sealant applicator to ensure that sealant, gaskets, and similar items required for interior side seal are installed concurrently with installation of precast units.
- E. Joint Sealants: As specified in Section 07920 – Sealants.

3.3 REPAIR

- A. Repair exposed surfaces of units to match color, texture, and uniformity of surrounding units.
- B. Remove and replace damaged units when repairs do not meet requirements.

3.4 CLEANING

- A. Clean exposed surfaces of units after erection if soiled or stained.
 - 1. Wash and rinse according to architectural precast concrete fabricator's recommendations. Protect other work from damage while cleaning.
 - 2. Do not use cleaning materials or methods that change the appearance of architectural precast concrete finishes. Test clean a small area to verify adequacy and safety of materials and methods.

3.5 PROTECTION

- A. Protect finished surfaces from soiling or damage.

--- END OF SECTION ---

SECTION 03 48 46
PRECAST CONCRETE DOUBLE-DEPTH LAWN CRYPTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this Section includes fabrication, handling, delivery to the site, storage and installation of precast concrete burial crypts; hereafter referred to as units or crypts, subbase foundation and drainage, placement of the units, backfilling, grading, fine grading and turf establishment, and other, all as shown on the plans or specified herein. In addition contractor to provide:
1. Three (3) crypt lid lifting apparatus.
 2. Four (4) extra concrete crypt lids.
 3. A device to retrieve and lower the inside shelf without Owner entering the crypt.
- B. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the plans. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter. All designs will require that the manufacturer provide fabrication drawings stamped by a Professional Engineer, licensed in the State of Arkansas, indicating that the design meets or exceeds the structural requirements contained herein. The Contractor may propose alternative designs of the corresponding components if all the following requirements are met.
1. Any proposed alternative design shall comply with the design criteria and the functional tests of this specification.
 2. All provisions of this specification shall apply to any proposed alternative design.
 3. The Government may accept or reject part or all of any proposed alternative design.

The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.2 RELATED WORK

- A. Section 31 20 00, EARTH MOVING
- B. Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Section 33 46 13, FOUNDATION DRAINAGE

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: With submittal of bid documents, Contractor shall submit documentation regarding the manufacture of the units. Contractor shall provide evidence that manufacturer has a minimum of three years experience with pre-casting

units of similar type, and provide evidence that the manufacturer plant(s) used are certified by the National Precast Concrete Association (NPCA).

- B. Precast concrete manufacturer shall provide a licensed Structural Engineer, licensed in the State of Arkansas, to certify that the units conform to specified requirements.
- C. Erector Qualifications: Regularly engaged for at least three years in erection of pre-cast concrete similar to this project.
- D. Fabricate crypts to the interior dimensions described below. Replace or repair units that do not comply with the individual dimensions and tolerances.
- E. Before starting full scale production of units, furnish at the site, two perimeter crypt units and a single interior crypt unit to demonstrate quality of construction of completed units and in-field load testing. Commence production of units only after submittal and field load testing approval has been obtained.
- F. Design Criteria (Double Depth Crypt):
 - 1. The units shall be of the following type, style, and size:
 - a. Type: Precast concrete.
 - b. Style: One-piece box with separate outer lid, and a removable one-piece inside shelf.
 - c. Crypt interior size: Interior minimum dimensions are as follows: 30" minimum width at the inside bottom floor and for the full height of the crypt; 86" minimum length along the inside bottom floor and for the full height of the crypt; 25" minimum clear height from the highest part of the inside shelf to the underside of the lid and; 25" minimum clear height from the lowest part of the inside shelf to the top of the casket risers and; 3/4" minimum height casket risers from the crypt floor spaced 20" from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.
 - d. Crypt height and wall thickness: Exterior maximum height dimension: 60" including the lid. Crypt wall thickness: 2-inches plus or minus 1/2 inch. Perimeter crypts may exceed wall thickness dimension.
 - e. Layout: Crypts shall fit in a 3-foot by 8-foot plot or a lesser plot size as noted on the plans. The lesser plot size shall govern. If the contractor's layout or crypt size dimensions differ, the Contractor at no cost to the Owner shall submit a Layout/Size Plan for approval by the Resident Engineer.

2. Units shall be designed for a burial depth with soil cover as indicated on the plans, and be capable of structurally withstanding passage of a wheel axle load of 12,000 lbs after burial, and a center point load of 6,000 lbs.
3. The Contractor shall submit to the Resident Engineer for approval five sets of design documentation showing structural design of the units. Contractor to provide one set to NCA Crypt Specialist. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.
4. The concrete lid shall be designed to be removable and replaceable. Lid lifting shall be from top positioned galvanized anchors (4-required per lid) with a removable anchor covers to prevent dirt from entering the anchor bowl as specified in Sec 2.2 and installed in such a manner as not to be hit by excavating equipment when scraping backfill off the top of the lid. The Contractor shall furnish the cemetery with three (3) OSHA approved lifting devices for removing the lid. Inside shelf will be one piece rigid construction, fully conceal the lower casket with a rigid barrier, weigh 40 lbs. or less, allow for easy casket lowering belt removal, and capable of holding 400 lbs indefinitely. The entire inside shelf should be rigid, non-brittle and non-deteriorating. Provide a tool that Owner can easily retrieve and install the shelf from ground level without entering the crypt.
5. Through the use of spaced concrete chairs or other means, the design of casket risers shall allow the casket to rest above the inside bottom of the crypt and above the top of the inside shelf in order that the casket lowering straps can be removed without pinching from around the casket.
6. There shall be two 1" diameter drain holes in the bottom at opposite ends of each crypt to allow for drainage.
7. The crypt lifting wire/cable shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire/cable once crypt has been installed.

G. Design Criteria (Quad Crypt):

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

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

1. Unconfined Loading: A single interior unit will be placed on a flat surface above ground with no support against any side or end. The center point of the top lid will be subjected to a simulated uniform load of 6,000 lbs. over a one square foot area. The load will be maintained for 24 hours. At end of the loading period, the maximum deflection in the lid shall be no more than 1/4". Upon removal of the load from the lid the residual deflection shall be no more than 1/8".
2. Confined Loading: An interior unit between two perimeter units shall be placed in a hole dug in the ground on site and covered with 24 inches of soil or covered to the maximum depth as shown on the plans, which ever is greater. The soil will be compacted to 95% density at optimum moisture content along the sides and over the lid. An axle load of 12,000 lbs. will then be passed over the covered crypts for a minimum of 20 times in repetition, in a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts. The crypts shall then be fully excavated, exposed and the lid removed to allow careful examination inside and outside. The crypts must not show any signs of stress or cracking.
3. Concurrent with Confined Loading, the inside shelve of the interior crypt shall be loaded with 400 lbs. Upon uncovering and load removal, the shelf shall be removed and must not show any signs of stress, cracking or deflection.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, within 45 days of the approval of the shop drawings, Contractor shall furnish the following:
 1. Samples: deliver to the site for testing and inspection:
 - a. Two perimeter crypts and one interior crypt.
- B. Shop Drawings:
 1. Erection Narrative:
 - a. Method of transportation.
 - b. Method of handling and placement.
 2. Production Drawings:

- a. Elevation view of each unit.
- b. Plan view of unit.
- c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.
- d. Section, details and location of specialty lid lifting anchors, caps, and lid lifting system.
- e. Dimensions and finishes.

C. Product Design Data:

- 1. Self Consolidated Concrete mix design calculations of units, performed by a licensed Structural Engineer.
- 2. Loadings for Design Calculations:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads specified.
 - c. Other loads specified for units as applicable.
 - d. Deflection of precast members.
 - e. Product test reports:
 - 1). The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the Resident Engineer immediately after the strength tests have been completed. The tests shall be as specified herein.
 - 2). The Resident Engineer may request more frequent testing to ensure quality of the product.
- 3. Manufacturer's Literature and Data:
 - a. Each type of anchorage, angle, and fastener.

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

B. ASTM International (ASTM):

A36..... Standard Specification for Carbon Structural Steel

A82.....	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
A153.....	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A615/A615M.....	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
C33	Standard Specification for Concrete Aggregates
C150	Standard Specification for Portland Cement
C494/C494M	Standard Specification for Chemical Admixtures for Concrete
C1116.....	Standard Specification for Fiber-Reinforced Concrete and Shotcrete
C995	Standard Test Method for Time of Flow of Fiber-Reinforced Concrete Through Inverted Slump Cone
D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft ³ (600 kN m/m ³))

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. The Contractor shall provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Contractor is responsible for transportation, storage and handling of units such that any negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting cable to transport crypts. On the job site, forklift handling of crypts may be approved by the VA upon demonstration that no crypt damage will be incurred.
- B. Storage:
 1. Units may be stored at designated locations(s) on site.
- C. Markings and Identifications:
 1. Markings, including logos, trademarks and proprietary information are prohibited on surfaces of crypts.
 2. Date of manufacture (month, day, year) shall be written on the box and lid with permanent ink or an equivalent marking.

1.7 COORDINATION

- A. The Contractor shall be responsible for coordinating the work for furnishing and installing the crypts with the manufacturer and installer to insure that delivery, storage and installation of the units progress without unplanned delays or interference with other work.

1.8 GUARANTEE

- A. After erection, completed work will be subject to terms of Article, GUARANTEE in Section 01001, GENERAL CONDITIONS, except guarantee period is extended to five years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The following materials are listed to establish minimums to be utilized by the crypt manufacturer and design engineer in establishing materials and their proportions needed to create approved precast concrete burial crypts (units) that meet or exceed the dimensional and/or performance requirements indicated in this specification.
- B. Precast Concrete: All crypts including lids shall be of concrete with a minimum 28 days compressive strength of 5,000 psi, be Self Consolidated Concrete (SCC) containing structural fiber with an inverted slump between 22" and 28" and meet the following requirements:
 - 1. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
 - 2. Normalweight Aggregates: ASTM C 33
 - 3. Water: ASTM C1602
 - 4. Chemical Admixtures:
 - a. Water reducers, accelerating and retarding: ASTM C 494
 - b. Air Entraining: ASTM C260
 - c. Admixtures for flowing concrete: ASTM C1017
 - d. Admixtures with no standard designation shall be used only with approval of VA.
 - 5. Prohibited Admixtures: Calcium Chloride thycyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Reinforcement:
 - 1. Welded Steel Wire Fabric: ASTM A185.
 - 2. Steel Wire Reinforcement: ASTM A82, cold drawn.

3. Steel Reinforcement: ASTM A615 Grade 60, deformed.
4. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A36, zinc coated ASTM A153 hot-dipped galvanized finish G90.
5. Fiber: Macrofiber complying with ASTM C1116

C. Form Coatings:

1. Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.

2.2 FABRICATION

A. General:

1. Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.

B. Finishes:

1. Surface holes (1/4 " and smaller) caused by air bubbles, normal color variations, normal form joint marks, small chips (1/4" and smaller) and spalling (no more than one square foot total per unit) are permitted.
2. Exposed steel reinforcing, honeycomb, bugholes, and thruwall cracks are not permitted.
3. The lid lifting system shall be top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 2-1/2" diameter minimum recessed bowl of depth sufficient to easily connect lifting device as designated compatible by anchor manufacturer. Anchors to be installed at locations to ensure maximum lid lifting stability. A removable plastic cap secured to the anchor will prevent fill material from entering the anchor bowl. Cap to be flush mounted to ensure the entire assembly is not an obstruction for crypt excavating equipment.
4. Concrete shall have no evidence of segregation of materials.

C. Reinforcement:

1. Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads.
2. Reinforcing steel shall be free of dirt, mill scale, rust, oil grease, ice, snow, water and placed within approved tolerances in accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.

D. Concrete Placement:

1. Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
2. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.

E. Curing:

1. 95 percent of specified concrete compressive strength shall be attained before transportation of units to the cemetery or storage site.
2. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally.
3. Units shall be properly cured in accordance with the applicable provisions of the current ACI Manual of Concrete Practice.

F. Surface Treatment and Corrective Work:

1. Units that have minor chipping of edges and corners shall be repaired by a method approved by the Resident Engineer.
2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.

2.3 ALLOWABLE TOLERANCES FOR FABRICATION

A. Tolerances of individual units shall be as follows:

1. Variation in overall crypt outside dimensions of unit (height, length and width): 1/8" plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.
2. Variation in thickness of precast panels and elements: 1/16" plus or minus.
3. Maximum height differential in final placement in the ground: 1/4" above or below design grade.
4. Cracks greater than 1/32th inch in width may be cause for crypt rejection or repair at the discretion of the Resident Engineer at no cost to VA. Any cracking that extends completely thru wall or lid will be rejected and the crypt replaced at no cost to VA.

2.4 TESTING AND INSPECTION

- A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including the removal and replacement of the lids for inspection of the interior by the COTR. The Contractor shall inspect each unit before it is unloaded from the truck to insure compliance with the provisions of these specifications. The COTR reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements

PART 3 - EXECUTION

3.1 CRYPT FIELD QUALITY ASSURANCE

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

3.2 GENERAL LAYOUT CONTROL

- A. A professional land surveyor or civil engineer licensed in the State of Arkansas as specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish and control horizontal and vertical alignment of units.

3.3 PREPARATION

- A. Before beginning installation, inspect work of other trades insofar as it affects the work of this Section. Commencing installation of units will be construed as accepting as suitable the work of other trades.

- B. Verify by survey, grading of subgrade and aggregate base for proper installation of units.
- C. Verify by testing, compaction of prepared subbase material.
- D. Verify by survey locations and elevations of units relative to control points indicated on the contract drawings. Submit new control point layout if a crypt size other than that shown is submitted and approved for use.

3.3 HANDLING AND INSTALLATION

A. Handling:

- 1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. On the job site, use the designed lifting cable to transport crypts from the truck to storage to the final installation.
- 2. Lift units with suitable lifting devices at points provided by manufacturer.
- 3. Provide temporary wood bracing to comply with manufacturer's recommendations to keep crypt bottom off ground during storage.

B. Installation:

- 1. Install units by competent erector crews trained and certified as competent by manufacturer.
- 2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids that show damage from bouncing during transport shall be replaced by the contractor at no cost to the Owner.
- 3. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.
- 4. After crypts installation and prior to backfill, the contractor shall remove lids with the specified lifting apparatus for crypt inspection by the Resident Engineer and numbering. Numbers furnished by NCA shall be painted by the contractor on the outside of the crypt lids and on the upper inside crypt wall, both at the headstone end. Numbers shall be permanent paint twelve inches high. After completion of inspection and marking, the Contractor shall replace the lids. Any damage to lids or crypts will be the responsibility of the contractor. Prior to lid replacement on all "perimeter" crypts, the contractor shall notify and allow for inspection by the NCA Crypt Specialist.

- 5. Place crypts on minimum 6 inch depth of compacted crushed aggregate size $\frac{3}{4}$

inches to Number 4 or as designated on the plans. Protect aggregate from disturbance from equipment.

3.4 ALLOWABLE TOLERANCES FOR UNIT INSTALLATION

- A. Maximum height differential between adjacent units in final placement in the ground: 1/4 inch above or below the adjacent unit. If units are to be installed stepped then only two sides must meet this requirement.
- B. Position within the gravesite plot area: Crypts shall be centered within the imaginary (3-foot by 7-foot 7-inch) gravesite plot lines to minimize the space between crypts. The maximum deviation from the center of the gravesite plot shall be 1/2 inch in any direction. Position of adjoining crypts within plot areas shall not vary beyond the amount that will allow free removal of crypt lids with provided lid lifting device.

3.5 PROTECTION OF WORK

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

3.6 REPLACEMENT AND REPAIR

- A. Remove and replace units that the COTR has determined are damaged, cracked, broken, improperly fabricated, or otherwise, do not meet specifications.
- B. Units having minor defects not affecting serviceability or appearance may be repaired when approved by the COTR.
- C. Repair work shall be sound, permanent, and flush with adjacent surfaces.

3.7 BACKFILLING AND MATERIAL STORAGE

- A. Protect installed crypt units during backfill operations.
- B. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall contain no material that will cause a concentrated point load. The perimeter wall backfill shall be compacted to 95% density to the level equal to the top of the crypts.
- C. Install an approved fine fill material (sand or pea gravel) into gaps between crypts leaving no voids. Use rod or water to assure no bridging occurs and void areas are eliminated.
- D. Install backfill on top of units and compact. Backfill on top of units working from bottom up consists of 2 inches of sand, soil to specified level, and 4 inches of topsoil as the final layer. The entire backfill atop the units shall be compacted to 85% density.
- E. No equipment over the crypts should exceed crypt design loads as specified herein

(12,000lbs axle), which includes compacting equipment. No vibratory compaction equipment over the crypts unless impact loads are shown not to exceed crypt design loads.

- F. Finish grading and prepare topsoil as indicated on plans.
- G. The contractor shall not store or stockpile any stone, sand, backfill or any other material or loaded equipment within ten (10) yards of installed crypts. All costs to inspect affected crypts for possible damages will be at contractor's expense.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance will be by the COTR.

- - - E N D - - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
1. Concrete masonry units (CMUs).
 2. Split face concrete masonry units.
 3. Face brick.
 4. Mortar and grout.
 5. Reinforcing steel.
 6. Masonry joint reinforcement.
 7. Ties and anchors.
 8. Embedded flashing.
 9. Miscellaneous masonry accessories.
 10. Cavity-wall insulation.
- B. Related Sections include the following:
1. Division 7 Section "Bituminous Dampproofing" for dampproofing applied to cavity face of backup wythes of cavity walls.
 2. Division 7 Section "Flashing and Sheet Metal" for sheet metal flashing.
 3. Division 7 Section "Sealants and Caulking" for sealing control and expansion joints in unit masonry.
 4. Division 7 Section "Thermal Insulation" for additional cavity-wall insulation requirements.
- C. Products furnished, but not installed, under this Section include the following:
1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5 Section "Structural Steel."
- D. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 7 Section "Flashing and Sheet Metal."

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.
- B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- C. Determine net-area compressive strength (f'_m) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection: For the following:
1. Decorative concrete masonry units, in the form of small-scale units.
 2. Face brick, in the form of straps of five or more bricks.
 3. Colored mortar.
 4. Weep holes/vents.
- D. Qualification Data: For testing agency.
- E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.

- b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
- 2. Cementitious materials. Include brand, type, and name of manufacturer.
- 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
- 4. Grout mixes. Include description of type and proportions of ingredients.
- 5. Reinforcing bars.
- 6. Joint reinforcement.
- 7. Anchors, ties, and metal accessories.
- F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.

2. Weight Classification: Normal weight unless otherwise indicated.
 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- C. Split Face Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 2. Weight Classification: Normal weight.
 3. Size (Width): Manufactured to dimensions specified in "Concrete Masonry Units" Paragraph above.
 4. Pattern and Texture:
 - a. Standard pattern, split-face finish. Match Architect's samples.
 5. Colors: As selected by Architect from manufacturer's full range.
 6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.4 CONCRETE AND MASONRY LINTELS

- A. General: Provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.
- B. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated. Cure precast lintels by same method used for concrete masonry units.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 3 Section "Cast-in-Place Concrete."
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 BRICK

- A. General: Provide shapes indicated and as follows:
 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBA.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi. Consider retaining first subparagraph below; it eliminates the need to wet brick before laying. Before retaining, verify that brick selected complies with requirements. See Evaluations.
 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet or shall have a history of successful use in Project's area.
 5. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 6. Application: Use where brick is exposed, unless otherwise indicated.
 7. Color and Texture: As selected by Architect.
 8. Provide units with rough, combed, or scored faces.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Masonry Cement: ASTM C 91.

1. Available Products:

- a. Capital Materials Corporation; Flamingo Color Masonry Cement.
- b. Essroc, Italcementi Group; Brixment or Velvet.
- c. Holcim (US) Inc.; Mortamix Masonry Cement or Rainbow Mortamix Custom Buff Masonry Cement.
- d. Lafarge North America Inc.; Magnolia Masonry Cement; Lafarge Masonry Cement or Florida Super Masonry.
- e. Lehigh Cement Company; Lehigh Masonry Cement.
- f. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Cement: ASTM C 1329.

1. Available Products:

- a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

- a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
- b. Davis Colors; True Tone Mortar Colors.
- c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

G. Colored Cement Product: Packaged blend made from portland cement and lime, masonry cement, or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Pigments shall not exceed 5 percent of **[masonry cement]** **[or]** **[mortar cement]** by weight.
4. Available Products:
 - a. Colored Portland Cement-Lime Mix:

- 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
 - 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) Lafarge North America Inc.; Eaglebond.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
- b. Colored Masonry Cement:
- 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Essroc, Italcementi Group; Brixment-in-Color.
 - 3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 4) Lafarge North America Inc.; Florida Custom Color Masonry or Magnolia Masonry Cement.
 - 5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 6) National Cement Company, Inc.; Coosa Masonry Cement.
- c. Colored Mortar Cement:
- 1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.
- H. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- J. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- K. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- L. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
 - 4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 - 5. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches on center
 - 7. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
 - 1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 2 side rods at each wythe of masonry 4 inches or less in width.
 - 2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
 - 3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8- cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.
- E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- diameter, hot-dip galvanized, carbon steel continuous wire.

2.8 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
 - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
 - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
 - 3. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 4. Stainless Steel bars: ASTM A 276 or ASTM a 666, Type 304.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
 - 2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 - 3. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire. Retain first paragraph and subparagraphs below if applicable to Project. Indicate details on Drawings.
- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, **hot**-dip galvanized steel wire. Delete first option in subparagraph below if triangular wire ties are used for connecting to concrete. If retaining last option, note that the 2002 MSJC Code does not allow ties made from mill-galvanized wire for interior use in spaces where humidity exceeds 75 percent.
 - 2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch- diameter, hot-dip galvanized steel

wire. If selecting either of last two options in subparagraph below, note that the 2002 MSJC Code does not allow ties made from galvanized steel sheet for interior use in spaces where humidity exceeds 75 percent.

2.9 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- B. Postinstalled Anchors: Provide chemical or torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
 - 2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4) for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.10 EMBEDDED FLASHING MATERIALS

- A. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.
 - a. Available Products:
 - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
 - 2) Firestone Building Products; FlashGuard.
 - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
- B. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use one of the following, unless otherwise indicated:
 - 1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity between wythes. Use only for weeps.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Provide one of the following configurations:
 - a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
 - b. Strips, not less than 1-1/2 inches thick and 10 inches (wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
 - c. Sheets or strips full depth of cavity and installed to full height of cavity.
 - d. Sheets or strips not less than 1 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from being clogged with mortar.
 - 2. Available Products:
 - a. Advanced Building Products Inc.; Mortar Break or Mortar Break II.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.

2.12 CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV or X, closed-cell product extruded with an integral skin.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.13 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.14 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.
 - 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

- D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M or S.
 2. For reinforced masonry, use Type S or N.
 3. For mortar parge coats, use Type S or N.
 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- E. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 3. Mix to match Architect's sample.
- F. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Architect's sample.
- G. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
- H. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches on center, unless otherwise indicated.
 - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 square feet of wall area spaced not to exceed 16 inches on center horizontally and 16 inches on center vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches on center vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
 - 3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 8 inches clear horizontally and 16 inches clear vertically.
 - 4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

- D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.
- E. Coat cavity face of backup wythe to comply with Division 7 Section "Bituminous Dampproofing."
- F. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches on center both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches on center
 - 2. Space reinforcement not more than 8 inches on center in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches on center vertically and 36 inches on center horizontally.

3.8 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:
 1. Fasten anchors through sheathing to wall framing and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 3. Embed tie sections and connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 5. Space anchors as indicated, but not more than 18 inches on center vertically and 24 inches on center horizontally, with not less than 1 anchor for each 2 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
 6. Space anchors as indicated, but not more than 16 inches on center vertically and 24 inches on center horizontally with not less than 1 anchor for each 2.67 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick made from clay or shale as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 3. Build in compressible joint fillers where indicated.
 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch. Revise subparagraph below to suit Project. Show locations of joints on Drawings. See BIA and NCMA references.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
4. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
5. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
7. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 3. Space weep holes 24 inches on center, unless otherwise indicated.
 4. Space weep holes formed from plastic tubing or wicking material 16 inches on center
 5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
 6. Trim wicking material flush with outside face of wall after mortar has set.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches

3.13 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
1. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: One set of tests for each 5000 square feet of wall area or portion thereof.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- H. Prism Test: For each type of construction provided, per ASTM C 1314 at 28 days.

3.14 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

- - -END- - -

SECTION 04 43 00 STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for construction of stone masonry for the following work:
 - 1. Stone masonry veneer for exterior stone walls and columns.

1.2 RELATED WORK

- A. Reinforced Concrete: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Submit four stone samples, minimum 3 inch by 4 inch in size, illustrating general color range and texture.

2. Submit mortar color samples.

C. Certification:

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

D. Manufacturer's Literature and Data:

1. Anchors.

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. ASTM International:

C91 Standard Specification for Masonry Cement

C270 Standard Specification for Mortar for Unit Masonry

- C. Masonry Standards Joint Committee: Specification for Masonry Structures (ACI 530.1-08/ASCE 6-08/TMS 602-08) (MSJC).

PART 2 - PRODUCTS

2.1 STONE

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

2.2 ANCHORS AND TIES

- A. Anchors and ties shall conform to one of the following specifications (subsection B or C).
Use only one type throughout the project.

B. Adjustable Veneer Anchors and Ties(for attachment to concrete after concrete is poured and cured):

1. Provide anchor straps and ties as specified in following paragraphs.
 - a. Anchor Strap: Screw-on hot-dip galvanized steel or stainless steel anchor strap 3/4 inch wide by 5 inches long by 12 gage (2.7 mm) thick, with 1/4 inch offset (clearance) and hole at each end for fasteners. Dur-O-Wal DA207 MSSA Veneer Anchor Screw-on Straps, or approved equal.
 - b. Tie: Triangular wire tie 4 by 4 inches formed of 9 gage hot-dip galvanized steel or stainless steel wire. Tie to extend at least 3 inches into masonry. Dur-O-Wal DA700 Series Triangular Ties, or approved equal.
 - c. Fasteners: Tapcon® concrete screws, stainless steel.

C. Dovetail Anchors (for casting into concrete):

1. Dovetail triangular ties with 12 gage dovetail clip and 3/16 inch wire tie, 3 1/2 inch minimum length. Provide hot-dip galvanized steel or stainless steel clip and wire. Anchor length to extend at least 3 inches into masonry. Dur-O-Wal DA720 Series Dovetail Triangular Ties, or approved equal.
2. Provide dovetail anchor slots fabricated from 0.0239 inch thick (24 gage) minimum thickness galvanized steel with felt, fiber or foam filler. Dur-O-Wal DA100 Dovetail Anchor Slots, or approved equal.

2.3 MASONRY MORTAR

- A. Masonry mortar shall be masonry cement mortar consisting of cementitious material, aggregates and water conforming to the requirements of ASTM C270, Type S or M.
- B. Masonry cement shall conform to ASTM C 91, Type S or M.
- C. Admixtures:
 1. Do not use mortar admixtures, except for high bond mortar and color admixtures, unless approved by the 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.
- D. Colored Mortar:
 1. Maintain uniform mortar color for exposed work throughout.
 2. Match mortar color in approved mock-up.

E. Color Admixtures:

1. Proportion as specified by manufacturer.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Protection:

1. Cover tops of walls with nonstaining waterproof covering when work is not in progress. Secure to prevent wind blow-off.
2. On new work, protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.

B. Cold Weather Protection:

1. Masonry may be laid when air temperature is below 40 degrees F provided that methods of protection are utilized in compliance with the referenced MSJC publication and as approved by the COTR.

3.2 PREPARATION

- A. Reinforced concrete construction for stone walls and columns shall be completed and accepted by the COTR as specified in Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Lay out stones in roughly the configuration and pattern to be provided on the wall as specified in subsection 3.5.D. Pattern shall match existing stone wall and approved mock-up.
- C. Clean stones before setting. Do not use tools which will mark or damage exposed surfaces.

3.3 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in subsection 3.4, ANCHORAGE.
- C. Tooling Joints:
 1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
 2. Tool while mortar is soft enough to be compressed into joints and not raked out.
 3. Provide joints sizes and shape to match existing stone wall.
- D. Temporary Formwork: Provide formwork and shores as required for temporary support of stone masonry.

3.4 ANCHORAGE

- A. Conform to one of the following specifications (paragraph 1 or 2) for anchorage of stone masonry to concrete:
 - 1. Cast dovetail anchor slots into concrete in vertical orientation at required spacing.
Attach dovetail triangular ties to slots at required vertical spacing.
 - 2. Attach anchor screw-on straps to concrete after concrete is poured and cured using specified concrete screws. Attach triangular ties to anchor straps.
- B. Spacing of anchor and ties shall be installed to provide spacing of 16 inches on center vertically and 16 inches on center horizontally.

3.5 STONE MASONRY CONSTRUCTION

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

3.6 CONSTRUCTION TOLERANCES

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

3.7 CLEANING AND REPAIR

- A. General:
 - 1. Clean exposed masonry surfaces on completion.
 - 2. Protect adjoining construction materials and landscaping during cleaning operations.
 - 3. Cut out defective exposed new joints to required depth and repoint.
 - 4. Remove mortar droppings and other foreign substances from wall surfaces.
- B. Stone:
 - 1. First wet surfaces with clean water, then wash down with a solution of soapless detergent. Do not use muriatic acid.
 - 2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
 - 3. Wash surfaces with water to remove traces of detergent, foreign streaks, and stains.

- - - E N D - - -

SECTION 05 50 00 METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
 - 1. Support for Wall and Ceiling Mounted Items
 - 2. Frames
 - 3. Guards
 - 4. Covers and Frames for Pits and Trenches
 - 5. Gratings
 - 6. Loose Lintels
 - 7. Shelf Angles

1.2 RELATED WORK

- A. Prime and finish painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - Grating, each type
- C. 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.
- D. Manufacturer's Certificates:
 - 1. Anodized finish as specified.
 - 2. Live load designs as specified.
- E. Design Calculations for specified live loads including dead loads.

- F. 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(R97)..... Wood Screws
- B18.2.2-87(R93)..... Square and Hex Nuts
- C. ASTM International (ASTM):
- A36/A36M Standard Specification for Carbon Structural Steel
- A47 Standard Specification for Ferritic Malleable Iron Castings
- A48..... Standard Specification for Gray Iron Castings
- A53..... Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A123..... Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- A269..... Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

- A653..... Standard Specification for Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process
- A786/A786M..... Standard Specification for Hot-Rolled Carbon, Low-Alloy,
High-Strength Low-Alloy, and Alloy Steel Floor Plates
- B221..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire,
Shapes, and Tubes
- B632..... Standard Specification for Aluminum-Alloy Rolled Tread
Plate
- C1107-02 Standard Specification for Packaged Dry, Hydraulic-
Cement Grout (Nonshrink)
- D3656-04 Standard Specification for Insect Screening and Louver
Cloth Woven from Vinyl-Coated Glass Yarns
- F436-03..... Standard Specification for Hardened Steel Washers
- F468-03..... Standard Specification for Nonferrous Bolts, Hex Cap
Screws, and Studs for General Use
- F593-02..... Standard Specification for Stainless Steel Bolts, Hex Cap
Screws, and Studs
- F1667-03..... Standard Specification for 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)
 - 12 – 1985 Pipe Railing Manual
 - AMP 500-505-1988 Metal Finishes Manual
 - MBG 531-00..... Metal Bar Grating Manual
 - MBG 532-88..... Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC):
 - SP 1-82 No. 1, Solvent Cleaning
 - SP 2-82 No. 2, Hand Tool Cleaning
 - SP 3-82 No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):

RR-T-650E Treads, Metallic and Nonmetallic, Nonskid

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
- B. Ladders and Rungs: 250 pounds at any point.
- C. Railings and Handrails: 200 pounds in any direction at any point.
- D. Manhole Covers: 250 pounds per square foot.

2.2 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. Floor Plate:
 - 1. Steel ASTM A786.
 - 2. Aluminum: ASTM B632.
- E. Steel Pipe: ASTM A53.
 - 1. Galvanized for exterior locations.
 - 2. Type S, Grade A unless specified otherwise.
 - 3. NPS (inside diameter) as shown.
- F. Cast-Iron: ASTM A48, Class 30, commercial pattern.
- G. Malleable Iron Castings: A47.
- H. Primer Paint: As specified in Section 09 91 00, PAINTING.
- I. Stainless Steel Tubing: ASTM A269, type 302 or 304.
- J. Modular Channel Units:
 - 1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
 - 2. Form channel with in turned pyramid shaped clamping ridges on each side.
 - 3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.

4. Factory finish channels and parts with oven baked primer when exposed to view.
Channels fabricated of ASTM A653, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.0125 inch thick stainless steel.

K. Grout: ASTM C1107, pourable type.

L. Insect Screening: ASTM D3656.

2.3 HARDWARE

A. Rough Hardware:

1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

B. Fasteners:

1. Bolts with Nuts:
 - a. ASME B18.2.2.
 - b. ASTM A307 for 60,000 psi tensile strength bolts.
 - c. ASTM F468 for nonferrous bolts.
 - d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.4 FABRICATION GENERAL

A. Material

1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:

1. Size and thickness of members as shown.

2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections

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

D. Fasteners and Anchors

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

E. Workmanship

1. General:
 - a. Fabricate items to design shown.

- b. Furnish members in longest lengths commercially available within the limits shown and specified.
 - c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
 - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
 - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
 - f. Prepare members for the installation and fitting of hardware.
 - g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
 - h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
2. Welding:
- a. Weld in accordance with AWS.
 - b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
 - c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
 - d. Finish welded joints to match finish of adjacent surface.
3. Joining:
- a. Miter or butt members at corners.
 - b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Anchors:
- a. Where metal fabrications are shown to be preset in concrete, weld 1-1/4 by 1/8 inch steel strap anchors, 6 inches long with one inch hooked end, to back of member at 2 feet on center, unless otherwise shown.
 - b. Where metal fabrications are shown to be built into masonry use 1-1/4 by 1/8 inch steel strap anchors, 10 inches long with 2 inch hooked end, welded to back of member at 2 feet on center, unless otherwise shown.
5. Cutting and Fitting:

- a. Accurately cut, machine and fit joints, corners, copes, and miters.
- b. Fit removable members to be easily removed.
- c. Design and construct field connections in the most practical place for appearance and ease of installation.
- d. Fit pieces together as required.
- e. Fabricate connections for ease of assembly and disassembly without use of special tools.
- f. Joints firm when assembled.
- g. Conceal joining, fitting and welding on exposed work as far as practical.
- h. Do not show rivets and screws prominently on the exposed face.
- i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:

- 1. Finish exposed surfaces in accordance with NAAMM 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) Items not specified to have other coatings.
 - b) Galvanized surfaces specified to have prime paint.

- c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
- d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
- e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.

2) Non ferrous metals: Comply with MAAMM-500 series.

4. Stainless Steel: NAAMM AMP-504 Finish No. 4.

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.

2.5 SUPPORTS

A. General:

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

2.6 FRAMES

A. Channel Door Frames:

- 1. Fabricate of structural steel channels of size shown.
- 2. Miter and weld frames at corners.
- 3. Where anchored to masonry or embedded in concrete, weld to back of frame at each jamb, 3/16 inch thick by 1-3/4 inch wide steel strap anchors with ends turned 2 inches, and of sufficient length to extend at least 12 inches into wall. Space anchors 24 inches above bottom of frame and 24 inches o.c. to top of jamb. Weld clip angles to bottom of jambs and provide holes for expansion bolts.
- 4. Where anchored to concrete or masonry in prepared openings, drill holes at jambs for anchoring with expansion bolts. Weld clip angles to bottom of frame and provide holes for expansion bolt anchors as shown. Drill holes starting 24 inches above

bottom of frame and 24 inches o.c. to top of jamb and at top of jamb. Provide pipe spacers at holes welded to channel.

5. Where closure plates are shown, continuously weld them to the channel flanges.
6. Weld continuous 3/4 x 3/4 x 1/8 inch thick steel angles to the interior side of each channel leg at the head and jambs to form a caulking groove.
7. Prepare frame for installation of hardware as indicated on the Drawings.
 - a. Cut a slot in the lock jamb to receive the lock bolt.
 - b. Where shown use continuous solid steel bar stops at perimeter of frame, weld or secure with countersunk machine screws at not more than 18 inches on center.

2.7 COVERS AND FRAMES FOR PITS AND TRENCHES

- A. Fabricate covers to support live loads specified.
- B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating.
- C. Steel Covers:
 1. Use 1/4 inch thick floor plate for covers unless otherwise shown. Use gratings where shown as specified in paragraph GRATINGS. Use smooth floor plate unless noted otherwise.
 2. Provide clearance at all sides to permit easy removal of covers.
 3. Make cutouts within 1/4 inch of penetration for passage of pipes and ducts.
 4. Drill covers for flat head countersunk screws.
 5. Make cover sections not to exceed 25 square feet in area and 200 pounds in weight.
 6. Fabricate trench cover sections not be over 3 feet long and if width of trench is more than 3 feet or over, equip one end of each section with an angle or "T" bar stiffener to support adjoining plate.
 7. Use two, 1/2 inch diameter steel bar flush drop handles for each cover section.
- D. Steel Frames:
 1. Form frame from structural steel angles as shown. Where not shown use 2-1/2 x 2-1/2 x 1/4 inch angles for frame openings over 4 feet long and 2 x 2 x 1/4 inch for frame openings less than 4 feet.
 2. Fabricate intermediate supporting members from steel "T's" or angles; located to support cover section edges.
 3. Where covers are required use steel border bars at frames so that top of cover will be flush with frame and finish floor.

4. Weld steel strap anchors to frame. Space straps not over 24 inches o.c., not shown otherwise between end anchors. Use 1/4 x 1 x 8 inches with 2 inch bent ends strap anchors unless shown otherwise.
5. Drill and tap frames for screw anchors where plate covers occur.

2.8 GRATINGS

A. Cast Iron Gratings:

1. Fabricate gratings to support a live load of 500 pounds per square foot.
2. Fabricate gratings and frames for gutter type drains from cast-iron conforming to ASTM A48.
3. Fabricate gratings in section not longer than 4 feet or over 200 pounds and fit so as to be readily removable.

2.9 LOOSE LINTELS

- A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.
- B. Fabricate lintels with not less than 6 inch bearing at each end for nonbearing masonry walls, and 8 inch bearing at each end for bearing walls.
- C. Provide one angle lintel for each 4 inches of masonry thickness as follows except as otherwise specified or shown.
 1. Openings 2-1/2 feet to 6 feet - 4 x 3-1/2 x 5/16 inch.
 2. Openings 6 feet to 10 feet - 6 x 3-1/2 x 3/8 inch.
- D. For 6 inch thick masonry openings 2-1/2 feet to 10 feet use one angle 6 x 3-1/2 x 3/8 inch.
- E. Provide bearing plates for lintels where shown.
- F. Weld or bolt upstanding legs of double angle lintels together with 3/4 inch bolts spaced at 12 inches on centers.
- G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.
- H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.
- I. Elevator Entrance:
 1. Fabricate lintel from plate bent to channel shape, and provide a minimum of 4 inch bearing each end.

2. Cut away the front leg of the channel at each end to allow for concealment behind elevator hoistway entrance frame.

2.10 SHELF ANGLES

- A. Fabricate from steel angles of size shown.
- B. Fabricate angles with horizontal slotted holes for 3/4 inch bolts spaced at not over 3 feet on centers and within 12 inches of ends.
- C. Provide adjustable malleable iron inserts for embedded in concrete framing.

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.
- H. Secure escutcheon plate with set screw.

3.2 INSTALLATION OF SUPPORTS

- A. Anchorage to structure.
 1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.

2. Secure supports to concrete inserts by bolting or continuous welding as shown.
3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
4. Secure steel plate or hat channels to studs as detailed.

3.3 COVERS AND FRAMES FOR PITS AND TRENCHES

- A. Set frame and cover flush with finish floor.
- B. Secure plates to frame with flat head countersunk screws.
- C. Set gratings loose in drainage trenches or over pits unless shown anchored.

3.4 DOOR FRAMES

- A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.
- B. Level and plumb frame; brace in position required.
- C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.
- D. Set frames in formwork for frames cast into concrete.
- E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

3.5 OTHER FRAMES

- A. Set frame flush with surface unless shown otherwise.
- B. Anchor frames at ends and not over 18 inches on centers unless shown otherwise.
- C. Set in formwork before concrete is placed.

3.6 GRATINGS

- A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.
- B. Set frame in formwork before concrete is placed.
- C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.
- D. Secure removable supporting members in place with stainless steel bolts.
- E. Bolt gratings to supports.

3.7 STEEL LINTELS

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding, except for openings in 6 inch masonry walls install lintels with longest leg horizontal.

- C. Install lintels to have not less than 6 inch bearing at each end for nonbearing walls, and 8 inch bearing at each end for bearing walls.

3.8 SHELF ANGLES

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

3.9 PLATE DOOR SILL

- A. Install after roofing base flashing and counter flashing work is completed.
- B. Set in sealant and bolt to curb.
- C. Install nosing to within 4 inches of ends of concrete stair treads, except where shown to extend full width.
- D. Extend nosings full width of door openings.
- E. Extend nosings, full width between stringers of metal stairs, and terminate at point of curvature of steps having short radius curved ends.

3.11 STEEL COMPONENTS FOR MILLWORK ITEMS

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

3.12 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 stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

- - - E N D - - -

**SECTION 07 41 00
PREFORMED METAL STANDING SEAM ROOFING**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section covers the pre-finished, pre-fabricated Architectural standing seam roof system. All metal trim, accessories, fasteners, insulation, and sealants indicated on the drawings are included as part of this section.
- B. Related Work Specified Elsewhere:
 - 1. Section 07 60 00 - Flashing and Sheet Metal.

1.2 QUALITY ASSURANCE

- A. Products manufactured by Petersen Aluminum Corporation, Kennesaw, GA (phone 800-272-4482) establish a minimum of quality required.
- B. Manufacturer and erector shall demonstrate experience, of a minimum of five (5) years in this type of project.

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. ASTM International (ASTM):
 - B209Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - E283Standard Test Method for Determining Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 - E331Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 - E1592Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

E1646Standard Test Method for Water Penetration of Exterior
Metal Roof Panel Systems by Uniform Static Air Pressure
Difference

E1646Standard Test Method for Rate of Air Leakage Through
Exterior Metal Roof Panel Systems

1.4 SUBSTITUTIONS

- A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.5 ROOF SYSTEM PERFORMANCE TESTING

- A. Water Penetration: When tested in accordance with ASTM E283 or ASTM E1680 (as applicable) and ASTM E331 or ASTM E1646 (as applicable), there shall be no uncontrolled water penetration or air infiltration through the panel joints.
- B. Roof System shall be designed to meet the applicable Building Code wind load requirements for the specific project location.
- C. Roof System shall be designed to meet a UL Class 60 wind uplift in accordance with UL standard 580 and panel system shall be tested and approved in accordance with ASTM 1592 (U. S Army Corps of Engineer requirement).

1.6 WARRANTIES

- A. The Contractor shall warrant for twenty years (20) from the date of substantial completion of the Work related to this section, that the work is not defective in workmanship or material, and that the roof will be adequate to prevent leaks. This warranty may be provided in the short term by the Contractor/Roof Installer, however must have the backing and assurance of the roof system manufacturer.
- B. Finish Warranty on Aluminum:
Written 20 Year Finish Warranty shall be required for the Aluminum Standing Seam Roof System including Flashings, and related rain-carrying equipment as supplied by the manufacturer and roofing contractor. This warranty will be for 20 Years and cover: Chalking, Fading and Integrity of the anodized paint finish on the Aluminum.

1.7 SUBMITTALS

- A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and

type of sealants, and any other details as may be required for a weather-tight installation.

Include engineering documentation of clip spacing and attachment required to meet job specific wind requirements of the applicable Building Code.

- B. Provide finish samples of all colors specified.

PART 2 - PRODUCTS

2.1 PANEL DESIGN

- A. Roof panels shall be standing seam in 16-inch widths with 1 3/4 inch high seam. Panels shall be prefabricated with manufacturer's standard factory striations to maximize appearance of flatness.

2.2 ACCEPTABLE MANUFACTURERS

- A. This project is detailed around the roofing product of Petersen Aluminum Corporation, "SNAP-CLAD" PANEL.
- B. Other acceptable Manufacturers, provided with compliance with this specification:
1. IMETCO, Tucker, GA, "Snap-Lock" panel.
 2. Merchant & Evans, Burlington, NJ, "305" panel.

2.3 MATERIAL AND FINISHES

- A. Face Sheet Material: Aluminum Standing Seam sheet shall be produced from ASTM B209 quality Aluminum, 3105 H-14 Alloy and Temper material. Aluminum shall be tension leveled (temper passed and stretcher leveled) with camber a maximum of 1/4 inch in 20 feet, manufactured in the USA, and be .040 inch thick Aluminum U.S. standard gauge. Product to meet UL-60 Design Standards and shall meet applicable Building Code Wind load requirements for this project location. Professional Engineer Stamped Calculations will be required for the project to certify the roof panel assembly meets the applicable Building Code wind loads. Engineer Calculations shall be per ASCE 7-2002 latest standards.
- B. Finish:
1. Finish shall be anodized coating with a top side film thickness of 0.70 to 0.90 mil over 0.25 to 0.31 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side, where not exposed, shall be coated with a primer with a dry film thickness of 0.25 mil. Bottom side of panels, where exposed, shall be coated to match top side of panels. Finish shall conform to all tests for adhesion, flexibility and longevity as specified by finish supplier

2. Strippable coating shall be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and field handling. This strippable coating shall be removed before installation.
 3. Field protection must be provided by the Contractor at the job site so material is not exposed to weather and moisture.
- C. Exposed Flashing and Trim:
1. Unless otherwise specified, all exposed adjacent flashing and trim shall be of the same material and finish as panel system.
- D. Forming: Use continuous end rolling method. No end laps on panels.
No portable rollforming machines by the installer shall be permitted.
Panels shall be "factory manufactured" and "tension-leveled" by the designated manufacturer listed above.
- E. Trim: Trim shall be fabricated of the same material and finish to match the profiled sheeting and press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer or their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
- F. Closures: Use composition or metal profiled closures at top of each elevation to close ends of the panels. Metal closures shall be made in the same material and finish as face sheet.
- G. Panel Clips: Shall be Stainless Steel as required by the panel manufacturer in appropriate Gage and spacing of Clips to meet the job-specific Wind Load requirements by the Arkansas Building Code. Necessary engineering documentation of this clip spacing and attachment shall be provided in the submittal stage to the COTR.
- H. Fasteners: Fasteners shall be 400 series stainless steel, dished washers stainless steel with bonded neoprene.

2.4 SEALANTS

- A. Furnish sealants conforming to one of the following specifications:
1. Two part polysulfide class "B" non-sag type for vertical and horizontal joints, or;
 2. One part polysulfide not containing pitch or phenolic extenders, or;
 3. Exterior grade silicone sealant recommended by roofing manufacturer, or;
 4. One part non-sag, gun grade, exterior type polyurethane recommended by roofing manufacturer.

2.5 FABRICATION

- A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown and, if not shown, provide manufacturer's standard product fabrication.
- B. Fabricate components of the system in factory, ready for field assembly.
- C. Fabricate components and assemble units to comply with fire and performance requirements specified.
- D. Apply specified finishes in conformance with manufacturer's standards, and according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine alignment of structural decking or exposed steel framing and related accessories prior to installation and do not proceed until the defects are corrected by the responsible contractor.

3.2 FASTENERS

- A. Secure clips to decking or exposed steel framing and panel units and trim to clips per approved submittal and per manufacturer's recommendations.

3.3 INSTALLATION

- A. Panels shall be installed plumb and true in proper alignment and relation to the structural decking. The erector must have at least five years successful experience with similar applications.
- B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
- C. Remove all strippable coating and provide a dry wipe-down cleaning of the panels as they are erected.

3.4 DAMAGED MATERIAL

- A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

- - - END- - -

SECTION 07 92 00 SEALANTS AND CAULKING

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. 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.

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 40 degrees 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 exceeding 90 degrees F or less than 40 degrees 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" Article specified in the GENERAL CONDITIONS, 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. ASTM International (ASTM):
C612 Standard Specification for Mineral Fiber Block and Board
Thermal Insulation.
C717 Standard Terminology of Building Seals and Sealants.
C834 Standard Specification for Latex Sealants.

- C919 Standard Practice for Use of Sealants in Acoustical Applications.
- C920 Standard Specification for Elastomeric Joint Sealants.
- C1193..... Standard Guide for Use of Joint Sealants.
- C1330..... Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- D1056..... Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

- 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-5:

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

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.
6. Minimum elongation of 1200 percent.

G. S-7:

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

H. S-8:

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

I. S-9:

1. ASTM C920 silicone.

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

J. S-10:

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

K. S-11:

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

L. S-12:

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

2.2 CAULKING COMPOUND:

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: One component acoustical caulking, nondrying, 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 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 FOR NONPOROUS SURFACES:

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent nonporous 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: concrete, masonry, and unglazed surfaces of ceramic tile.
 - 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. Nonporous joint surfaces include: metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printer 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 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 1/4 inch, sealant depth equal to width.
- B. At widths over 1/4 inch, sealant depth 1/2 of width up to 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. Apply sealants and caulking only when ambient temperature is between 40 and 100 degrees F.
 - 2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
 - 3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
 - 4. Apply caulking and sealing compound in accordance with manufacturer's printer instructions.
 - 5. Avoid dropping or smearing compound on adjacent surfaces.
 - 6. Fill joints solidly with compound and finish compound smooth.
 - 7. Tool joints to concave surface unless shown or specified otherwise.
 - 8. Finish paving or floor joints flush unless joint is otherwise detailed.
 - 9. Apply compounds with nozzle size to fit joint width.

10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- 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 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 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 FIELD QUALITY CONTROL:

- A. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements.

3.7 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.

3.8 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. Cast Stone to Cast Stone: Type S-1
 6. Threshold Setting Bed: Type S-1, S-3, S-4
 7. Masonry Expansion and Control Joints: Type S-6
 8. Wood to Masonry: Type S-1
- B. Metal Reglets and Flashings:
1. Flashings to Wall: Type S-6
 2. Metal to Metal: Type S-6
- C. Sanitary Joints:
1. Walls to Plumbing Fixtures: Type S-9
 2. Counter Tops to Walls: Type S-9
 3. Pipe Penetrations: Type S-9
- D. Horizontal Traffic Joints:
1. Concrete Paving, Unit Pavers: Type S-11 or S-12
 2. Garage/Parking Decks: Type S-10
- E. High Temperature Joints over 400 degrees F:
1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8
- F. Interior Caulking:
1. Typical Narrow Joint 1/4 inch or less at Walls and Adjacent Components: Type C-1, C-2, C-3.
 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Type C-1, C-2, C-3.
 3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Type C-1, C-2, C-3.
 4. Perimeter of Lead Faced Control Windows and Plaster or Gypsum Wallboard Walls: Type C-1, C-2, C-3.
 5. Exposed Isolation Joints at Top of Full Height Walls: Type C-1, C-2, C-3.

- - - E N D - - -

SECTION 09 91 00 PAINTING

PART 1-GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Factory finish overhead coiling doors – standard finish.
- B. Shop prime painting of steel and ferrous metals: Section 05 12 00, STRUCTURAL STEEL FRAMING; and Section 05 50 00, METAL FABRICATIONS.

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. Sample of identity markers if used.
- D. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. High temperature aluminum paint.
 - 3. Epoxy coating.

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 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-1992 Threshold Limit Values (TLV) for Chemical Substances
and Physical Agents and Biological Exposure Indices
(BEIs)
 - ACGIH TLV-DOC Documentation of Threshold Limit Values and Biological
Exposure Indices, (Sixth Edition)
- C. American National Standards Institute (ANSI):
 - A13.1-96..... Scheme for the Identification of Piping Systems
- D. ASTM International (ASTM):
 - D260-86.....Boiled Linseed Oil
- E. Commercial Item Description (CID):
 - A-A-1555 Water Paint, Powder (Cementitious, White and Colors)
(WPC) (cancelled)
 - A-A-3120 Paint, For Swimming Pools (RF) (cancelled)

F. Federal Specifications (Fed Spec):

TT-P-1411A..... Paint, Copolymer-Resin, Cementitious (For Waterproofing
Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

No. 1-04 Aluminum Paint (AP)
No. 4-04 Interior/ Exterior Latex Block Filler
No. 5-04 Exterior Alkyd Wood Primer
No. 7-04 Exterior Oil Wood Primer
No. 8-04 Exterior Alkyd, Flat MPI Gloss Level 1 (EO)
No. 9-04 Exterior Alkyd Enamel MPI Gloss Level 6 (EO)
No. 10-04 Exterior Latex, Flat (AE)
No. 11-04 Exterior Latex, Semi-Gloss (AE)
No. 18-04 Organic Zinc Rich Primer
No. 22-04 Aluminum Paint, High Heat (up to 590° - 1100F) (HR)
No. 26-04 Cementitious Galvanized Metal Primer
No. 27-04 Exterior / Interior Alkyd Floor Enamel, Gloss (FE)
No. 31-04 Polyurethane, Moisture Cured, Clear Gloss (PV)
No. 36-04 Knot Sealer
No. 43-04 Interior Satin Latex, MPI Gloss Level 4
No. 44-04 Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-04 Interior Primer Sealer
No. 46-04 Interior Enamel Undercoat
No. 47-04 Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)
No. 48-04 Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 49-04 Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
No. 50-04 Interior Latex Primer Sealer
No. 51-04 Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-04 Interior Latex, MPI Gloss Level 3 (LE)
No. 53-04 Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-04 Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)
No. 59-04 Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss
(FE)
No. 60-04 Interior/Exterior Latex Porch & Floor Paint, Low Gloss

- No. 66-04 Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC)
- No. 67-04 Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)
- No. 68-04 Interior/ Exterior Latex Porch & Floor Paint, Gloss
- No. 71-04 Polyurethane, Moisture Cured, Clear, Flat (PV)
- No. 74-04 Interior Alkyd Varnish, Semi-Gloss
- No. 77-04 Epoxy Cold Cured, Gloss (EC)
- No. 79-04 Marine Alkyd Metal Primer
- No. 90-04 Interior Wood Stain, Semi-Transparent (WS)
- No. 91-04 Wood Filler Paste
- No. 94-04 Exterior Alkyd, Semi-Gloss (EO)
- No. 95-04 Fast Drying Metal Primer
- No. 98-04 High Build Epoxy Coating
- No. 101-04 Epoxy Anti-Corrosive Metal Primer
- No. 108-04 High Build Epoxy Coating, Low Gloss (EC)
- No. 114-04 Interior Latex, Gloss (LE) and (LG)
- No. 119-04 Exterior Latex, High Gloss (acrylic) (AE)
- No. 135-04 Non-Cementitious Galvanized Primer
- No. 138-04 Interior High Performance Latex, MPI Gloss Level 2 (LF)
- No. 139-04 Interior High Performance Latex, MPI Gloss Level 3 (LL)
- No. 140-02 Interior High Performance Latex, MPI Gloss Level 4
- No. 141-04 Interior High Performance Latex (SG) MPI Gloss Level 5
- H. Steel Structures Painting Council (SSPC):
 - SSPC SP 1-00..... Solvent Cleaning
 - SSPC SP 2-00..... Hand Tool Cleaning
 - SSPC SP 3-00..... Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cementitious Paint (CEP): TT-P-1411A [Paint, Copolymer-Resin, Cementitious (CEP)], Type 1 for exterior use, Type II for interior use.
- B. Wood Sealer: MPI 31 (gloss) or MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.

- C. Aluminum Paint (AP): MPI 1.
- D. Interior/Exterior Latex Block Filler: MPI 4.
- E. Exterior Alkyd Wood Primer: MPI 5.
- F. Exterior Oil Wood Primer: MPI 7.
- G. Exterior Alkyd, Flat (EO): MPI 8.
- H. Exterior Alkyd Enamel (EO): MPI 9.
- I. Exterior Latex, Flat (AE): MPI 10.
- J. Exterior Latex, Semi-Gloss (AE): MPI 11.
- K. Organic Zinc rich Coating (HR): MPI 22.
- L. High Heat Resistant Coating (HR): MPI 22.
- M. Cementitious Galvanized Metal Primer: MPI 26.
- N. Exterior/ interior Alkyd Floor Enamel, Gloss (FE): MPI 27.
- O. Knot Sealer: MPI 36.
- P. Interior Satin Latex: MPI 43.
- Q. Interior Low Sheen Latex: MPI 44.
- R. Interior Primer Sealer: MPI 45.
- S. Interior Enamel Undercoat: MPI 47.
- T. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- U. Interior Alkyd, Gloss (AK): MPI 49.
- V. Interior Latex Primer Sealer: MPI 50.
- W. Interior Alkyd, Eggshell: MPI 51
- X. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- Y. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- Z. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- AA. Interior / Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE): MPI 59.
- BB. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.
- CC. Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC): MPI 66.
- DD. Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR): MPI 67.
- EE. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.
- RR. Epoxy Cold Cured, Gloss (EC): MPI 77.
- GG. Marine Alkyd Metal primer: MPI 79.
- HH. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- II. Wood Filler Paste: MPI 91.

- JJ. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- KK. Fast Drying Metal Primer: MPI 95.
- LL. High Build Epoxy Coating: MPI 98.
- MM. Epoxy Anti-Corrosive Metal Primer: MPI 101.
- NN. High Build Epoxy Marine Coating (EC): MPI 108.
- OO. Interior latex, Gloss (LE) and (LG): MPI 114.
- PP. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- QQ. Waterborne Galvanized Primer: MPI 134.
- RR. Non-Cementitious Galvanized Primer: MPI 135.
- SS. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.
- TT. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.
- UU. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.
- VV. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

2.2 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS

- A. Paint materials 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 local, state or district requirements.
 - 2. Lead-Based Paint:
 - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
 - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
 - 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. Comply with the Regional Ozone Transport Commission (OTC) regulations regarding Volatile Organic Content (VOC).

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 days work.
- B. Atmospheric and Surface Conditions:
 1. Do not apply coating when air or substrate conditions are:
 - a. Less than 5 degrees F above dew point.
 - b. Below 50 degrees F or over 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.
 6. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.

- c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
 - 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 - 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
 - 3. See other sections of specifications for specified surface conditions and prime coat.
 - 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.
- C. Wood:
 - 1. Sand to a smooth even surface and then dust off.
 - 2. Sand surfaces showing raised grain smooth between each coat.
 - 3. Wipe surface with a tack rag prior to applying finish.
 - 4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
 - b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
 - 5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
 - 6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
 - 7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.
- D. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
 2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning).
Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
 3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
 - a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
 4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
 5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- E. Zinc-Coated (Galvanized) Metal, Aluminum, Copper and Copper Alloys 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 MPI 18 (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. Cement Plaster and Stucco:
1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
 2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products.
Use of solvents, acid, or steam is not permitted.

3.3 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

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

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COTR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush or roller except as otherwise specified.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
- G. Do not paint in closed position operable items such as access doors and panels, overhead doors, and similar items.

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. Metals:
 - 1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer) or MPI 95 (Fast Drying Metal Primer).
 - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer).
 - 3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
 - 4. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
 - 5. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
 - 6. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
 - 7. Metal over 200 degrees F, Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).
 - 8. Surfaces scheduled to receive vinyl coated fabric wallcovering:
Use MPI45 (Interior Primer Sealer) or MPI46 (Interior Enamel Undercoat).
 - 9. Use MPI101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI77 (Epoxy Cold Cured, Gloss (EC), MPI98 (High Build Epoxy Coating), or MPI108 (High Build Epoxy Marine Coating (EC) finish.
- H. Concrete Masonry Units except glazed or integrally colored and decorative units:
 - 1. MPI 4 (Block Filler) on interior surfaces.
 - 2. Prime exterior surface as specified for exterior finishes.
- I. Cement Plaster or stucco, Concrete Masonry, Brick Masonry, and Cement board, and Interior Surfaces of Ceilings and Walls:
 - 1. MPI53 (Interior Latex, Flat, MPI Gloss Level 1 LE)), MPI52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), or MPI114 (Interior Latex, Gloss (LE) and (LG)), except use two coats where substrate has aged less than six months.
 - 2. Use MPI138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI140 (Interior High Performance latex, MPI Gloss Level 4), MPI141 (Interior High Performance Latex (SG) MPI Gloss Level 5), MPI114 (Interior Latex, Gloss (LE) and (LG)), TT-P-1411A (Paint, Copolymer Resin, Cementitious (CEP)) Type II, MPI77 (Epoxy Cold Cured,

Gloss (EC), MPI98 (High Build Epoxy Coating), MPI108 (High Build Epoxy Marine Coating (EC)) or CID-A-A-1555 (Water, Paint, Powder) as scheduled.

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified.
- B. Wood:
 - 1. Do not apply finish coats on surfaces concealed after installation, or on top and bottom edges of wood doors.
 - 2. Two coats of MPI10 Exterior Latex, Flat (AE)), MPI11 (Exterior Latex, Semi-Gloss (AE)), and MPI119 (Exterior Latex, High Gloss (acrylic) (AE)) on exposed surfaces, except where transparent finish is specified.
 - 3. Two coats of MPI31 (Polyurethane, Moisture Cured, Clear Gloss (PV)) or MPI71 (Polyurethane, Moisture Cured, Clear Flat (PV)) for transparent finish.
- C. Steel and Ferrous Metal:
 - 1. Two coats of MPI 8 (Exterior Alkyd, Flat (EO)), MPI9 (Exterior Alkyd Enamel (EO)), and MPI94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 200 degrees F.
- D. Machinery without factory finish except for primer: One coat MPI8 (Exterior Alkyd, Flat (EO)), MPI9 (Exterior Alkyd Enamel (EO)), or MPI94 (Exterior Alkyd, Semi-Gloss (EO)).
- E. Concrete Masonry Units, Cement Plaster, and Concrete:
 - 1. General:
 - a. Where specified or shown.
 - b. Mix as specified in manufacturer's printed directions.
 - c. Do not mix more paint at one time than can be used within four hours after mixing. Discard paint that has started to set.
 - d. Dampen warm surfaces above 75 degrees F with fine mist of water before application of paint. Do not leave free water on surface.
 - e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.
 - 2. Use two coats of TT-P-1411 (Paint, Co-polymer-Resin, Cementitious (CEP)), unless specified otherwise.

3.7 INTERIOR FINISHES

- A. Apply finish coats over prime coats as specified in following paragraphs.
- 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. Two coats of MPI48 (Interior Alkyd Gloss (AK)) or MPI51 (Interior Alkyd, Eggshell (AK)).
 - c. One coat of MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) on exposed interior surfaces of alkyd-amine enamel prime finished windows.
 - d. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).
 - e. Asphalt Coated Metal: One coat MPI 1 (Aluminum Paint (AP)).
 4. One coat of MPI45 (Interior Primer Sealer) or MPI46 (Interior Enamel Undercoat) plus one coat of MPI48 (Interior Alkyd Gloss (AK)).
- D. Masonry and Concrete Walls:
1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
 2. Two coats of MPI53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)), MPI52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), or MPI114 (Interior Latex, Gloss (LE) and (LG)).
 3. Two coats of MPI138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI140 (Interior High Performance Latex MPI Gloss level 4), MPI141 (Interior High Performance Latex (SG) MPI Gloss level 5) or MPI114 (Interior Latex, Gloss (LE) and (LG)) .
- E. Wood:
1. Sanding:
 - a. Use 220-grit sandpaper.
 - b. Sand sealers and varnish between coats.
 - c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
 2. Sealers:

- a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
 - b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
 - c. Sand as specified.
- 3. Paint Finish:
 - a. One coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).
 - b. One coat of MPI 45 Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).
 - c. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).
- 4. Transparent Finishes on Wood.
 - a. Natural Finish:
 - 1) One coat of sealer.
 - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) or MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)).
 - b. Stain Finish:
 - 1) One coat of MPI 90 (Interior Wood Stain, Semi-Transparent (WS)).
 - 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
 - 3) One coat of sealer.
 - 4) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) or MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).
 - c. Varnish Finish:
 - 1) One coat of sealer.
 - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) or MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).
- F. Cement Board: One coat of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI 140 (Interior High Performance Latex MPI Gloss level 4), MPI 141 (Interior High Performance Latex (SG) MPI Gloss Level 5, or MPI 114 (Interior Latex, Gloss (LE) and (LG)).

G. Miscellaneous:

1. Apply where specified: MPI 1 (Aluminum Paint), two coats of aluminum paint.

H. Interstitial floor markings: One coat MPI 27 (Exterior/ Interior Alkyd Floor Enamel, Gloss (FE)), MPI 59 ((Interior/ Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE)), MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss), or MPI 60 (interior/ Exterior Latex Porch & Floor Paint, Low Gloss (FR)).

3.8 PAINT COLOR

A. Color and gloss of finish coats shall be as selected by the VA representative.

B. 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.

C. 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.

3.9 PROTECTION CLEAN UP, AND TOUCH-UP

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

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SECTION 26 05 11 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, load center 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 utility's system) shall conform to the utility's requirements. Coordinate fuses, circuit breakers and relays with the utility's system, and obtain utility 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 International Building Code (IBC), 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, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified; equipment or product 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 APPLICABLE PUBLICATIONS

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

1.6 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 or type 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.

1.7 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.

1.8 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, loadcenters, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
 2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 3. Damaged equipment shall be, as determined by the COTR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of 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 and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
 - 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COTR.
- 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, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 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 quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices, load centers and other significant equipment.
- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.12 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. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.
- 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 instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of 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 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, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

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

1.14 ACCEPTANCE CHECKS AND TESTS

The contractor shall furnish the instruments, materials and labor for field tests.

1.15 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.

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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. Section 31 20 00, EARTH MOVING.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Manufacturer's Literature and Data: Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the 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):
 - 70-05 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 3/4 inch wide tape. Apply tape in half overlapping turns for a minimum of three 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 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, load centers 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 INSTALLATION IN MANHOLES

Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

3.3 SPLICE 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.

3.5 CONTROL AND SIGNAL WIRING INSTALLATION

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

3.6 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

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

3.7 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.

3.8 DIRECT BURIAL CABLE IN CONDUIT INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 24 inches unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 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 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.

- 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 3 inch layer of sand in the trenches before installing the conduit.
 - 3. Place a three inch layer of sand over the installed conduits.
 - 4. Install continuous horizontal, 1 inch by 8 inch preservative impregnated wood planking three inches above the conduits 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 12 inches above the buried conduits.

3.9 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.

3.10 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.

- - - E N D - - -

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

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

- A. American Society for Testing and Materials (ASTM):
 - B1-2001..... Standard Specification for Hard-Drawn Copper Wire
 - B8-2004..... Standard Specification for Concentric-Lay-Stranded
Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-1983 IEEE Guide for Measuring Earth Resistivity, Ground
Impedance, and Earth Surface Potentials of a Ground
System
- C. National Fire Protection Association (NFPA):
 - 70-2005 National Electrical Code (NEC)
 - 99-2005 Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
 - 44-2005 Thermoset-Insulated Wires and Cables
 - 83-2003 Thermoplastic-Insulated Wires and Cables
 - 467-2004 Grounding and Bonding Equipment
 - 486A-486B-2003 Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 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 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, 3/4-inch diameter by 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 EQUIPMENT RACK AND CABINET GROUND BARS

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 3/8 inch x 3/4 inch.

2.6 GROUND TERMINAL BLOCKS

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

2.7 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 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

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

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 - 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. 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. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic 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.
- F. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- G. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- H. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate 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.
- K. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- L. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 10 AWG. These conductors shall be installed in rigid metal conduit.

3.5 CORROSION INHIBITORS

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

3.6 CONDUCTIVE PIPING

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

3.7 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.

3.8 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 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 00, EARTH MOVING.
- 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

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

- A. Shop Drawings:
 - 1. Size and location of main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the 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):
 - 70-05 National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
 - 1-03 Flexible Metal Conduit
 - 5-01 Surface Metal Raceway and Fittings
 - 6-03 Rigid Metal Conduit
 - 50-03 Enclosures for Electrical Equipment
 - 360-03 Liquid-Tight Flexible Steel Conduit
 - 467-01 Grounding and Bonding Equipment
 - 514A-01 Metallic Outlet Boxes
 - 514B-02 Fittings for Cable and Conduit
 - 514C-05 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
 - 651-02 Schedule 40 and 80 Rigid PVC Conduit
 - 651A-03 Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-03 Electrical Metallic Tubing
 - 1242-00 Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
 - TC-3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB1-03 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 1/2 inch unless otherwise shown. Where permitted by the NEC, 1/2 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 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).
8. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - c. 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.
 - d. 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.
 - e. 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 2 inches and smaller. Use set screw type couplings with four set screws each for conduit sizes over 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. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 8. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 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 1-1/2 by 1-1/2 inch, 12 gage steel, cold formed, lipped channels; with not less than 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. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 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. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. 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 1 foot of changes of direction, and within 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.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
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. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 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 3/4 inch of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.

- b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
- 3. Align and run conduit parallel or perpendicular to the building lines.
- 4. 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 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. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using two inch high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 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 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 24 inches below finished grade.
 - b. Not less than 30 inches below road and other paved surfaces.
 - c. Installation under railroad tracks is prohibited.
 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
 6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
 - a. Cut the trenches neatly and uniformly.
 - b. Do not kink the conduits.
 7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
 8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with 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 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 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 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 20 mil bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.8

EXPANSION JOINTS

- A. Conduits 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 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 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 15 inches and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.

3.9 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 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 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 1/4 inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners not less than 1/4 inch diameter with depth of penetration not less than 3 inches.
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 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 4 inch square by 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 24 16 PANELBOARDS AND LOAD CENTERS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

- A. National Electrical Manufacturers Association (NEMA):
 - PB-1-2006 Panelboards
 - AB-1-2002 Molded Case Circuit Breakers, Molded Case Switches and
Circuit Breaker Enclosures
- B. National Fire Protection Association (NFPA):
 - 70-2005 National Electrical Code (NEC)
 - 70E-2004..... Standard for Electrical Life Safety in the Workplace
- C. Underwriters Laboratories, Inc. (UL):
 - 50-2003 Enclosures for Electrical Equipment
 - 67-2003 Panel boards
 - 489-2006 Molded Case Circuit Breakers and Circuit Breaker
Enclosures

PART 2 - PRODUCTS

2.1 PANELBOARDS /LOAD CENTERS:

- A. Panelboards /load centers shall be in accordance with UL, NEMA, NEC, and as shown on the drawings. Panelboards/loadcenters shall be service entrance rated when indicated on the drawings.
- B. Panelboards / load centers shall be standard manufactured products. All components of the panelboards /load centers shall be the product and assembly of the same manufacturer. All similar units of all panelboards /load centers to be of the same manufacturer.
- C. All panelboards /load centers 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/ load centers shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard/load center cover.
- E. Panelboards /load centers 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 /load centers shall conform to NEMA PB-1, NEMA AB-1 and UL 67 and have the following features:
 - 1. Nonreduced size, full capacity copper bus bars (phase bus, neutral bus and grounding bus). Buses shall extend the entire length of the panelboard/load center. Provide 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/load centers 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/load centers shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
 - 4. Neutral bus: Provide bare neutral bus , mounted on insulated supports. Provide neutral disconnect links to permit isolation of the neutral bus from the common ground bus and service entrance conductors.
 - 5. Grounding bus: Provide an uninsulated 1/4 inch by 2 inch copper equipment ground bus bar equipped with screws or lugs for the connection of grounding wires.
 - 6. Main Bonding Jumper: An Insulated 1/4 inch x2 inch copper bus shall interconnect the neutral and ground buses to establish the system common ground point.

- .7 Buses braced for the available short circuit current, but not less than 22,000 amperes symmetrical for 120/208 volt and 120/240 volt panelboards/load centers.
8. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
9. Protective devices shall be designed so that they can be easily replaced.
10. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.
11. In two section panelboards/load centers, 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.
12. Series rated panelboards are not permitted.

2.2 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards/load centers. 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/load centers 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/LOAD CENTERS:

- 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/load centers 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/load centers shall have minimum interrupting rating as indicated but not less than:
 - a. 120/240 Volt Panelboard/load centers: 22,000 amperes symmetrical AIC Rating
- C. Breaker features shall be as follows:
 1. A rugged, integral housing of molded insulating material.
 2. Silver alloy contacts.
 3. Arc quenchers and phase barriers for each pole.

4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
 - a. Line connections shall be bolted.
 - b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals//as indicated on the drawings,
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

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/load centers 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 words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and 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/load center fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 78 inches. For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 6 inches above the finished floor.
- F. For panelboards/load centers 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.

H. Provide ARC flash identification per NFPA 70E.

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SECTION 26 29 21 DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of low voltage disconnect switches.

1.2 RELATED WORK

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

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
 - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
 - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the Resident Engineer two weeks prior to final inspection.
 - 2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
 - 3. Wiring diagrams shall indicate internal wiring and any interlocking.

- D. Certification: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the equipment has been properly installed, adjusted, 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. National Electrical Manufacturers Association (NEMA):
KS I-01 Enclosed and Miscellaneous Distribution Equipment
Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
70-05 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
98-98 Enclosed and Dead-Front Switches
198C-89 High-Interrupting-Capacity Fuses, Current Limiting Types
198E-94 Class R Fuses
977-99 Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.1 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- B. Shall have a minimum duty rating, NEMA classification General Duty (GD) for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.
- C. Shall be horsepower rated.
- D. Shall have the following features:
1. Switch mechanism shall be the quick-make, quick-break type.
 2. Copper blades, visible in the OFF position.
 3. An arc chute for each pole.
 4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
 6. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 7. Ground Lugs: One for each ground conductor.

8. Enclosures:

- a. Shall be the NEMA types shown on the drawings for the switches.
- b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
- c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

2.2 IDENTIFICATION SIGNS

- A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
- B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 1/4-inch high. Secure nameplates with screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.

3.2 SPARE PARTS

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COTR.

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SECTION 31 20 00 EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
 2. Excavation.
 3. Filling and backfilling.
 4. Grading.
 5. Soil Disposal.
 6. Clean-up.

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 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698.
 2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
 3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to the COTR's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 5 feet outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trench work required for utility and drainage lines.

- D. Site Earthwork: Earthwork operations required in area outside of a line located 5 feet outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of specified field density testing.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term “fill” means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the COTR. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the COTR based on the determination by the Government’s soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminants as defined and determined by the COTR or the Government's testing agency.

1.3 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- D. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- E. Site preparation: Section 02 41 00, DEMOLITION.
- F. Paving subgrade requirements: Section 32 12 16, ASPHALT PAVING.
- G. Drainage Piping: Section 33 46 13, FOUNDATION DRAINAGE.

1.4 CLASSIFICATION OF EXCAVATION:

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Rock Excavation:
 - 1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, track-mounted hydraulic excavator; equipped with a 42 inch wide, short-tip-radius rock bucket; rated at not less than 138 hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 19,000 lbf; measured according to SAE J-1179. Trenches in excess of 10 feet wide and pits in excess of 30 feet in either length or width are classified as open excavation.

2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at not less than 210 hp flywheel power and developing a minimum of 48,510 lbf breakout force; measured according to SAE J-732.
3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 1 cubic yard for open excavation, or 3/4 cubic yard for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.
4. Definitions of rock and guidelines for equipment are presented for general information purposes only. The Contractor is expected to use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit the following during work progress:
 1. Laboratory test reports and certifications by suppliers for proposed borrow materials showing conformance with the specifications.
 2. Field and laboratory test reports of all specified field quality control testing showing conformance of the constructed work with the specifications.
- C. Submit the following at completion of the work:
 1. As-built drawings of completed grading as specified in Section 01 00 00, GENERAL REQUIREMENTS.

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
T99..... Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb)
Rammer and a 305 mm (12 inch) Drop

T180..... Moisture-Density Relations of Soils using a 4.54 kg (10 lb)
Rammer and a 457 mm (18 inch) Drop

C. ASTM International (ASTM):

D698 Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort (12,400 ft.
lbf/ft³ (600 kN m/m³))

D1556..... Standard Test Method for Density and Unit Weight of Soil
in Place by the Sand-Cone Method

D2216..... Standard Test Method for Laboratory Determination of
Water (Moisture) Content of Soil and Rock by Mass

D2487..... Standard Classification of Soil for Engineering Purposes
(Unified Soil Classification System)

D2937..... Standard Test Method for Density of Soil in Place by the
Drive-Cylinder Method

D4959..... Standard Test Method for Determination of Water
(Moisture) Content of Soil By Direct Heating

D6938..... Standard Test Method for In-Place Density and Water
Content of Soil and Soil-Aggregate by Nuclear Methods
(Shallow Depth)

D. Code of Federal Regulations (CFR):

29 CFR Part 1926 Safety and Health Regulations for Construction

E. Society of Automotive Engineers (SAE):

J732-92 Specification Definitions - Loaders

J1179-02 Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Proposed materials and source of supply shall be approved by the COTR as specified, prior to delivery and use in the construction.
- B. Contractor's quality control testing firm shall perform the following testing:
 - 1. Pipe Bedding and Initial Trench Backfill: Soil classification (ASTM D2487), minimum of one test for each visible change in material.
 - 2. Final Backfill: Moisture-density curve (ASTM D698), minimum of one test for each visible change in material.

2.2 MATERIALS:

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the COTR or material with at least 90 percent passing a 1 1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- D. Pipe Bedding and Initial Trench Backfill: Soil in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, or any combination of these groups; with maximum particle size of 1 inch. Material obtained from trench excavations may be used, provided it conforms to the above specifications and is substantially free of roots, trash and other material which may be compressible or which cannot be compacted properly.
- E. Final Backfill: Soil obtained from excavation for installation of piping, drop inlets and manholes, provided that it is substantially free of material which may be compressible or which cannot be compacted properly
- E. Drainage Fill Beneath and Between Precast Concrete Crypts: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel with gradation conforming to the requirements indicated on the Drawings.
- F. Granular Fill:
 - 1. Under concrete slab, use crushed stone or gravel graded from 1 inch to No. 4.
- G. Perforated Drainage Pipe Bedding and Backfill: Specified in Section 33 46 13, FOUNDATION DRAINAGE.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

- A. If any unexpected material is encountered, all work shall stop immediately and the Government shall be notified.

- B. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Cemetery Property.
- C. Grubbing: Remove stumps and roots 3 inch and larger diameter. Undisturbed sound stumps, roots up to 3 inch diameter, and nonperishable solid objects a minimum of 3 feet below subgrade or finished embankment may be left. Do not leave material within burial profile up to 8 feet below finished grade.
- D. Trees and Shrubs: Trees and shrubs not shown for removal may be removed from areas within 15 feet of new construction and 7.5 feet of utility lines when removal is approved in advance by the COTR. Remove materials from Cemetery Property. Trees and shrubs shown to be transplanted shall be dug with a ball of earth and burlapped in accordance with latest issue of, "American Standard for Nursery Stock" of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semiannually (until conclusion of contract) with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus, and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until conclusion of contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. For trees and shrubs that are to remain, do not store building materials closer than the farthest extension of their limbs.
- E. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COTR. Eliminate foreign materials such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 1/2 cubic foot in volume from soil as it is stockpiled. Retain topsoil on the site. Remove foreign materials larger than 2 inches in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the

soil will be destroyed. Test the topsoil for chemicals, pesticides and fertilizers to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established.

- F. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 12 inches on each side of widest part of trench excavation so that final score lines are approximately parallel unless otherwise indicated. Remove material from Cemetery Property.
- G. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
 - 1. Grades shall conform to elevations indicated on the Drawings within the tolerances herein specified. Generally, grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated, the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
 - 2. Locations of existing elevations indicated on the Drawings, except spot elevations, are approximate and are from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify the COTR of any differences between existing elevations shown on the Drawings and those encountered on the site by Surveyor/Engineer described above. Notify the COTR of any differences between existing or constructed grades, as compared to those shown on the Drawings.
 - 3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that the site is graded to conform to elevations indicated on the Drawings.
 - 4. Finish grading is specified in Section 32 90 00, PLANTING.
- H. 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: Sides of excavations shall be shored, braced, or sloped in conformance with applicable local, state, and federal regulations (including 29 CFR 1926, Subpart P – Excavations) to protect workers, adjacent burial plots, roadway, structures, and utilities.
 - 1. Design of the temporary support of excavation system is the responsibility of the Contractor.
 - 2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the COTR.
 - 3. Extend shoring and bracing to a minimum of 5 feet below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
 - 4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall place and compact additional granular base material to required subgrade elevation as directed by the COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by the COTR.
- B. Excavation Drainage: Operate pumping equipment and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from the COTR.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with granular base or pipe bedding material as approved by the COTR.

D. Proofrolling:

1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

E. Building Earthwork:

1. Excavation shall be accomplished as required by the Drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 3000 psi concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.

F. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. Length of open trench in advance of piping laying shall not be greater than is authorized by the COTR.
2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 6 inches above top of pipe shall be 24 inches maximum for pipe up to and including 12 inches diameter, and four-thirds diameter of pipe plus 8 inches for pipe larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.

- 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 12 inches above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular (Aggregate) Backfill: Depth of backfill shall be a minimum of 3 inches plus one sixth of pipe diameter below pipe to 12 inches above top of pipe (or as otherwise specified in Section 33 46 16, FOUNDATION DRAINAGE PIPE). Place and tamp fill material by hand.
 - c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.
- G. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by the Drawings and Specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by 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, 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, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.
1. Site Grading:
 - a. Provide a smooth transition between adjacent existing grades and new grades.
 - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:

- 1) Lawn or Unpaved Areas: Plus or minus 1 inch.
- 2) Walks: Plus or minus 1 inch.
- 3) Pavements: Plus or minus 1/2 inch.
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10 foot straightedge.

3.3 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Do not use unsuitable excavated materials. Do not backfill until: foundation walls have been completed above grade and adequately braced; waterproofing or dampproofing has been applied; foundation drainage and pipes coming in contact with backfill have been installed; and work has been inspected and approved by the COTR.
- B. Placing: Place materials in horizontal layers not exceeding 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (except as specified in 3.3.C) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction:
 1. Compaction of Backfill for Precast Concrete Crypts: Place backfill in maximum 12-inch lifts, and compact with vibrating plates or walk-behind non-vibrating rollers. Drivable rolling compactors such as sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, and vibrator compactors are not allowed over the crypts.
 2. For all other locations, compact fill and backfill with approved rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without prior approval of the COTR. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 as specified in the following paragraphs 3 through 6.

3. Under proposed structures, building slabs, steps, and paved areas: Scarify and recompact top 12 inches of existing subgrade and each 12-inch layer of backfill or fill material to 98 percent of the material's maximum dry density as determined by ASTM D698.
4. Under curbs and gutters and sidewalks, compact top 6 inches of existing subgrade and each 8-inch layer of backfill or fill material to 95 percent of the material's maximum dry density as determined by ASTM D698.
5. In lawn areas, compact top 16 inches to 85 percent of the material's maximum dry density as determined by ASTM D698.
6. In lawn areas, greater than 16 inches beneath finished grade, compact to 90 percent of the material's maximum dry density as determined by 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. Slope backfill outside building away from building walls for a minimum distance of 6 feet.
- C. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 6 inches unless otherwise shown.
- D. Finish subgrade in a condition acceptable to the COTR at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- E. Finished surface of graded areas and finished subgrade under roadway within the limits of construction shall be graded to the elevations shown on the Drawings within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus 2 inches
 2. Roadway Subgrade (bottom of aggregate surface course): Plus or minus 1 inch.

3.5 FIELD QUALITY CONTROL

- A. The following tests shall be performed during placement of soil backfill in pipe trenches and other excavations:

1. In-Place Density (using ASTM D1556, ASTM D2937, or ASTM D6938), minimum of one test for every three lifts of backfill placed at each structure and for every 200 linear feet of trench or fraction thereof.
 2. Moisture Content (using ASTM D2216 or ASTM D6938), minimum of one test for every three lifts of backfill placed at each structure and for every 200 linear feet of trench or fraction thereof.
- B. The following tests shall be performed during placement of road subgrade materials:
1. In-Place Density (using ASTM D6938 or ASTM D1556), minimum of one test for each six-inch thick fill layer per 500 square feet or fraction thereof.
 2. Moisture Content (using ASTM D4959 or ASTM D6938), minimum of one test for each six-inch thick fill layer per 500 square feet or fraction thereof.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

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

3.7 CLEAN UP:

Upon completion of earthwork operations, clean areas within contract limits, and remove tools and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Cemetery Property.

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**SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes 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:
 - 1. Curb, gutter, and combination curb and gutter.
 - 2. Pedestrian Pavement: Walks, grade slabs, wheelchair curb ramps, steps.
 - 3. Vehicular Pavement: Driveway apron.
 - 4. Reinforced Concrete Core for Stone Walls and Columns

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING
LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53,
CAST-IN-PLACE CONCRETE.
- D. Stone Veneer on Stone Walls and Columns: Section 04 43 00, STONE MASONRY.
- E. Capstones for Stone Walls and Columns: Section 03 45 00, PRECAST
ARCHITECTURAL CONCRETE
- F. Metal Components of Steps (Nosing and Railing): Section 05 50 00, METAL
FABRICATIONS.

1.3 DESIGN REQUIREMENTS

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

1.4 WEATHER LIMITATIONS

- A. Weather limitations for placement of concrete shall be as specified under paragraphs 3.4.D and 3.4.E of Section 03 30 53, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

- A. The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the COTR, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index,

liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the submittals specified in the following paragraphs.
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Reinforcement
 - 3. 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.

1.7 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. Refer to the latest edition of all referenced Standards and codes.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - M31 Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement (ASTM A615/A615M)
 - M55M/M55 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete (ASTM A185)
 - M147 Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses
 - M148 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
 - M171 Standard Specification for Sheet Materials for Curing Concrete (ASTM C171)
 - M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

M213 Standard Specification for Preformed Expansion Joint
Fillers for Concrete Paving and Structural Construction
(Non-extruding and Resilient Bituminous Type) (ASTM
D1751)

T99 Standard Method of Test for Moisture-Density Relations of
Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12
in.) Drop

T180 Standard Method of Test for Moisture-Density Relations of
Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18
in.) Drop

C. ASTM International (ASTM):

C94/C94M Standard Specification for Ready-Mixed Concrete

C143/C143M Standard Test Method for Slump of Hydraulic Cement
Concrete

PART 2 - PRODUCTS

2.1 GENERAL

- A. Concrete shall meet the mix design requirements for air-entrained concrete with a minimum 28-day compressive strength of 3000 psi as specified in Article 2.3 of Section 03 30 53, CAST-IN-PLACE CONCRETE, except maximum slump shall conform to the following:

<u>TYPE</u>	<u>MAXIMUM SLUMP*</u>
Curb & Gutter	3"
Pedestrian Pavement	3"
Concrete for Stone Walls and Columns	3"
Vehicular Pavement	2" (Machine Finished) 4" (Hand Finished)
Equipment Pad	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.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Reinforcing steel bars shall conform to AASHTO M31, deformed, grade 60, unfinished.
- D. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31.

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 1/8 inch in any ten foot long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 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 seven ounces or more per square yard when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1, and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- 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 SELECT SUBBASE (WHERE REQUIRED)

- A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.
- B. Placing:
 - 1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 8 inches, and that when compacted, will produce a layer of the designated thickness.
 - 2. When the designated compacted thickness exceeds 6 inches, place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
 - 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 - 4. If the elevation of the top layer is 1/2 inch or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches compacted thickness.
- C. Compaction:
 - 1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
 - 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.

D. Smoothness Test and Thickness Control:

1. Test the completed subbase for grade and cross-section with a straight edge.
2. The surface of each layer shall not show any deviations in excess of 3/8 inch.
3. The completed thickness shall be within 1/2 inch of the thickness as shown.

E. Protection:

1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 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 1/8 inch when checked with a straightedge and shall not deviate from true line by more than 1/4 inch at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

- C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.
 - 1. Make necessary corrections to forms immediately before placing concrete.
 - 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The 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.
- C. Curb-forming machines for constructing curbs and gutters will be approved based on trial use on the project. If the equipment produces unsatisfactory results, as determined by the COTR, discontinue use of the equipment at any time during construction and accomplish the work by hand method construction as specified. Remove unsatisfactory work and reconstruct the full length between regularly scheduled joints. Dispose of removed portions off Cemetery property.

3.5 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.

3.6 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.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross-section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

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

3.9 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.
- B. Surface preparation for concrete core for stone walls and columns after form removal shall conform to the requirements of Section 03 30 53, CAST-IN-PLACE CONCRETE.

No additional finishing will be required for surfaces which will be concealed by stone masonry.

3.10 CONCRETE FINISHING FOR CURB AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 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 1/8 inch for gutter and 1/4 inch for top and face of curb, when tested with a 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, and combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING FOR PEDESTRIAN PAVEMENT

- A. Walks, Grade Slabs, Wheelchair Curb Ramps:
 - 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 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 3/16 inch when tested with a 10-foot straightedge.
 6. The thickness of the concrete shall not vary more than 1/2 inch.
 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.
1. Remove the riser forms one at a time, starting with the top riser.
 2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.
 3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.
 4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 3/16 inch.

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet long and 6 inches wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet in length, and straightedges 10 feet in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 10-foot straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

- D. The finished surface of the pavement shall not vary more than 1/4 inch in both longitudinal and transverse directions when tested with a 10-foot straightedge.
- E. The thickness of the pavement shall not vary more than 1/4 inch.
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 18 inches wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1/8 inch in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.
- G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.13 CONCRETE FINISHING FOR EQUIPMENT PADS

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

3.14 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.

3.15 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. Construct joints in curbs and gutters by inserting 1/4 inch steel plates conforming to the cross-sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.

- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.16 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 where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 - 2. Using joint filler of the type, thickness, and width as shown.
 - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.17 CONSTRUCTION JOINTS

- A. Locate // longitudinal // and transverse // construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.18 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.

3.20 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 6 inches.
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 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 12 inches. Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 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.

3.21 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.

3.22 PROTECTION

- A. 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.

3.23 FINAL CLEAN-UP

- A. Remove all debris, rubbish and excess material from the Cemetery property.

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SECTION 32 12 16 ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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, thicknesses, 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: Section 31 20 00, EARTH MOVING.

1.3 INSPECTION OF PLANT AND EQUIPMENT

- A. The COTR shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

- A. The Contractor's Registered Professional Land Surveyor specified in Section 01 00 00, GENERAL REQUIREMENTS 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.

1.5 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 the Arkansas State Highway and Transportation Department (AHTD).

2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by AHTD.
3. Job-mix formula.
- C. Certifications :
 1. Asphalt prime and tack coat material certificate of conformance to AHTD requirements.
 2. Asphalt cement certificate of conformance to AHTD requirements.
 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the referenced AHTD Specification.

D. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

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. Arkansas State Highway and Transportation Department(AHTD):
Standard Specifications for Highway Construction, 2003 Edition

PART 2 - PRODUCTS

2.1 GENERAL

- A. Aggregate subbase (where required), aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the AHTD Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the AHTD Specifications, it shall mean the VA COTR or 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 material (where required): Conform to Section 302 of the AHTD Standard Specifications, Class SM-1 material (or as otherwise approved by the COTR); 2-inch maximum size particles; maximum 25 percent passing number 200 sieve; maximum Plasticity Index 3.
- C. Aggregate base course material: Conform to Section 303 of the AHTD Standard Specifications, and as specified below
 1. Base course over 6-inch thick: AHTD Class 4, 5, 6 or 7;
 2. Other base courses: AHTD Class 8.

D. Aggregates for asphalt concrete base course:

1. Aggregates shall conform to the requirements of Sections 405 and 409 of the AHTD Standard Specifications for 1-1/2" [37.5 mm] Asphalt Concrete Hot Mix (ACHM) Base Course.

E. Aggregates for asphalt concrete surface course:

1. Aggregates shall conform to the requirements of Sections 407 and 409 of the AHTD Standard Specifications for 1/2" [12.5 mm] Asphalt Concrete Hot Mix (ACHM) Surface Course.

2.3 ASPHALT PAVING MIXTURES

- A. Asphalt Concrete Base Course: Provide a mixture of mineral aggregates and asphalt binder conforming to the requirements of Sections 404, 405 and 409 of the AHTD Standard Specifications for 1-1/2" [37.5 mm] ACHM Base Course.
- B. Asphalt Concrete Surface Course: Provide a mixture of mineral aggregates and asphalt binder conforming to the requirements of Sections 404, 407 and 409 of the AHTD Standard Specifications for 1/2" [12.5 mm] ACHM Surface Course.

2.4 ASPHALT PRIME AND TACK COATS

- A. Asphalt prime and tack coat materials shall conform to Sections 401 and 403 of the AHTD Standard Specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. 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 AHTD Standard Specifications for the type of material specified.

3.2 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 50 ton gross weight dump truck, unless otherwise required in Section 212 of the AHTD Standard Specifications, and as approved by VA COTR or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 AGGREGATE SUBBASE AND BASE COURSES

- A. Aggregate 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. Aggregate 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 0.0 inch to plus 0.5 inch.
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 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 ASPHALT CONCRETE PAVING

- A. Remove all loose materials from the compacted aggregate 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 COTR.
- C. Receipt of asphalt concrete materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature conforming to the AHTD Standard Specifications.

2. Do not commence placement of asphalt concrete materials when the atmospheric temperature is below 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 3 inches or less, spread in one layer (unless otherwise required in the AHTD Standard Specifications)..

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 1/8 inch in six feet.

3.6 PROTECTION

- A. Protect the asphalt concrete paved areas from traffic until acceptance of the construction work.

3.7 FINAL CLEAN-UP

- A. Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 14 13 PRECAST CONCRETE UNIT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

Section includes furnishing and installation of precast concrete grid or open-celled concrete pavers with stone subbase, base and bedding courses, concrete edge restraint, and topsoil infill.

1.2 RELATED WORK

- A. Subgrade preparation: Section 31 20 00, EARTH MOVING.
- B. Topsoil material: Section 32 90 00, PLANTING.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
M288 Geotextile Specification for Highway Applications
- C. American Concrete Institute (ACI):
301-05 Specifications for Structural Concrete
- D. ASTM International (ASTM):
C33 Standard Specification for Concrete Aggregates
C150 Standard Specification for Portland Cement
C1319..... Standard Specification for Concrete Grid Paving Units
D448 Standard Classification for Sizes of Aggregate for Road
and Bridge Construction
D4873..... Standard Guide for Identification, Storage, and Handling of
Geosynthetic Rolls and Samples
- E. Arkansas State Highway and Transportation Department (AHTD):
Standard Specifications for Highway Construction, 2003 Edition

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit the following for review prior to scheduled delivery of materials to the Site:

1. Written documentation (including gradation test results) signed by the material producer, indicating that the stone subbase, base and bedding course materials meet or exceed the specified requirements.
 2. Manufacturers' descriptive documentation (including material properties sheet) for geotextile showing conformance with the specifications.
 3. Concrete mix design for edge restraint.
 4. Manufacturer's product data sheets, installation instructions and material safety data sheets for concrete pavers.
 5. Full-size sample set of concrete pavers to indicate color, size, finishes and textures.
 6. Test results from an independent testing laboratory for compliance of concrete pavers to ASTM C1319.
- B. Submit the following for review at time of shipment of geotextile:
1. The manufacturers' quality control certifications, to verify that the materials supplied for the project are in compliance with the product specifications in this Section. The certifications shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers, and corresponding shipping information.

1.5 QUALITY ASSURANCE

- A. Manufacturer shall be a firm specializing in the manufacture of concrete grid or open-celled concrete pavers for a minimum of 3 years.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Geotextile product rolls shall be marked or tagged with manufacturer's name, product identification, lot number, roll number, and roll dimensions. Procedures for storage and handling of geotextile shall conform to ASTM D4873 and the manufacturer's recommendations.
- B. Stone materials shall be adequately protected to preserve the fitness and quality of the materials.
- C. Deliver concrete pavers in steel banded, plastic banded, or plastic wrapped packaging suitable for unloading by forklift or clamp lift. Contents shall be clearly labeled. Unload pavers as recommended by the manufacturer to prevent damage to the products.
- D. Concrete pavers shall be visually inspected by the Contractor upon delivery to the Site. All pavers shall be sound and free of defects that would interfere with the proper placing

of pavers or impair the strength and quality of the construction. Minor cracks or chipping resulting from standard methods of handling in shipment and delivery will be acceptable. Products that fail to conform to material specifications shall be rejected as determined by the COTR.

- E. Coordinate delivery and installation schedule to minimize interference with adjacent construction.

PART 2 - PRODUCTS

2.1 CONCRETE EDGE RESTRAINT

- A. Concrete shall consist of: Type I or II Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and clean water. Mix shall be proportioned such that the 28-day compressive strength of moist-cured laboratory samples achieves not less than 3,000 psi.
- B. Reinforcing steel shall be deformed billet steel bars conforming to ASTM A 615, grade 60, unfinished.

2.2 GEOTEXTILE

- A. Geotextile shall be nonwoven geotextile conforming to the specifications for Survivability Class 1 or Class 2 geotextile as defined in AASHTO M288.

2.3 STONE SUBBASE MATERIAL

- A. Stone subbase material shall conform to the material specifications for aggregate in Section 303 of the AHTD Standard Specifications, except gradation shall be as specified in ASTM D448 for size number 2 coarse aggregate.

2.4 STONE OPEN-GRADED BASE MATERIAL

- A. Stone open-graded base material shall conform to the material specifications for aggregate in Section 303 of the AHTD Standard Specifications, except gradation shall be as specified in ASTM D448 for size number 57 coarse aggregate.

2.5 BEDDING COURSE MATERIAL

- A. Aggregate to be used for bedding course shall consist of granite "trap rock". Gradation shall be as specified in ASTM D448 for size number 8 coarse aggregate.

2.6 CONCRETE PAVERS

- A. Precast open-celled concrete (concrete grid) pavers shall meet the physical requirements specified in ASTM C1319, including the following:
 - 1. Average compressive strength (of three tested units) shall be 5000 psi, with no individual unit less than 4500 psi.

2. Maximum water absorption (of three tested units) shall be 10 pounds per cubic foot.
- B. Maximum thickness of concrete grid paver units shall be 4 inches. Dimensions shall meet the dimensional tolerances of ASTM C1319. Color shall be natural concrete.
- C. Acceptable Products and Manufacturers:
 1. EcoGrid®, manufactured by Hanover® Architectural Products (web site: www.hanoverpavers.com).
 2. Turf Paver, manufactured by EP Henry (web site: www.ephenry.com).
 3. Turf Stone, manufactured by Paver Systems of Florida (web site: www.paversystems.com).

2.7 JOINT FILLER MATERIAL

- A. Material to be used for filling of joints and openings in paver units shall consist of topsoil obtained from stockpiles established under Section 31 20 00, EARTH MOVING. Topsoil shall meet the material requirements specified in Section 32 90 00, PLANTING.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Grading of the subgrade shall be completed as indicated on the Drawings and as specified in Section 31 20 00, EARTH MOVING. Subgrade shall be compacted as specified for asphalt pavement subgrade. Maintain subgrade in a smooth, compacted condition until installation of overlying stone materials or concrete edge restraint, as applicable.

3.2 CONCRETE EDGE RESTRAINT CONSTRUCTION

- A. Construct formwork as necessary to provide the required dimensions for concrete construction indicated on the Drawings. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain required shape.
- B. Concrete edge restraint shall be constructed on prepared subgrade at the locations, elevations and dimensions indicated on the Drawings. Install reinforcing steel where indicated on the Drawings. Accurately position, support, and secure reinforcement against displacement.
- C. Mix and place concrete in accordance with the applicable requirements of ACI 301-05. Exposed top of edge restraints shall receive a smooth-rubbed finish.
- D. Expansion and contraction joints shall be provided as specified below (unless otherwise indicated on the Drawings):

1. Expansion joints shall be formed at concrete curbs. Expansion joint width shall be 3/4 inch. Joint filler shall extend for the full depth of the joint. Install joint filler in accordance with the manufacturer's recommendations.
 2. Contraction joints shall be provided for crack control at maximum spacing of 27 feet. Dimension of each formed or saw cut contraction joint shall be two inches deep by 1/8 inch wide.
- E. Immediately following concrete placement and finishing operations, cure and protect concrete in conformance with the applicable requirements of ACI 301-05.

3.3 GEOTEXTILE INSTALLATION

- A. Geotextile shall be placed on excavated and graded subgrade within the limits of precast concrete unit paving as indicated on the Drawings.
- B. Install geotextile in such a manner that placement of overlying material will not excessively stretch or tear the fabric. Seaming of geotextile will not be required. Overlap adjacent sections of geotextile a minimum of 9 inches.
- C. Heavy equipment shall not be allowed to travel directly on installed geotextile.
- D. Cover geotextile as soon as possible after installation and approval. Installed geotextile shall not be left exposed for more than 15 days.
- E. Holes or tears in the geotextile shall be repaired with a patch of the same material. Geotextile patches shall be sized to cover a minimum of 24 inches beyond the limits of the damaged area in all directions.
- F. The surface of the installed geotextile shall be free of trash and debris prior to placement of stone subbase material.

3.4 PLACEMENT OF STONE SUBBASE AND BASE

- A. Place each course of stone at the required locations and to the dimensions and thicknesses indicated on the Drawings. Construct each course of stone in one uniform layer.
- B. Stone subbase and stone open-graded base courses shall be placed and compacted using equipment and methods that will prevent damage to the installed geotextile. Geotextile damaged during placement of stone shall be repaired as specified in subsection 3.3.
- C. Compact each course using several passes of hand-operated, walk-behind, lightweight compaction equipment. Grade the finished surface of each course to provide a firm and uniform surface.

3.5 PLACEMENT OF BEDDING COURSE

- A. Spread bedding course material evenly over the stone open-graded base and screed to a nominal 2-inch thickness. The screeded bedding course material shall not be disturbed. Place sufficient bedding course material to stay ahead of the laid pavers.

3.6 PLACEMENT OF CONCRETE PAVERS

- A. Make sure that pavers are free of foreign materials before installation.
- B. Lay the pavers in the pattern(s) shown on the Drawings or as directed by the COTR. Maintain straight joint lines.
- C. Joints between the pavers shall not exceed 3/16 inch width. Fill gaps at the edges of the paved area with cut pavers or edge units. Cut pavers to be placed along the edges with a double bladed splitter or masonry saw.
- D. Place and sweep topsoil into the joints and openings of the pavers until full.
- E. Use a low amplitude, high frequency plate vibrator to vibrate the pavers into the bedding course as recommended by the manufacturer. Use rollers or pads between the compactor and pavers to prevent cracking or chipping. Do not vibrate within 6 feet of the unrestrained edges of the pavers.
- F. All work to within 6 feet of the laying face shall be left fully compacted with filled joints and openings at the completion of each day.
- G. Sweep off excess topsoil material from the surface is concrete paver installation is complete.
- H. The final surface elevation of pavers shall be as indicated on the Drawings and shall not deviate more than 3/8 inch under a 10-foot long straightedge. Top surface shall be 1/8 inch to 1/4 inch above adjacent concrete edge restraint.

3.7 CLEANUP

- A. Remove all excess pavers, bedding course material and filler material from the Site at the completion of the Work.

3.8 MAINTENANCE AND PROTECTION

- A. Work shall be protected against damage from subsequent construction operations.
- B. Refill paver joints and openings as necessary for a period of 90 days after completion of concrete paver installation work.

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SECTION 32 31 13 CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This work consists of all labor, materials, and equipment necessary for furnishing and installing chain link fence, 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: Section 31 20 00, EARTH MOVING, and Section 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: Chain link fencing, gates and all accessories.
 - 2. Manufacturer's Certificates: Certification that zinc coating complies with the specifications.
- B. Certification that fence alignment meets requirements of contract documents.

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. ASTM International:
 - A392..... Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - A817..... Standard Specification for Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
 - C94/C94M..... Standard Specification for Ready-Mixed Concrete
 - F567..... Standard Practice for Installation of Chain-Link Fence
 - F626..... Standard Specification for Fence Fittings
 - F900..... Standard Specification for Industrial and Commercial Swing Gates

- F1043..... Standard Specification for Strength and Protective
Coatings on Steel Industrial Chain-Link Fence Framework
- F1083..... Standard Specification for Pipe, Steel, Hot-Dipped Zinc-
Coated (Galvanized) Welded, for Fence Structures.

C. Federal Specifications (Fed. Spec.):

- FF-P-110J Padlock, Changeable Combination

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials shall conform to ASTM F1083 and ASTM A392 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 and sal-ammoniac spots.

2.2 CHAIN-LINK FABRIC

- A. Chain-link fabric shall conform to ASTM A392, 9 gauge wire woven in a 2-inch mesh. Top and bottom selvages shall have twisted and barbed finish. Zinc coating weight shall be 2.0 ounces per square foot.

2.3 POSTS FOR GATES AND FENCING

- A. Posts shall conform to ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification. Provide post braces and truss rods for each gate, corner, pull or end post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

2.4 TOP RAIL

- A. Top rail shall conform to ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification; fitted with suitable expansion sleeves and means for securing rail to each gate, corner, and end posts.

2.5 BOTTOM TENSION WIRE

- A. Tension wire shall conform to ASTM A817, zinc-coated, having minimum coating the same as the fence fabric.

2.6 ACCESSORIES

- A. Provide accessories as necessary, including caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories conforming to ASTM F626

2.7 GATES

- A. Gates shall conform to ASTM F900, type as shown. Gate framing, bracing, latches, and other hardware zinc-coating weight shall be the same as the fence fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods, or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gates less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement.

2.8 GATE HARDWARE

- A. Provide manufacturer's standard products, installed complete. The type of hinges shall allow gates to swing through 180 degrees, from closed to open position. Hang and secure gates in such a manner that, when locked, they cannot be lifted off hinges.
- B. Provide stops and keepers for all double gates. Latches shall have a plunger-bar arranged to engage the center stop. Arrange latches for locking. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger bar. Keepers shall consist of a mechanical device for securing the free end of the gate when in full open position.
- C. Equip gate openings with padlock conforming to Fed Spec FF-P-110H, Type EPC, size 2 inch. Padlocks shall have chains that are securely attached to the gate or gate post. Before padlocks are delivered to project, submit sample to the COTR for approval. Approved sample may be incorporated in work. Key padlock as directed by the COTR.

2.9 CONCRETE

- A. Concrete for post footings shall conform to ASTM C94/C94M, using 3/4 inch maximum-size aggregate, and shall have a minimum compressive strength of 3000 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.

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 ASTM F567 and with the manufacturer's printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project site in sufficient quantities and capacities for proper installation of posts, chain-link fabric, and accessories.
- B. A Registered Professional Land Surveyor or Registered Civil Engineer specified in Section 01 00 00, GENERAL REQUIREMENTS, shall stake out and certify the fence alignment to meet 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 into the bedrock, whichever is less, and provide a minimum of 2 inches 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 to be free of voids, and finish exposed top of concrete footing in a slope or dome to divert water running down the post away from the footing. Straight runs between braced posts shall not exceed 500 feet.
- B. Install posts in bedrock (if encountered) with a minimum of one inch of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids, and finish exposed top of grout in a slope or dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

3.4 POST CAPS

- A. Fit all exposed ends of post with caps. Provide caps that fit snugly and are weathertight. Where top rail is used, provide caps to accommodate the top rail. Install post caps as recommended by the manufacturer and as shown.

3.5 SUPPORTING ARMS

- A. Design supporting arms, when required, to be weather tight. 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 TOP RAILS

- A. Install rails before installing chain link fabric. Provide suitable means for securing rail ends to terminal and intermediate post. Top rails shall pass through intermediate post supporting arms or caps as shown. The rails shall have expansion couplings (rail sleeves) spaced as recommended by the manufacturer. Where fence is located on top of a wall, install expansion couplings over expansion joints in wall.

3.7 BOTTOM TENSION WIRE

- A. Install and pull taut tension wire before installing the chain-link fabric.

3.8 ACCESSORIES

- A. Supply accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to accommodate the installation of a complete fence, with fabric that is taut and attached properly to posts, rails, and tension wire.

3.9 FABRIC

- A. Pull fabric taut and secured with wire ties or clips to the top rail and tension wire close to both sides of each post and at intervals of not more than 24 inches on centers. Secure fabric to posts using stretcher bars and ties or clips.

3.10 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. Adjust hardware for smooth operation and lubricate where necessary.

3.11 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.

3.12 FINAL CLEAN-UP

- A. Remove all debris, rubbish and excess material from the cemetery property.

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SECTION 32 31 19 ORNAMENTAL PICKET FENCES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies ornamental picket fencing and accessories.

1.2 RELATED WORK

- A. Section 04 43 00, STONE MASONRY.

1.3 SUBMITTALS

- A. Shop Drawings: Layout of fences with dimensions, details, and finishes of component accessories and post foundations.
- B. Product Data: Manufacturer's catalogue cuts indicating material compliance and specified options.
- C. Samples: Color selections for finishes. If requested, samples of materials (including finials, caps, and accessories).

1.4 SPECIAL WARRANTY

- A. Provide manufacturer's standard limited warranty that its ornamental fence system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of 15 years from the date of purchase.
 - 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.

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. ASTM International (ASTM):
 - B221..... Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes

- C579 Standard Test Methods for Compressive Strength of
Chemical-Resistant Mortars, Grouts, Monolithic
Surfacings, and Polymer Concretes
- C827 Standard Test Method for Change in Height at Early Ages
of Cylindrical Specimens of Cementitious Mixtures

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER(S) AND PRODUCT(S)

- A. Ameristar Fence Products 1555 North Mingo Tulsa, OK 74116. The requirements of this Section are based on the manufacturer's specifications for the indicated fence product. Products from other qualified manufacturers having a minimum of 5 years experience manufacturing ornamental picket fencing will be acceptable by the COTR, if approved in writing, and if they meet the following specifications for design, size, gauge of metal parts and fabrication.
- B. The manufacturer shall supply a total industrial ornamental aluminum fence system of the Ameristar® Echelon II™ Classic™, 2-rail style, 60-inch height. The system shall include all components (i.e., tubular pickets, rails, posts, gates and hardware) required.

2.2 ORNAMENTAL PICKET FENCE

- A. Aluminum material for fence framework (including tubular pickets, rails and posts) shall conform to the requirements of ASTM B221. The aluminum extrusions for posts and rails (outer channel) shall be Alloy and Temper Designation 6005-T5. The aluminum extrusions for pickets and rail inner slide channels shall be Alloy and Temper Designation 6063-T5.
- B. The manufactured framework shall be subjected to the Ameristar® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/ wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils. The color shall be black.
- C. Material for fence pickets shall be 1 inch square by .065 inch thick extruded tubing. The cross-sectional shape of the rails shall conform to the manufacturer's ForeRunner™ design with outside cross-section dimensions of 1.75 inch square. The top wall of the outer channel of the rail shall be .100" thick; the side walls shall be .120 inch thick for

superior vertical load strength. The inner slide channel of the rail shall be .080 inch. Picket holes in the ForeRunner™ rail shall be spaced 4.98 inches on center. Picket retaining rods shall be .125 inch diameter galvanized steel. Posts shall be a minimum of 2 1/2 inches square with a perimeter wall thickness of .080 inch and an interior reinforcing web thickness of .080 inch. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections.

- D. All fasteners shall be stainless steel. Bracket to rail attachments shall be made using specially designed one-way tamperproof security bolts with inverted “t-nuts”. Bracket to post connections shall be made using self-drilling hex-head screws.
- E. Aluminum castings shall be used for all rings, post caps, finials, and miscellaneous adornments.

2.3 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. ForeRunner™ rails shall be pre-punched to accept pickets.
- B. The rail inner slide shall be fully inserted into the rail outer channel to form the raceway for the internal retaining rod. Grommets shall be inserted into the pre-punched holes in the rails, and pickets shall be inserted into the pre-punched holes in the rails, and pickets shall be inserted through the grommets so that pre-drilled picket holes align with the internal raceway of the two-part ForeRunner™ rails. (Note: This can best be accomplished by using an alignment template). Retaining rods shall be inserted into each ForeRunner™ rail so that they pass through the pre-drilled holes in each picket, thus completing the panel assembly.
- C. Completed panels shall be capable of supporting a 300 pound load (applied at midspan) without permanent deformation. Panels shall be biasable to a 25 percent change in grade.

2.4 NON-SHRINK GROUT

- A. Furnish non-shrink, non-metallic, non-corrosive epoxy grout conforming to the following specifications.
 - 1. Shrinkage at 28 days: No shrinkage (0.00 shrinkage when tested in accordance with ASTM C827, modified procedure).
 - 2. Compressive strength, minimum: 10,000 psi at seven days when tested in accordance with ASTM C579.

- 3. Initial setting time: approximately one hour at 70 degrees F.
- B. Epoxy grouts which are volatile and which give off noxious fumes are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations, including construction of stone masonry walls as specified in Section 04 43 00, STONE MASONRY.

3.2 INSTALLATION

- A. Install fence in accordance with manufacturer's instructions.
- B. Space posts uniformly at 7 feet 8-3/4 inches maximum face to face unless otherwise indicated.
- C. Anchor posts to top of wall by core drilling holes to a minimum depth of 18 inches below top of wall capstone and to a diameter of approximately 4 inches. Drill holes at the required spacing and alignment within allowable tolerances as recommended by the manufacturer.
- D. Clean holes of all loose material and insert posts. Check each post for vertical and top alignment, and maintain in position during grout placement and finishing operation.
- E. Fill annular space between post and corehole wall with non-shrink grout at each post location. Mix components using proper mechanical mixers and place the grout in accordance with the manufacturer's recommendations.
- F. Grout shall be allowed to cure as recommended by the manufacturer prior to attachment of fence materials.
- G. Align fence panels between posts. Firmly attach rail brackets to posts with 1/4 inch bolt and lock nut, ensuring panels and posts remain plumb.

3.3 ACCESSORIES

- A. Install post caps and other accessories to complete fence.

3.4 CLEANING

- A. Clean up debris and unused material, and remove from site.

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SECTION 32 84 00 PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

This work consists of furnishing and installing an automatically-controlled irrigation system, complete, including piping, backflow preventer, sprinkler heads, valves, controls, control wiring, fittings, electrical connections and necessary accessories.

1.2 RELATED WORK

- A. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- D. Division 26, ELECTRICAL.
- E. Section 32 90 00, PLANTING

1.3 QUALITY ASSURANCE

- A. Criteria:
 - 1. Manufacturer regularly and presently manufactures the item submitted as one of their principal products.
 - 2. There is a permanent service organization, maintained or trained by the manufacturer, which will render satisfactory service within eight hours of receipt of notification that service is requested.
 - 3. Installer, or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform the specified work.
- B. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.
 - 2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 - a. All components of an assembled unit need not be products of the same manufacturer but component parts which are alike are the product of a single manufacturer.

- b. Components are compatible with each other and with the total assembly for the intended service.
- 3. Nameplates: Nameplate bearing manufacturer's name or identification 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.
- 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 without overthrow on roadways, sidewalks, window wells, or buildings and to protect trees from close high spray velocity.
 - 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. Lines are to be common trenched wherever possible.
 - 3. Locations of remote control valves is schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads.
 - 4. Irrigation lines and control wire shall run at boundaries of graves, thru designated utility lanes or beside roadways so that any gravesite may be opened in the future without disruption of the irrigation system.
 - 5. Connect new system to new and existing mains as shown in the drawings.
- D. Maintenance and Operating Instructions: Prior to final acceptance, verbal instructions, for a period of not less than 16 hours, shall be provided to the operating personnel. Provide two additional years of software support for one hour each month. Provide manuals as specified in Section 01 00 00, GENERAL REQUIREMENTS.
- E. Completely program controller and satellites according to approved irrigation schedule.
- F. Follow manufacturer's instructions for installation.
- G. Manufacturer of Control Systems to certify Control System is complete, including all related components, and totally operational. Submit certificate to Resident Engineer.
- H. As-Built Record Drawings: Maintain a complete set of as-built drawings which shall be corrected daily to show changes in locations of all pipe, valves, pumps and related irrigation equipment. Valves shall be shown with dimensions to reference points.
- I. Controller Chart:

1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
2. Provide one controller chart showing the area covered by each satellite controller supplied at the maximum size the controller door will allow. The chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door.
3. The chart shall be a photographically reproduced print with a different color used to show coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of clear plastic, each piece being a minimum of 10 mils thick. Charts must be completed and approved prior to final inspection of the irrigation system.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data:
 1. Piping.
 2. Jointing materials.
 3. Valves.
 4. Backflow preventer.
 5. Water meter.
 6. Frames and covers.
 7. Manhole Steps.
 8. Strainers.
 9. Pressure gages.
 10. Automatic control equipment.
 11. Sprinkler heads.
 12. Drip Emitters
 13. Quick couplers.
 14. Valve boxes.

- C. Complete detailed layout shop drawings covering design of system showing pipe sizes and lengths; fittings, locations, types and sizes of sprinkler heads; controls; backflow preventers; valves; drainage pits; location and mounting details of electrical control equipment; complete wiring diagram showing routes and wire sizes; wiring details and source of current and connections to proposed services. Do not start work before final shop drawing approval.
- D. Name and address of a permanent service organization maintained or trained by the manufacturers that will render satisfactory service within eight hours of receipt of notification that service is requested.
- E. Reproducible "as-built" drawings.
- F. After "as-built" drawings have been approved, submit print of controller chart.

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.):
 - AA-60005 Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole
- C. American National Standard Institute (ANSI):
 - B40.1-98..... Gauges-Pressure Indicating Dial Type-Elastic Element
- D. American Society of Sanitary Engineers (ASSE):
 - 1013-2005 Reduced Pressure Principle Backflow Preventers
- E. ASTM International (ASTM):
 - B61-02..... Steam or Valve Bronze Castings
 - B62-02..... Composition Bronze or Ounce Metal Castings
 - D1785-04a Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D2241-04b Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 - D2287-96(2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
 - D2464-99e1 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

- D2466-05 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2564-04 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- D2855-96(2002) Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- F477-02e1 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F. American Water Works Association (AWWA):
 - C110/A21.10-03 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water
 - C111/A21.11-00 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - C115/A21.15-99 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 - C151/A21.51-02 Ductile-Iron Pipe, Centrifugally Cast, for Water
 - C153/A21.53-00 Ductile-Iron Compact Fittings for Water Service
 - C500-02 Metal-seated Gate Valves for Water Supply Service C504-00 Rubber Seated Butterfly Valves
 - C600-99 Installation of Ductile-Iron Water Mains and Their Appurtenances
- G. Manufacturers Standardization Society (MSS):
 - SP70-1998 Cast Iron gate Valves, Flanged and Thread Ends
- H. National Electrical Manufacturers Association (NEMA):
 - 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum);

PART 2 - PRODUCTS

2.1 PIPING

- A. Irrigation Mains: Provide one of the following materials.
 - 1. Ductile Iron, AWWA 151, working pressure 150 psi, cement lined, exterior bituminous coated.

2. Polyvinyl Chloride (PVC) Pressure Pipe, AWWA C900, PVC 1120, working pressure 150 psi. Pipe shall conform to outside diameters of AWWA 151 cast iron pressure pipe to accommodate cast iron fittings.
- B. Irrigation Laterals: Polyvinyl Chloride, ASTM D2241, PVC 1120, SDR 21, solvent welded.
- C. Threaded Pipe: Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.
- D. Above Grade and in Concrete Pit: AWWA C115, flanged joints and fittings working pressure 150 psi.
(moved to 2.16.E)
- E. Fittings:
 1. Irrigation Mains (Ductile Iron and PVC Pipe): Ductile Iron, AWWA 110.
 2. Irrigation Laterals: PVC, schedule 40, solvent welded socket type, ASTM D2466.
 3. Threaded Pipe: PVC, schedule 80, ASTM D2464.
 4. Swing Joints: Threaded fittings with elastomeric seals that allow 360 degree rotation, and designed for minimum 200 psi working pressure, may be used in lieu of standard threaded fittings.
- F. Jointing Materials:
 1. Irrigation Mains: Rubber gaskets, AWWA C111.
 2. Irrigation Laterals: Solvent cement, ASTM D2564.

2.2 VALVES (EXCEPT REMOTE CONTROL VALVES)

- A. Underground Shut-Off Valves: Provide One of the Following:
 1. Gate valves 2 inches and larger: Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 150 psi minimum working pressure. AWWA C504.
 2. Butterfly valves 3 inches and larger: cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, 150 psi minimum pressure. AWWA C504.
 3. Ball valves (for isolation valves 1-1/2" and smaller): Full-port ball valves with bronze body, PTFE seats, and 90 degree on/off handle. Ball valves to have NPT female end connections.

B. Operations:

1. Underground: furnish valves with 2 inch nut for T-Handle socket wrench operation.
2. Above ground and in pits: MSS SP70, with handwheels.
3. All butterfly valves 6 inches and above shall have enclosed gear drive operators.
4. Ends of valves shall accommodate the type of pipe installed.

C. Check: Swing.

1. Smaller than 4 inches: Bronze body and bonnet, ASTM B61 or B62, 125 pound WSP.
2. One hundred 4 inches and larger: Iron body, bronze trim, vertical or horizontal installation, flange connection, 200 pound WOG.

D. Pressure Reducing Valve: Cast steel body with renewable seats, with stainless steel trim. Flow passages and all parts designed to withstand high velocity applications, flange connected.

2.3 VALVE BOX

- A. Gate and Butterfly Valve:** Valve boxes shall be precast concrete (from Rigid Cast Iron Forms) with compressive strength of the concrete in excess of 30 Mpa (4000 psi). Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to differentiate between lawn irrigation system and domestic water supply system and set flush with finished grade. Provide two (2)"T" handle socket wrenches of 5/8 inch round stock with sufficient length to extend 2 feet above top of deepest valve box cover.
- B. Remote Control Valves:** When in pavement, valve boxes shall be precast concrete (from Rigid Cast Iron Forms) with compressive strength of the concrete in excess of 30 MPa (4000 psi). In planter areas, valve boxes shall be HDPE structural foam Type A, Class III, green in color. Box shall be minimum 19 inches long by 14 inches deep with key-lockable hinged cast iron cover.
1. After installation, label boxes with two 3 inch size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.
 2. Furnish two (2) 30 inch long valve adjustment keys.

2.4 BACKFLOW PREVENTER

- A. Provide reduced pressure principle backflow preventer in each new connection to existing water distribution system, ASSE 1013, except pressure drop at design flow shall not exceed 10 psi.
- B. Installation of backflow prevention assemblies on water service lines shall be accomplished by personnel licensed by the State of Arkansas. Name and address of the installer and owner shall be provided with installation plans.
- C. Installation shall not begin without a construction permit issued by the Approving Authority. All backflow prevention assemblies shall be installed in a manner that provides easy access for testing, maintaining, repairing and replacing the assembly. The recipient of the construction permit shall be responsible for installing the backflow prevention assembly in a manner prescribed by the approved installation plans. Failure to install the backflow prevention assembly in a manner approved by the Approving Authority shall be justification for refusing permanent water service. Plans are required to be submitted to the Arkansas State Health Department for approval in addition to submittal to the local approving authority. A sequence of construction is required to be submitted.
- D. Backflow prevention assembly shall be installed in accordance with the manufacturer's instructions and installation plans approved by the Approving Authority. The lowest point of the assembly shall be at least 12-inches but not more than 30 inches above the concrete pad or high water level, whichever is highest. Piping connected to the assembly shall not be used for electrical grounding. Piping connected to the assembly shall be thoroughly flushed and disinfected before installing the assembly. The assembly installation shall be protected from vandalism and freezing. Adequate support, excluding water lines, shall be provided under assembly valves for assemblies that are 3-inches or larger. Adjustable pipe stand supports shall be constructed of min. 2-inches diameter pipe and shall have a floor flange for fastening stand to concrete slab. Pipe stands shall be fastened to concrete slab using concrete expansion anchors. All test cocks shall be in place with shut-off valves. The assembly must be completely testable. Approved assemblies are ordered as an assembly with valves attached and tested at the factory in that configuration. Do not install an assembly with valves purchased separately. It is acceptable practice for the factory to ship assembly valves

in separate containers on the larger assemblies. These valves, however, are part of the assembly configuration. Access doors must be installed on the test cock side of the assembly. Assemblies must be installed horizontally. Assembly enclosures shall be affixed to a 6-inches thick concrete pad of 3,000 psi mix concrete with at least (1) layer of welded wire mesh. Pad shall be pitched to drain at a slope of 1% towards drain port end of valve enclosure. Enclosure must set flush with pad surface. Pad shall extend a minimum 6-inches beyond the enclosure on all sides. For 4-inches and smaller assemblies a 4-inches thick pad may be used. One enclosure or building exterior door key must be provided to the Approving Authority, upon request. Enclosure doors must be easy to remove and reinstall without binding. Commercial/Industrial lawn irrigation assemblies must be installed in a LokBox, as manufactured by Hot Box®, or equivalent. An approved blow-off shall be installed in the water line immediately after the assembly, to allow for flushing. Two through 8-inch assemblies shall have a blow-off not less than 2 inches in diameter. If not part of the approved assembly, an approved strainer shall be installed on the inlet side of the RPZA prior to the assembly isolation valve, so that all water must pass through the strainer immediately before entering the assembly.

- E. The installer is responsible for insuring the installation is in accordance with the City approved installation plans. Failure to do this may result in the denial of water service, occupancy of building, and Assembly Permit pending compliance with approved installation plans. Upon completion of installation, the installer must notify the Approving Authority. The assembly shall be inspected by the Approving Authority to verify conformance to approved installation plans. The installer shall then verify proper operation of the assembly through a test accomplished by a Certified Assembly Testing Technician. Test results shall be documented on the City of Fort Smith Cross-Connection Control Appendix C Testing Form and a copy sent to the Approving Authority before the installation is accepted. An Assembly Permit will not be issued until the installation has passed the final inspection.

2.5 WATER METER

- A. Paid for by Contractor, Furnished and installed by City of Fort Smith Utility Department..

2.6 PIT

- A. Reinforced poured in place concrete or approved precast concrete.

2.7 FRAMES AND COVERS

- A. When not in roadway:
 - 1. Fed. Spec. RR-F-621. Cast Iron. Provide covers with cast-in identification symbol "WATER".
 - 2. Frame: Figure 1, Type I, Style A, Size 30A.
 - 3. Cover: Figure 8, Type A, Size 30A
- B. When in roadway use traffic rated frame and cover

2.8 STEPS

- A. Precast Concrete: Constructed of cast iron or aluminum with asphalt coating where in contact with the concrete. Rungs shall be one inch diameter, 12 inches wide with 7 inches of clear space between the rung and the wall and a minimum of 2 1/2 inch depth in the wall.
- B. Reinforced Concrete: Same as above except a minimum of 6 inches in the wall.
- C. Rungs shall be free of sharp edges, burrs or projections and be designed so a foot cannot slide off the end. Provide in all structures exceeding 4 feet in depth.

2.9 STRAINERS

Basket or "Y" type with brass strainer basket. Body smaller than 2-1/2 inch shall be brass or bronze; 2-1/2 inch and larger shall be cast iron or semi-steel. Strainer cover to be furnished with blow-off connection and shut-off valve to accommodate 3/4 inch diameter hose connection.

2.10 PRESSURE GAUGES:

- A. ANSI B40 1, 4-1/2 inch diameter, all metal case, bottom connected. Dial shall be either dead black or white lacquered throughout. Provide shut-off cocks. Maximum graduations of 2 psi.

2.11 AUTOMATIC CONTROL EQUIPMENT—INDEPENDENT ELECTRIC CONTROLLER WITH NO FLOW SENSING(FOR SMALLER INSTALLATIONS)

- A. Overall control concept: The electric automatic control system shall consist of one controller which operates individual remote control valves in accordance with timing schedules programmed into the independent unit. The location of the controller is shown on the drawings. Toro Custom Command Series, or equal.
- B. Four independent programs.
- C. Seven (7) day calendar, odd/even day or day interval options of one (1) to thirty (30) days.

- D. Exclude a day option to allow for the selection of specific day(s) not to water.
- E. Three hundred sixty-five (365) day clock/calendar.
- F. Station run times of one (1) minute to ten (10) hours in one (1) minute increments.
- G. 16 total start times.
- H. Start time stacking within each program.
- I. Season adjust setting from ten (10) to two hundred (200) percent in ten (10) percent increments.
- J. Rain delay setting from one (1) to seven (7) days
- K. Automatic, semi-automatic, and manual and timed-manual operation.
- L. 10 position programming dial and LCD display.
- M. Lightning surge protection.
- N. Self-diagnostic circuit breakers that identify and override electrical malfunction of valves.
- O. Non-volatile memory to retain power during power failures of any duration.
- P. Battery backup to maintain accurate time for up to ninety (90) days.
- Q. Sensor hook-up with sensor override switch on faceplate.
- R. Weather-resistant, locking metal cabinet with heavy duty internal transformer.

2.12 REMOTE CONTROL VALVES:

- A. Each sprinkler section shall be automatically operated by a remote control valve installed underground and operated by a 24-volt AC/DC direct drive thermal hydraulic motor. Valves shall be globe type of heavy duty construction and shall have manual shut-off and flow control adjustment and provide for manual operation. Install valves with unions on each side to allow for easy removal. Valves shall have a minimum of 150 psi working pressure.
- B. Valves shall be of all brass construction furnished as straight or angle pattern type, or valve body shall be cast-iron with brass bonnet, trim and renewable seat and have two inlet tapings (furnished with one plugged) to allow installation as either a straight or angle pattern valve.
- C. Valves shall be diaphragm type designed to operate in water containing sand and debris and shall have a self cleaning type contamination filter to filter all water leading to the solenoid actuator and the diaphragm chamber. Valve shall incorporate a non-adjustable type opening and closing speed control for protection against surge pressures, or valves

shall operate by means of a slow acting direct drive thermal hydraulic motor without ports, screens or diaphragms.

- D. Valves shall be completely serviceable from the top without removing valve body from the system. Furnish two (2) 30 inch long adjustment keys. Valves to operate at no more than 7 psi pressure loss at manufacturers maximum recommended flow rate.

2.13 SPRINKLER HEADS

- A. Shall be of make, type and performance as indicated on drawings. The entire internal assembly including filter screen, to be capable of removal from the top without removing the sprinkler case from the riser.
- B. Rotary Pop-up Sprinklers: To be gear-driven.
 - 1. Full Circle Sprinklers: To be a dual or tri-nozzle combination type with positive drive by means of a water-driven gear assembly. Sprinkler head to rotate uniformly and to be driven by means of a train of gears. Sprinklers to be equipped with an integral anti-drain valve to be self-closing at pressures of 3.0m (10 feet) of head or less. Gears and pinions shall be assembled on stainless steel spindles in a water-lubricated sandproof gear case. An inlet screen shall prevent debris from entering the sprinkler and shall be removable with the internal assembly. Sprinklers outer case shall be constructed of corrosion resistant, impact resistant, heavy-duty ABS.
 - 2. Part circle sprinklers to be variable arc type as required with same type drive used for full circle heads.
- C. Shrub Spray Heads: Nozzle shall be pop-up or fixed spray type of standard, undersize or oversize configuration as noted on plans. The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty, ultraviolet resistant plastic. It shall have a heavy duty stainless steel retract spring and a ratcheting system for alignment of the pattern. The sprinkler shall have a soft elastomer pressure-activated comolded wiper seal for cleaning debris from the pop-up stem. The sprinkler shall have a plastic or brass nozzle with an adjusting screw capable of regulating the radius and flow. The sprinkler shall be capable of housing protective, nonclogging filter screens or pressure compensating screens (PCS) under the nozzle.

2.14 QUICK COUPLERS

- A. Shall have all parts contained in a two-piece unit and shall consist of a coupler water seal valve assembly and a removable upper body to allow the spring and key track to be serviced without shut down of the main.
- B. Metal parts shall be brass.
- C. Lids shall be lockable vinyl covered and have springs for positive closure on key removal.
- D. Furnish two (2) hose swivels and operating keys for each size coupler to the Resident Engineer.

2.15 LOW VOLTAGE CONTROL VALVE WIRE

Wire: Solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground. Size of wire shall be in accordance with manufacturer's recommendations, but in no case less than No. 14.

2.16 SPLICING MATERIALS: EPOXY WATERPROOF SEALING PACKET. LOW VOLTAGE CONTROLLER CABLE

Multi-strand cable, Underwriters Laboratories Inc. approved for direct burial in ground. Size and type of wire shall be in accordance with manufacturer's recommendations.

2.17 SLEEVE MATERIAL

PVC-1120-5DR 17, Schedule 40.

2.18 WARNING TAPE

Standard, 4-Mil polyethylene 3 inch wide tape, non-detectable type blue with black letters (if potable water), or purple with black letters (if reclaimed or untreated well water), and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".

A. TRACER WIRES

No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

2.19 POST HYDRANT

Shall be brass with detachable, automatic closing, T-handle, straight or angle body, and be of compression type 3/4-inch hose threaded on spout; 3/4 inch pipe threaded on inlet. Finish may be rough; exposed surfaces shall be chrome plated, except handle may be painted. Provide integral vacuum breaker. Hydrant to automatically drain when hydrant is shut off to prevent freezing.

PART 3 - EXECUTION

3.1 PIPE LAYING - GENERAL

- A. Do not lay pipe on unstable material, in wet trench or when, in the opinion of Resident Engineer, trench or weather conditions are unsuitable for the work.
- B. Concrete thrust block shall be installed where the irrigation main changes direction as at ells and tees and where the irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks. Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.
- C. Allow a minimum of 3 inches between parallel pipes in the same trench.
- D. Hold pipe securely in place while joint is being made.
- E. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 12 inches over pipe.
- F. Full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- G. Install sprinkler lines to avoid heating trenches, electric ducts, storm and sanitary sewer lines, and existing water and gas mains, all of which have right of way.
- H. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
- I. Minimum cover over water mains shall be 30 inches. Control valves shall never be less than 3 inches below finished grade. Cover laterals to minimum depth of 18 inches.
- J. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any concrete that cracks, due to settling, during the warranty period.
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- L. Warning tape shall be continuously placed 12 inches above sprinkler system water mains and laterals.

3.2 LAYING PLASTIC PIPE

- A. Shall be snaked in trench at least 1 foot per 100 feet to allow for thermal construction and expansion and to reduce strain on connections.
- B. Joints
 - 1. Solvent Welded Socket Type: ASTM D2855.
 - 2. Threaded Type: Apply liquid teflon thread lubricant of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.
 - 3. Elastomeric Gasket: ASTM F477.
 - a. Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
 - b. Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.
 - c. Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling shall be in accordance with the manufacturer's recommendations. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.
 - d. The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.

3.3 LAYING DUCTILE IRON PIPE

- A. Installation: AWWA C600.
- B. Joints:
 - 1. Mechanical: AWWA C111. Provide sufficient quantities of bolts, nuts, glands and gaskets for each socket opening on pipe and fittings.
 - 2. Push-on: Apply thin film of lubricant to gasket and place in proper position in contour of bell. Insert beveled end of joining pipe and make contact with gasket. Force beveled end of pipe to bottom of bell without displacing gasket. Do not caulk. Use only lubricant furnished by manufacturer of pipe.

3. Flanges: AWWA C115. Install only in concrete pits. Make watertight and set not less than 6 inches from walls or floor.

3.4 INSTALLATION OF SPRINKLERS AND QUICK COUPLERS

- A. Sprinkler heads and quick couplers shall be placed on temporary nipples extending at least 3 inches above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.
- B. Place part-circle rotary sprinkler heads no more than 6 inches from edge, of and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
- C. Install all shrub sprays, sprinklers and quick couplers on swing joints as detailed on plans.
- D. Set shrub heads 8 inches above grade and 1 foot from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Stakes to be parallel to riser.
- E. Install sprinklers and quick coupling valves on a swing joint assembly.

3.5 INSTALLATION OF CONTROL WIRING

- A. Wiring from master controllers to satellites and stub-cuts for future extension shall be located in trench with new mains or in separate trench at back of curb, unless cross-country route is shown. Locate in trench with mains when possible on cross-country routes.
- B. Wiring bundles located with piping shall be set with top of the bundle below top of the pipe. No two wires in any bundle shall be of the same color. Wires shall be bundled, and tied or taped at 4.5 m (15 foot) intervals. A numbered tag shall be provided at each end of a wire, i.e., at valve, at field located controllers and at master controller. The number at each end of wire to be the same.
- C. Splicing shall be held to a minimum. A pullbox shall be provided at each splice. No splices will be allowed between field located controllers and remote control valves.
- D. Provide 12 inch expansion loops in wiring at each wire connection or change in wire direction. Provide 24 inch loop at remote control valves.
- E. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.

3.6 Tracer Wire installation

- A. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling, and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.
- B. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record locations of tracer wires and their terminations on project record documents.

3.7 SETTING OF VALVES

- A. No valves shall be set under roads, pavement or walks.
- B. Clean interior of valves of foreign matter before installation.
- C. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.
- D. Set valve box cover flush with finished grade.

3.8 SLEEVING

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 12 inches beyond edges of paving or construction.
- C. Bed sleeves with a minimum of 4 inches of sand backfill above top of pipe.

3.9 TEST AND FLUSHING

- A. Pressure Test: Pressure test lines before joint areas are backfilled. Backfill a minimum of 12 inches over the pipe to maintain pipe stability during test period. Test piping at hydraulic pressure of 150 psi for two hours. Maximum loss shall be 0.8 gallons/inch pipe diameter/1000-feet. Locate pump at low point in line and apply pressure gradually. Install pressure gage shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair leaks. Line shall be retested until satisfactory.
- B. Flushing: After testing, flush system with a minimum of 150 percent of operating flow passing through each pipe beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
- C. Operation Test: Upon completion of the final adjustment of the sprinkler heads to permanent level at ground surface, test each sprinkler section by the pan test and visual

test to indicate a uniform distribution within any one sprinkler head area and over the entire area. Operate the entire installation to demonstrate the complete and successful operation of all equipment.

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SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

This work consists of furnishing and installing all planting materials required for landscaping hereinafter specified in locations as shown.

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. Topsoil Materials, Stripping Topsoil and Stockpiling: Section 31 20 00, EARTH MOVING.
- B. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Section 32 84 00, PLANTING IRRIGATION.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 SUBMITTALS

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

Inert Mulch	5 pounds of each type to be used.
Organic Mulch	5 pounds of each type to be used.
Pre-Emergent Herbicide	5 pounds of each type to be used.

- B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the Resident Engineer for approval:
 - 1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
 - 2. Fertilizers.
 - 3. Lime
 - 4. Seed
 - 5. Sod
- C. Manufacturer's Literature and Data:
 - 1. Antidesiccant

2. Hydro mulch
 3. Pre-emergent herbicide
- D. Soil laboratory testing results and any soil amendment recommendations from the Contractor.

1.5 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. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
4. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
5. During delivery: Protect sod from drying out and seed from contamination.

B. Storage:

1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
2. Keep seed, lime, and fertilizer in dry storage away from contaminants.
3. Store plants not installed on the day of arrival at the site as follows:
 - a. Shade and protect plants from the wind when stored outside.
 - b. 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.
 - c. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURF INSTALLATION SEASONS AND CONDITIONS

- A. No plant material is to be installed before the 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.

1.7 PLANT AND TURF ESTABLISHMENT PERIOD

- A. The Establishment Period for plants and turf shall begin immediately after installation, with the approval of the COTR, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Plant and Turf Establishment Period the Contractor shall:
 - 1. Water all plants and turf to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of 1 inch of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch or flood the plants and turf.
 - 2. Prune plants and replace mulch as required.
 - 3. Replace and restore stakes, guy wires, 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 3 inches.
 - 5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COTR.
 - 6. Provide the following turf establishment:
 - a. Eradicate all weeds. Water, fertilize, overseed, and perform any other operation necessary to promote the growth of grass.
 - b. Replant areas void of turf one square foot and larger in area.
 - c. Mow the new lawn at least three times prior to the final inspection. Begin mowing when grass is 4 inches high. Mow to a 2-1/2 inch height.
 - 7. Remove plants that die during this period and replace each plant with one of the same size and species.

1.8 PLANT AND TURF WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of FAR clause 52.246-21, including the following supplements:

1. A One Year Plant and Turf Warranty will begin on the date that the Government accepts the project or phase for beneficial use. The Contractor shall have completed, located, and installed all plants and turf according to the Drawings and Specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.
2. The Contractor shall replace any dead plant material and any areas void of turf immediately. A one year warranty for the plants and turf that was replaced will begin on the day the work is completed.
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 negligence requires replacement in kind and size.
4. The Government will reinspect all plants and turf at the end of the One Year Warranty. The Contractor shall replace any dead, missing, or defective plant material and turf immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:
 - a. Replace dead, missing or defective plant material prior to final inspection.
 - b. Mulch and weed plant beds and saucers. Just prior to this inspection, treat these areas to a second application of approved pre-emergent herbicide.
 - c. Remove stakes, guy wires and any required tree wrappings from plants having been installed for one year.
 - d. Complete remedial measures directed by the COTR to ensure plant and turf survival.
 - e. Repair damage caused while making plant or turf replacements.

1.9 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 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
- C. Hortus Third, A Concise Dictionary of Plants Cultivated in the U.S. and Canada.

D. Turfgrass Producers International:

Turfgrass Sodding.

E. U. S. Department of Agriculture Federal Seed Act.

1998 Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turf material shall 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 Drawings. Where the Drawings or Specifications are in conflict with ANSI Z60.1, the Drawings and Specifications shall prevail.
- B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs. Plants shall be healthy, normal, and unbroken root systems. Provide trees that are single trunked with a single leader, unless otherwise indicated, and display no weak crotches. Provide symmetrically developed deciduous trees 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. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti-desiccant at the nursery before digging.
- 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 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.
- E. Balled and burlapped (B&B) plant ball sizes and ratios shall conform to ANSI Z60.1, and shall consist of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.

- G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the COTR 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.

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 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 5.0 nor more than 7.5.
- B. Obtain material from stockpiles established under Section 31 20 00, EARTH MOVING, that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters.
- C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the COTR of the source(s) from which topsoil is to be furnished, and provide certificates showing it meets the contract requirements as stated above and comply with the requirements specified in 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 percent pass No. 8 mesh and not less than 25 percent pass No. 100 mesh. Moisture shall not exceed 10 percent.

2.6 PLANTING SOIL MIXTURE

The planting soil mixture shall be composed of topsoil and additives as required based on soil test results.

2.7 PLANT FERTILIZER

- 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 packet, table, or pellet forms of slow release fertilizers, bearing the manufacturer's warranted statement of analysis. Slow release fertilizers shall contain a minimum percentage by weight of 10 percent nitrogen (of which 50 percent will be organic), 10 percent available phosphoric acid, and 10 percent potash.

2.8 TURF FERTILIZER

Provide turf 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 15 percent nitrogen (of which 50 percent shall be organic), 5 percent available phosphoric acid, and 10 percent potash. Liquid starter fertilizer for use in the hydro seed slurry will be commercial type with 50 percent of the nitrogen in slow release form.

2.9 MULCH

- A. Mulch shall be free from deleterious materials and shall be stored as to prevent inclusion of foreign material.
- B. Organic mulch materials shall be straw for seeded areas and pine needles (pinestraw) for tree saucers.
 - 1. Straw for lawn seed bed mulch shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
 - 2. Pine needles shall be new crop bales free of sticks, pine cones, briars, and other objectionable material. All binding material shall be removed from the site.

2.10 STAKES AND GUYING WIRES

- 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 2 inches by 2 inches, or (2-1/2 inches in diameter, by 2 feet long and pointed at one end.
- B. Guying wire shall be 12 gage multi-strand annealed galvanized steel.

- C. Hose chafing guards shall be new or used 2-ply reinforced black rubber or plastic hose.
- D. Turnbuckles shall be galvanized or cadmium plated and have a 3 inch minimum lengthwise opening fitted with screw eyes.
- E. Eye bolts shall be galvanized or cadmium plated having a one inch diameter eye with a minimum screw length of 1-1/2 inches.

2.11 WATER

Water shall not contain elements toxic to plant life. It shall be provided by the contractor up to the time that the irrigation meter and backflow preventer are installed, and after that time may be obtained from the irrigation system.

2.12 SEED

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. Seed mixtures shall be proportioned by weight as indicated on the Drawings.

2.13 SOD

Sod shall be nursery grown as classified in the TPI Guideline Specifications to Turfgrass Sodding. The composition of the grass species in the sod shall be as indicated on the Drawings.

Quality shall conform to ASPA Guideline Specifications for Sodding.

2.14 HERBICIDES

All herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Keep all herbicides in the original labeled containers indicating the analysis and method of use.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations on project site for approval by the COTR before any plant pits are dug. The COTR may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION FOR PLANTING

- A. Prior to excavating for plant pits, verify the location of any underground utilities. Damage to utility lines shall be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turf before excavations are made in a manner that will protect turf areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to the Drawings 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 and the sides of the pits become glazed, scarify the glazed surface. Size and configuration of the plant pits shall be as shown on the Drawings.

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 plants so that the root crown is slightly higher than the surrounding grade as indicated on the Drawings. Add slow release packet, tablet or pellet fertilizer as each plant is installed as per manufacturer's recommendation for method of installation and quantity.
- B. Backfill balled and burlapped and container-grown plants with planting soil mixture as specified to approximately half the depth of the ball and then tamp and water. For balled and burlapped plants, carefully remove excess burlap and tying materials and fold back. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill Planting Soil Mixture; then form earth saucers or water basins around isolated plants with topsoil.

3.4 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 1-1/2 feet in such a manner as not to injure the ball or roots, unless otherwise shown on the drawings.

- C. Fasten flags securely on each guy wire approximately 2/3 of the distance up from ground level.
- D. Remove stakes and guy wires after one year.

3.7 MULCHING PLANTS

- A. Mulch within 48 hours after planting and applying a pre-emergent herbicide.
- B. Placing Organic Material: Spread mulch to a uniform minimum thickness of 3 inches.
- C. Keep mulch off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Prune new plant material in the following manner:
 - 1. Remove dead, broken and crossing branches. Prune deciduous trees to reduce total amount of anticipated foliage by 1/4 to 1/3 while retaining typical growth habit of individual plants with as much height and spread as is practicable.
 - 2. 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.
 - 3. Remove trimmings from the site. Paint cuts 1/2 inch in diameter and larger with the specified tree wound dressing.

3.10 TILLAGE FOR TURF AREAS

Thoroughly till the soil to a depth of at least 4 inches by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used, and especially under wet soil conditions. Remove all debris and stones larger than one inch remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a one inch depth and remove debris and stones.

3.11 FINISH GRADING

After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of 4 inches. Incorporate topsoil at least 2 to 3 inches into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.12 APPLICATION OF FERTILIZER AND LIME FOR TURF AREAS

- A. Apply turf fertilizer at the rate of 5 pounds per 1,000 square feet. In addition, adjust soil acidity and add soil conditioners as required herein for suitable topsoil.
- B. Spread lime at the rate indicated on the soils report.
- C. Incorporate fertilizers and lime into the soil to a depth of at least 4 inches as part of the finish grading operation. Immediately restore the soil to an even condition before any turf work.

3.13 MECHANICAL SEEDING

- A. Broadcast seed by approved sowing equipment at the rate [indicated on the Drawings of 3 pounds per 1,000 square feet. Sow one half of the seed in one direction, and the remainder at right angles to the first sowing. Cover seed to an average depth of 1/4 inch by means of spike-tooth harrow, cultipacker, or other approved device.
- B. Immediately after seeding, firm up the entire area with a roller not exceeding 150 pounds per foot of roller width. Where seeding is performed with a cultipacker-type seeder or where seed is applied in combination with hydro-mulching, no rolling is required.
- 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 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 either 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.

3.15 SODDING

- A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.
- B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area.

3.18 WATERING

Apply water to the turf areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 4 inches. Supervise watering

operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations.

3.19 PROTECTION OF TURF AREAS

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

3.20 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. 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.

3.21 RESTORATION AND CLEAN-UP

Where existing or new turf areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. In areas where planting and turf work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas is completed. Remove all debris, rubbish and excess material from the cemetery.

3.22 ENVIRONMENTAL PROTECTION

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

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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. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 31 20 00, EARTH MOVING.
- C. Section 03 30 53, CAST-IN-PLACE CONCRETE.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
- B. Manufacturers shall have manufacturing and quality control facilities capable of producing and assuring the quality of piping and structures specified.
- C. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit the following documentation to the COTR for review prior to commencement of the work of this Section:
 - 1. Manufacturers' documentation (including product data sheets) for all specified products.
 - 2. Shop drawings showing fabrication and construction details for drainage structures.
- C. At project completion, submit record (as-built) drawings showing installed system as specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. During loading, transporting and unloading, exercise care to prevent damage to all products furnished.
- B. Pipe shall be marked with manufacturer's identification symbol, size, date of manufacture, class of pipe, and applicable product specification identification number.
- C. All materials shall be inspected upon delivery to the Site. Damaged or defective materials shall be rejected or repaired as determined by the COTR.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASTM International (ASTM):
 - A48/A48M Standard Specification for Gray Iron Castings
 - A536..... Standard Specification for Ductile Iron Castings
 - A615/A615M..... Standard Specification for Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
 - C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
 - C150 Standard Specification for Portland Cement
 - C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - C478 Standard Specification for Precast Reinforced Concrete Manhole Sections
 - C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - C923 Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals
 - C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

- D2321..... Standard Practice for Underground Installation of
Thermoplastic Pipe for Sewers and Other Gravity-Flow
Applications
- D3034..... Standard Specification for Type PSM Poly(Vinyl Chloride)
(PVC) Sewer Pipe and Fittings
- D3212..... Standard Specification for Joints for Drain and Sewer
Plastic Pipes Using Flexible Elastomeric Seals
- F477 Standard Specification for Elastomeric Seals (Gaskets) for
Joining Plastic Pipe

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

- C. Arkansas State Highway and Transportation Department (AHTD):
Standard Specifications for Highway Construction, 2003 Edition

PART 2 - PRODUCTS

2.1 PIPING

- A. Gravity Lines (Pipe and Appurtenances):
1. Concrete:
 - a. Reinforced pipe, ASTM C76. Class III. Joints shall be watertight flexible joints made with rubber-type gaskets conforming to ASTM C443.
 2. Polyvinyl Chloride (PVC):
 - a. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.

2.2 JOINTING MATERIAL

- A. Concrete Pipe: Rubber gasket ASTM C443.
- B. Polyvinyl Chloride (PVC) Pipe:
1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

2.3 MANHOLES, INLETS AND CATCH BASINS

- A. Manholes, inlets and catch basins shall be constructed of precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch

basins shall be in accordance with the details shown on the Drawings, and the following VA requirements:

1. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric unless otherwise indicated on the Drawings. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Flat top manhole tops shall be reinforced concrete as detailed on the Drawings.
 4. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 5,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20 loading with 30 percent impact, and conform to ASTM C857.
 5. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet ASTM C990.
 6. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20 loading, and shall conform to the details shown on the Drawings. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 7. Manhole steps, if required, shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478. Steps shall be a minimum of 10 inches wide and project a minimum of 5 inches away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 12 inch centers.
- B. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48 or ductile iron conforming to ASTM A536. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the Drawings.

2.4 CONCRETE

- A. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Section 03 30 53, CAST-IN-PLACE CONCRETE.

2.5 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 60 unless otherwise noted.

2.6 OIL/WATER (OIL/GRIT) SEPARATOR

- A. Oil/water (oil/grit) separator shall be a precast concrete structure fabricated to the dimensions shown on the Drawings with required accessories, and conforming to the requirements of the local utility authority.

2.7 DRYWELL

- A. Dry well shall be a perforated precast concrete manhole structure conforming to the applicable structural requirements of subsection 2.3 of this Section, fabricated to the dimensions shown on the Drawings.

2.8 WARNING TAPE

- A. Standard, 4-Mil polyethylene 3 inch wide tape non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES

- A. Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material.

3.3 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations with gasketed joints.
 - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
- J. Warning tape shall be continuously placed 12 inches above storm sewer piping.

3.5 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified in the Drawings and Specifications.

3.6 DRAINAGE STRUCTURES

A. General:

1. Circular Structures:

- a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

B. Rectangular Structures:

1. Concrete work for cast-in-place reinforced concrete structures shall be constructed in accordance with Section 03 30 53, CAST-IN-PLACE CONCRETE, and as specified in Section 609 of the AHTD Standard Specifications.
2. Precast concrete base section of structures shall be set on an 8-inch thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast concrete section(s) on base section (as applicable) true and plumb. Seal all joints with preform flexible gasket material.

C. Do not construct cast-in-place concrete structures when air temperature is 32 degrees F or below.

D. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:

1. Forming directly in concrete base of structure.
2. Building up with brick and mortar.

E. Floor of structure outside the invert channels shall be smooth and slope toward channels not less than 1:12 (1 inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.

F. The wall that supports access steps shall be 90 degrees vertical from the floor of structure to manhole cover. Install steps per the manufacturer's recommendations. Steps shall not move or flex when used. All loose steps shall be replaced by the Contractor.

- G. Install each drop inlet and catch basin frame and grate on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall at finish grade. Install an 8-inch thick by 12-inch diameter concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 INSPECTION OF SEWERS

- A. 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.

3.9 TESTING OF STORM SEWERS

- A. Gravity Sewers (Select one of the following):
1. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 3 feet above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 3 feet above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 3.0 gallons per hour per 100 feet.
 - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

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SECTION 33 46 13 FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies foundation drainage system for burial crypts, 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 (geotextile), pipe, and fitting indicated.
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK:

- A. Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Section 01 00 00, GENERAL REQUIREMENTS.
- C. Section 31 20 00, EARTH MOVING.

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):
 - M252 Standard Specification for Corrugated Polyethylene Drainage Pipe
 - M288 Geotextile Specification for Highway Applications
- C. ASTM International (ASTM):
 - D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 - D2321..... Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - D3034..... Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F758..... Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

PART 2 - PRODUCTS

2.1 MATERIALS

A. Drainage Pipe:

1. Foundation drainage pipe shall be perforated and non-perforated corrugated high density polyethylene (HDPE) pipe with a smooth inner wall. Pipe shall conform to AASHTO M252, Type S or SP (as applicable). Pipe diameter shall be as indicated on the Drawings. Perforated pipe shall have Class 2 slotted perforations as defined by AASHTO M252. Manufacturer's standard perforation configuration shall be provided. Furnish required fittings and connectors for a complete system.

B. Cleanouts:

1. PVC sewer pipe and fittings per ASTM D3034, in NPS 4 to NPS 15 (DN 100 to DN 375). Joints shall be bell-and-spigot. ASTM F477, elastomeric seal gaskets shall be used.

C. Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the requirements for Survivability Class 2 geotextile as defined in AASHTO M288.

D. Aggregate Drainage Material:

1. Bedding: Crushed stone, 1 inch to 1/2 inch (size number 5) per ASTM D448.
2. Backfill to 6 inches above pipe: Same as bedding.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION

- A. Excavate trenches to the minimum width necessary for proper installation of the piping, and in compliance with OSHA regulations regarding trench excavation safety. Grade the bottom of the excavation to provide uniform bearing for the pipe.
- B. Check trench subgrade for adherence to specified line and grade. Install pipe only when acceptable conditions exist.
- C. Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the Construction Inspector or COTR.

3.2 GEOTEXTILE INSTALLATION

- A. Place the geotextile on the bottom and sides of the perforated pipe trenches as shown on the Drawings. The bottom and sides of the trench against which geotextile will be placed shall be free of litter and sharp protrusions.
- B. Place geotextile in such a manner that placement of overlying material will not stretch or tear the fabric.
- C. Overlaps of adjacent rolls of geotextile along trench alignment shall be a minimum of 18 inches. Geotextile shall be overlapped at the top of aggregate backfill a minimum of 6 inches.

3.3 PIPE INSTALLATION

- A. Install piping to alignment and grade indicated on the Drawings.
- B. Lay piping on firm bedding for entire length of alignment. Installation of all pipe and fittings shall be subject to the review of the COTR. Pipe and fittings shall be joined in accordance with the manufacturer's recommendations and in accordance with ASTM D2321
- C. Lay perforated drainage pipe and firmly bed in granular material (aggregate bedding) a minimum of 6 inches below invert.
- D. Lay non-perforated drainage pipe on prepared trench bottom.
- E. Slope pipe uniformly between elevations shown on the Drawings. Keep trenches dry until pipe is in place and backfilling is completed to 6 inches above top of pipe, unless otherwise directed by the COTR.
- F. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standard:
 - 1. PVC pipe installation shall be per ASTM D2321 and ASTM F758.
 - 2. PVC joint construction shall be per ASTM D3034 with elastomeric seals gaskets per ASTM D2321.
- G. Install cleanout extensions, including all required fittings, where shown on the Drawings.
- H. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil and other foreign matter from entering the piping.
- I. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.

3.4 BACKFILLING

- A. Perforated Pipe: Place aggregate backfill around and over pipe to 6 inches above top of pipe.
- B. Non-Perforated Pipe: Place soil backfill around and over non-perforated pipe in layers not exceeding 6 inches loose thickness up to finish grade.
- C. Placement and compaction of soil backfill shall be in accordance with Section 31 20 00, EARTH MOVING.
- D. Placement and compaction of backfill shall be performed in a manner that will not damage the pipe and geotextile.

- - -E N D - - -