

CONSTRUCTION SPECIFICATIONS

GRAVESITE EXPANSION PROJECT
Cheyenne National Veterans Burial Ground

Cheyenne, Wyoming

PREPARED BY:

DEPARTMENT OF VETERAN AFFAIRS
NATIONAL CEMETERY ADMINISTRATION

CONSTRUCTION SUPPORT DIVISION

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NCA Project No. 888CM3037



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00 01 15
LIST OF DRAWING SHEETS

The Drawings listed below accompanying these Specifications form a part of the Contract.

- Site Construction Details
- Columbarium Details
- Memorial wall details
- Alta Survey
- Grave Locator
- Gettysburg Address Plaque details and specifications
- Gettysburg Address text
- Dedication Plaque
- Dedication Plaque text
- VA Seal
- NCA Bivouac Plaque
- Patriotic Slogan

--- E N D ---

SECTION 00 11 21
DESIGN BUILD REQUIREMENTS

A. PART I - GENERAL

A1. Statement of work

- A. Provide all professional services, labor, materials, tools, equipment, and design-build services necessary for preparing, a Master Plan for the entire site, design development and construction documents for Phase 1 and Construction of the phase 1. The Design-Build Contractor shall, completely prepare site for construction operations, furnish labor and materials and perform work for the construction of Phase 1. Work also includes but is not limited to: concept reviews, master plans, design, geotechnical investigation, surveying, design reviews, master plan reviews, concept reviews, demolition and removal of existing structures, alterations, clearing, grubbing, cut and fill, earth work, grading, building construction, landscape, walls, roads, curbs, installation of pre-placed double depth concrete crypts, oversize crypts, private vaults, in-ground cremains, columbarium, installation of niche covers, utilities (water and electric), storm drainage, ornamental fencing, dignified entrance features, pedestrian paving, landscape planting and turf, site furnishings, electrical, mechanical, irrigation, certain other items and consulting with Wyoming State Historic Preservation Office (SHPO).

Master Plan Elements

The following elements will be included the master plan.

- Phased development of the site (ten year phases)
- Entrance feature (Architectural and landscape), to include Department of Veterans Affairs Emblems, cemetery name and lighting.
- Queue for approximately 30 cars
- A Flag/Assembly Area and the five (5) services seals, include structures for mounting.
- Provide flag poles for both the US and the POW/MIA flags with lighting for the US Flag.
- Roadway System and Parking
- Site Furnishings (Flower water stations and benches)

- Burial sections using double-depth crypts
- In-ground cremains burial sites
- Columbaria
- Oversize crypts burial sections
- Private vaults burial sections
- Committal Service Shelter with 110 volt electrical service.
- Grading and storm-water management,
- Fencing (ornamental and black vinyl chain-link)
- Ornamental Gate with electric opener, timer and card reader and manual opening with loss of power
- Landscaping
- Utility Distribution Systems (electrical and water)
- Irrigation System – Water sources identified in the Phase I Environmental Site assessment
- Signage, (way finding and Gravesite locator) See reference drawing Grave Locator Details provided. The D/B team may provide their unique design for the stand but it must be functional and architecturally appropriate.
- Memorial wall and memorial section.
- All cap stone will be natural stone (limestone)
- Infrastructure for connection to the City of Cheyenne municipal water system, which is located in the Hildreth Road right-of-way approximately 3000, feet northeast of the site.
- Area for monuments and plaques
 1. Gettysburg plaque, contractor furnished and installed. Should be mounted freestanding on a base or pedestal in the flag pole area. Plaque is cast iron; size is 34" wide x 57" high. Plaque is available at Rock Island Arsenal. See Gettysburg Plaque installation drawing and Picture attached herewith.
 2. Bivouac plaque, contractor furnished and installed. Should be mounted freestanding on a base or pedestal in the flag pole area. Plaque is aluminum, size is 24"w x 18" high. Plaque is available at The Southwell Co. 928 N. Alamo, San Antonio, TX . See VA NCA Bivouac Picture attached herewith.

3. Patriotic Slogan, contractor furnished and installed. Patriotic Slogan can be a bronze plaque or engraved in blocks of monument stone. Should be mounted freestanding on a base or pedestal in the flag pole area. See VA NCA Patriotic Slogan Detail provided.
4. Dedication plague, contractor furnished and installed, usually installed in the Public Information Center (PIC) but there is no PIC on this project so this will have to be installed on a granite tablet, adjacent to the gravesite locator stand. See VA Dedication Plague Detail provided. Plague is available at <http://www.matthewsbronze.com/>. is simple in both design and maintenance.

- **Design and Construction of Phase 1 Elements**

The following elements will be provided as part of the Phase I development.

- Acquire and install a 320 pre-placed 3'x8' concrete lawn crypts
- Provide 320 columbarium niches, niche covers will be government-furnished and contractor installed
- Provide 400 4'x4' In-ground cremains plots
- Acquire and install 40 oversize vaults
- Provide 40 plots for private vaults
- Landscaping & irrigation
- Flag/Assembly Area lighting for US Flag and the five (5) services seals, include structures for mounting
- Provide flag poles for both the US and the POW/MIA flags
- Storm-water management
- Provide site furnishings (benches flower water stations)
- Provide signage (way finding)
- Roads construction, including the necessary infrastructure for a functioning national burial ground
- Entrance feature (Architectural and landscape), to include Department of Veterans Affairs Emblems, cemetery name and lighting.
- Ornamental Gate with electric opener, timer and card reader and manual opening with loss of power.
- Provide an ornamental fence along the front of the site and black vinyl fence along the remaining sides

- Utility Distribution system (electrical and water)
- Memorial wall and section.
- Gravesite Locator Stand. See reference drawing L-1 Grave Locator Details provided herewith. This Grave Locator stand was done for another cemetery. The D/B team can do their unique design for the stand but it must be functional and architecturally appropriate.
- Committal Service Shelter with 110 volt electrical service
- All cap stone will be natural stone (limestone)
- Infrastructure for connection to the City of Cheyenne municipal water system, which is located in the Hildreth Road right-of-way approximately 3000, feet northeast of the site.
- Area for monuments and plaques
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B. The project is located on Hildreth subdivision, on the Northern side of Polo Ranch Road and East side of Hildreth Road, Cheyenne, Laramie County,

Wyoming. The contractor shall be furnished the NCA Interment projections through 2060. The master plan will develop 10 years phases with phase 1 constructed as part this project. This project was approved for the FY 16 Operating Plan, and was proposed as a Design-Build project. The contractor shall adhere to NCA Design criteria on the VA Website Technical Information Library (TIL). Although sample specifications are provided with the scope of work, the contractor is responsible for editing the Master Specifications and providing the required specifications and design drawings, and then construction for this project.

- C. The contractor shall reference the attached drawings, and NCA Design Criteria on VA Website Technical Information Library (TIL) as a guide for design. The contractor is totally responsible for producing their own detail drawings. The project also includes, but not limited to structural (foundation, columns, roads and sidewalk), landscape architecture and civil roads, (erosion and sediment control, landscaping (sod and trees), grading, site furnishings (Victor Stanley benches or equal, trash and flower vases and concrete-padded watering station), well and well water for the new irrigation and drainage, parking pull off, pavement improvements, sidewalk, signage, dignified entrance features, roads, etc. VA review comments shall be incorporated into final concept drawing. The Master Plan must be approved before commencing construction documents. The plantings area (sod and trees) shall be fully irrigated. All plantings shall be native as possible. All areas requiring grass shall be sodded. The contractor is responsible for all topographical and geotechnical surveys, and all necessary utilities needed for normal functioning of the Burial Grounds.

Sustainable Design. The sustainable design program strives to enhance VA's mission by incorporating sustainable design practices into the design and construction of VA facilities. Driven by numerous Federal mandates and VA policies, the program encourages design strategies that reduce energy and water consumption, integrate cost-effective renewable energy, promote healthy work environments, and protect vital natural resources. <http://www.cfm.va.gov/til/sustain.asp>.

Environmental Compliance. NCA has prepared an Environmental Assessment (EA) of the potential environmental consequences of constructing a proposed national cemetery Burial Ground in the Cheyenne, ND area. The EA has been completed pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal

Regulations [CFR] 1500--1508), and VA regulations (38 CFR 26.4 [a]). The EA is attached to this Scope of Work. The Master Plan is to ensure that the national burial ground is designed in conformance with the findings and recommendations of the EA. Development of the national burial grounds must be in compliance with applicable federal statutes, Executive Orders, and regulations establishing environmental standards. The Master Plan shall accommodate any biological and/or cultural resources including historical, archeological, architectural and landscape resources that were identified during the EA process. Appropriate mitigation measures outlined in the Final EA will be addressed and incorporated in the Master Plan. In consideration of EO 13112, Invasive Species, the Wyoming Department of Fish Game (WDFG) would be consulted during the master planning phase in order to identify appropriate mitigation measures for the removal and control of invasive species.

Historic Compliance: The A/E shall be responsible for coordinating all historic reviews and compliance required by the State Historic Preservation Officer (SHPO). VA will review and approve all material prepared on its behalf for submission to State agencies.

Topographic, Utilities and Landscape (Site) Survey: The Architect/Engineer (A/E) shall obtain professional surveying services from licensed surveyors to provide a topographic survey of the entire site. Detailed requirement for this survey are located on the VA website: <https://www.cfm.va.gov/til/nca.asp>

Geotechnical Soil Survey Report; The A/E shall obtain a report of subsurface investigations to include seismic data and geologic formations, analysis of soil fertility, organic content, and pH measurement. Detailed requirement for this survey are located on the VA website: <https://www.cfm.va.gov/til/nca.asp>

Accessibility. All features of the development (except gravesites) shall be readily accessible to and usable by people with disabilities, in compliance with the Americans with Disabilities Act-1990, Architectural Barriers Act of 1968, as amended and local accessibility requirements. To achieve compliance, the National Cemetery Administration uses as its standard for building and facility design the Architectural Barriers Act Accessibility Standard (ABAAS). It is NCA policy to make all cemetery structures accessible without the use of special facilities for the disabled. The A/E is responsible for checking to see whether there are local accessibility requirements. If they exist, the most stringent requirements will prevail between local and ABAAS. The

criteria of these standards should be considered a minimum in providing access for the physically disabled. Dimensions that are not stated as “maximum” or “minimum” are absolute. All dimensions are subject to conventional industry construction tolerances except where the requirement is stated as a range with specific minimum and maximum end points.

A2. Definitions

- A. Design-Build (DB) as defined by the Department of Veterans Affairs (VA) is the procurement by the Government, under one contract, with one firm or joint venture (JV) for both design and construction services for a specific project.
 - 1. Contracting Officer: The services to be performed under this contract are subject to the general supervision, direction, control and approval of the Contracting Officer.
 - 2. Project Manager: The Contracting Officer's representative responsible for administering contracts under the immediate direction of the Contracting Officer.
 - 3. Contract Officer Representative: (COR)
 - 4. Design Build Contract: This term, as used herein, refers to the Contract(s) to perform the design and construction of the project.
 - 5. Contractor: This term, as used herein, refers to the contractor under this contract or the DB team.
 - 6. AE: This term, as used herein, refers to the Architect-Engineer firms that are a part of the DB team, also referred to as DB AE.

A3. Cost Range

See solicitation

A4. Schedule

The anticipated completion of this project is 540 days from NTP.

B. PART II - RESPONSIBILITIES

B1. VA Team

- A. Not Used

B2. Design-Build Team:

- A. The DB team includes all J/V partners, consultants and sub contractors to the one firm. The DB team shall provide Architectural and Engineering disciplines for the preparation of construction documents, and construction contractor capabilities for construction of the project.
- B. The contract documents are intended to define existing conditions, certain required items, and design parameters to be included in the project. It is the DB Team's responsibility to complete the documents and construction in a manner consistent with the intent of the contract documents within the required time period (contract length).

C. PART III - PROPOSAL REQUIREMENTS

C1. General

See solicitation.

D. PART IV - POST AWARD REQUIREMENTS

D1. MASTER PLAN PREPARATION

A. Goals and Objectives of Master Plan Development

- 1. **Purpose.** The purpose of this phase is the development of a Master Plan for the Cheyenne National Veterans Burial Grounds. The preparation of the Master Plan follows the Environmental Assessment (EA) as the initial step in VA capital facilities planning. This EA is attached. The Department of Veterans Affairs considers the total environmental approach a necessity to good master planning. The planning process must be founded upon a sound understanding of the features and dynamics of the environment. The selected site is composed of a variety of components: topography, soils, plant communities, etc. Each component must be understood and interpreted as a contributing element to the natural functioning and development of the site. The existing landscape must be an integral part of the development plan.
- 2. **Goal.** The goal of the Master Plan is to provide an orderly, professional, and aesthetic development plan for the entire cemetery site of approximately 5 1/2 acres to support first interments. The Cheyenne area is projected to average approximately 115 interments per year. The completed Master Plan will consist of the required drawings, details, studies and reports of all the elements listed in the

solicitation. The completed Master Plan should be sufficiently detailed to enable the Department of Veterans Affairs to proceed directly into the preparation of Construction Documents for the Phase I development and for future development phases of the cemetery.

B. Requirements of Master Plan Development

- 1. Site Characteristics Report.** The A/E shall prepare a report of site characteristics from an analysis of the EA, data gathered from personal site visits and the topographic, utilities and landscape survey, wetlands inventory. The site analysis process should reflect an understanding of the natural systems of the site. The report will contain a graphic and narrative description of the cemetery site and a graphic and narrative description of the vicinity relationships with the cemetery site. The resulting vicinity map will be used in the set of Master Plan drawings.

2. Design

1.1 The A/E shall prepare a set of Master Plan drawings illustrating the overall design concept with all elements or features of the master plan as stated in this scope of work. Drawings will be developed to the Master Plan level of detail as prescribed in VA Program Guide PG-08-15, Volume D, "Minimum Requirements for A/E submission" for MP 1 - MP 5. Provide 3 distinct concept plans as part of the MP1 submission

1.2. Design criteria contained in the National Cemetery Administration (NCA) Design Guide will give the A/E an understanding of the unique requirements of cemetery operations and of each of the Elements or Features that make up a national cemetery. Detailed Functional Requirements, Relationship Diagrams and Narrative are described in the guide. Minor deviations and improvements to the information provided in the design guide as a result of evolving program requirements will be indicated to the A/E during the initial Master Planning sessions/charrette.

1.3. Originality and imaginative design relationships between site and structures, vehicular and pedestrian areas, visual elements, open and screened areas, and their relationship to each other should be combined to produce a plan that is both functional and aesthetic with due consideration given to economic cost factors. The plan should reflect, as much as possible, the history of the region, the culture of the people, and veterans of the area. Materials used should express strength and permanence, and should reflect the regional vernacular.

1.4. Outline specifications prescribing the major materials used in the design; e.g., paving materials, pipe materials, etc., are to be noted on the drawings. The location, orientation, and design of all features and plantings shall consider climatic conditions to reduce heating and cooling requirements. Prevailing wind, sun and precipitation patterns shall impact the functional design elements.

- 3. Drawings** Drawing submission will follow the requirement outlined in the VA Program Guide PG-08-15, Volume D, "Minimum Requirements for A/E submission." Provide a Phasing Plan for development of future expansions of the cemetery. Each phase should be planned to provide a ten-year supply of burial sites. The Phasing Plan shall be prepared as a separate drawing in the Master Plan set.
- 4. Cost Estimate.** During the Master Plan stage of the contract, the A/E shall prepare a cost estimate for the overall site developments with a break-out of the Phase I Development portion of the Master Plan based upon the level of design detail (Schematic). Format is prescribed in VA Program Guide PG-08-15, Volume D, "Minimum Requirements for A/E submission."
- 5. Cemetery Pamphlet.** The A/E shall prepare Cemetery Pamphlet illustrating information about the existing site, its surroundings, history, and the proposed cemetery development. VA will use the pamphlet in public relations efforts and as a guide for cemetery visitors. The pamphlet is to contain reductions of appropriate Master Plan drawings, renderings, photographs of the site, and any other illustrations that convey the concept of the Master Plan. The preparation of the pamphlet shall be in accordance with the template developed by the VA which will be provided to the A/E.
- 6 Submittals** The level of detail for submissions is prescribed in the VA Program Guide PG-08-15, Volume D, "Minimum Requirements for A/E Submissions." Additional information provided in this scope of work supplements and/or supersedes the requirements outlined in PG-08-15, Volume D.

D2. Construction Document Preparation:

A. Design Review Submissions:

1. The Design-Build Team A/E (DB A/E) shall prepare and submit design development 1 (DD1), design development 2 (DD2), construction document 1 (CD1) and construction documents 2 (CD2) construction documents for review and approval

by the VA in accordance with standard professional practice, the Department of Veterans Affairs contract documents, and prevailing codes. The specifications must be edited to represent the specific design and construction proposed by the Contractor. A commercial level of design, materials and construction quality is required.

2. All submission packages will be reviewed at (DD1), (DD2) and (CD1) completion stages. The (CD2) review submission packages will incorporate the final review comments from the (DD2) review. If any package is not complete for the required stage a post review may be required the cost of which will be borne by the DB team.

3. A minimum of five (5) review submission packages (see table 2 for submission requirement) shall be sent out for each review. Each review submission package shall include hard copy each drawing set, the cost estimate, and specifications and 1 CD-ROM (VA PM only) with one drawing set, cost estimate and specifications. The packages will include an index of drawings (by sheet number and title) and specifications (by section number and title) submitted. The a package will be distributed to the VA Project Manager, District Engineer, Cemetery Director, Chief, Cemetery Development & Improvement Service and others as determined to be appropriate by the VA Project Manager.

B. Submittal Requirements:

1. Drawing Sheets and Labeling Requirements:

- a) All plans are to use the standard VA base sheet. Sheet size is 30" x 42".
- b) All drawings shall be bound, along the left margin, into sets in the order of the drawing symbol list contained in this scope. The binding must not obscure any information on the drawings.
- c) Each set of drawings will have a cover sheet which indicates: project name, project number, and index of drawings in the set, names and addresses of all associated A/E firms, vicinity map, and site location map. Project location map and other pertinent project information.
- d) Each sheet as well as all materials submitted will be clearly labeled above the title block, what submission it is, corresponding to the required submissions in this SOW i.e., "100% Construction Documents Submittal". This label will be appropriately revised after the review.
- e) Drawing symbol Identification shall match of the National CAD standards.

2. Graphic Standards

- a) Plans must clearly demonstrate what new work is, what is existing and what is to be demolished. New work must be graphically bolder (darker than existing conditions). Dashed lines shall show demolition work. All lettering must be a minimum of 1/8-inch high.
- b) All sheets will have the same north arrow orientation. North shall be oriented to the top of each plan sheet. Each sheet having a drawing that requires it will have a north arrow on the sheet. Drawing scales must be indicated on each sheet in both written and graphic form. Each sheet will have a key map for locating and orienting individual drawing sheets to the whole site.
- c) All plans will show drafting symbols and abbreviations.
- d) Drawings using match lines must not overlap information. All information must stop at the match line and resume at the corresponding match line.
- e) Detail sheets will be organized logically and present the material intended in an orderly manner. Items with plan, front and side views will be arranged in that context to one another. Each detail must be clearly labeled and scale indicated.
- f) Specifications:
Submit 8 1/2" x 11" copies of all required calculations and specifications. All letter reports will be labeled with the project name, project number, name(s) of the A/E firm(s), date and title of the report or estimate. Final submittal of specifications shall be in Microsoft Word and PDF formats on CD/DVD.
- g) Submission package will be reviewed by VA for completion at each stage. If the submission package is not complete, a post review may be required, the cost of which will be borne by the DB team.
- h) The Design Review Submission package shall include hard copy sets with the following distribution:

VA STAFF	DRAWINGS	COST ESTIMATE	CALCS.	SPECS	CD
Project Manager	1 full size & 1/2 size sets	1 set	1 set	1 set	1
Contract Officer					
Continental District Engineer	1 full set	1 set	1 set	2 set	
Cemetery Director	1 full set			1 set	
Cemetery Coordinator	1/2 size sets	1 set		1 set	

Table 1

Submittal addresses and contact information:

VA STAFF	MAILING ADDRESS	PHONE /FAX/ E-MAIL
Project Manager:	Department of Veterans Affairs National Cemetery Administration (43B) 425 Eye Street, N.W. Washington, DC 20001 Attn: Stephen Davis	Phone: (202) 632-4833 steve.davis@va.gov
Contract Officer	Department of Veterans Affairs National Cemetery Administration (43C) 425 Eye Street, N.W. Washington, DC 20001	
Continental District Engineer:	Department of Veterans Affairs Continental District 155 Van Gordon Street Lakewood, CO 80228 Attn: District Engineer	
Cemetery Director:	Fort Logan National Cemetery 4400 West Kenyon Avenue Denver, CO 80236 Attn: Cemetery Director	
Chief, Cemetery Development & Improvement Service	Department of Veterans Affairs National Cemetery Administration 575 N. Pennsylvania Street, Suite 495 Indianapolis, IN 46204	

Table 2

i. All VA comments made on the Design Review Submission will be incorporated in this final submission. The final packages will be distributed the same as the Design Review Submission above.

C. Design Review Meetings:

1. A review meeting to resolve design issues will be held as determined necessary by the project manager to resolve design issues.
2. The DB team shall allow a minimum of fourteen (14) calendar days from the receipt of the submission package for each review cycle. A cycle includes:
 - a. The VA's receipt of the design review submission package.
 - b. DB teams receipt of comments from the VA, either electronically, by fax, or by hard copy delivery.

- c. Scheduling of review meeting (optional by project manager)
3. Coordination of the review meeting schedules will be the responsibility of the VA Project Manager and the DB Project Manager (for the DB team). See section H. Quality Assurance/Quality Control.

D. Electronic Media:

1. Design review submission drawings will be full size hard copy. Final Construction Document submission drawings will be a hard copy and executed in electronic format. All drawings will be in AutoCAD version 2014 format in accordance with the latest version of CADD standards these standards can be down loaded from the internet at <http://www.cfm.va.gov/til/nca.asp>.
2. Design review submission specifications and other 8 1/2 by 11 formatted material and final Construction Document submission specifications and other 8 1/2 by 11 formatted materials will be executed in electronic format Microsoft Word.
3. At the DB Team's request, the drawings included in the contract documents will be available to the DB team in hard copy only for use in preparing the construction drawings. Drawings are provided without warranty or obligation on the part of VA as to accuracy or information contained therein. The user shall independently verify all information in the files. Any user shall agree to indemnify and hold VA harmless from any and all claims, damages, losses, and expenses including, but not limited to, attorney's fee arising out of the use of the drawings.
4. The specifications included in the contract documents shall be available to the DB team in hardcopy for use in preparing the construction specifications.

E. Professional Licensing:

1. The DB A/E who prepares the construction documents shall be a professional architect or engineer licensed in the state in which the design work is completed.
2. The professional seal indicating such license by the state shall appear on the final construction documents. The architect whose seal is shown will be known as the Architect of Record. The DB AE shall certify compliance with the contract documents and all applicable codes.

F. Approved Construction Documents:

1. The final construction document submission package will be submitted by the DB team for approval by the VA after completion of the 100% review cycle for the final

package to be submitted by the DB team. The VA will have 14 calendar days to take approval action.

2. The final construction documents submission package will include a full set of construction documents including all disciplines.
3. The final construction documents submission package will incorporate all VA supplied comments from the earlier submissions and comply with the contract documents.
4. If the final construction documents submission package is not complete a post submittal may be required the cost of which will be borne by the DB team.
5. The approved final construction documents include such details that the project can be constructed and will be used for construction of the project.
6. See PART IV, D2 for Approved Construction Document distribution.

G. Construction Drawing Preparation: Mandatory material and equipment schedules and details may be indicated either on the drawings or in the specifications, at the option of the DB team. The construction drawings shall include a coordinated set of the following.

1. Civil engineering drawings including demolition plans, grading and drainage plans, paving plans, utility plans, schedules calculations and details.
2. Landscape drawings including demolition plans, landscape plans, plant schedule and list, special landscape elements, proposed materials to be used for each special landscape element, calculations and details.

H. Construction: Project specifications shall include specifications for all products, materials, equipment, methods, and systems shown on the construction drawings in accordance with standard professional practice and the contract documents. The specification submitted for review shall include:

1. The name of the manufacturer, the product name, model number, or other identification as appropriate to clearly identify the product that will be used in the construction of the project;
2. Other data as appropriate to clearly identify the product that will be used in the construction of the project i.e. shop drawings, product data, and samples as required by the contract documents; and
3. The required stamp of the licensed architect or engineer of record will be considered as certification of compliance with the contract requirements.

I. Design Requirements - Compliance with codes and standards.

1. Project design shall be in compliance with applicable standards and codes described in VA Program Guides and design materials included or referenced in the solicitation materials.
2. See Section D. Approved Construction documents, above, for required inclusion of design review comments.
3. The DB team shall identify all permitting requirements associated with the proposed project.
4. In the design of new work under this contract, the DB team shall consider all requirements (other than procedural requirements) of:
 - A. Zoning laws:
 - B. Environmental and erosion control regulations; and
 - C. Laws relating to landscaping, open space, minimum distance of a building from the property line, maximum height of a building, historic preservation, and esthetic qualities of a building. In addition, similar laws, of the State and local political division, which would apply to the building if it, were not to be constructed or altered by the U.S. Government.
 - D. Identify all permits needed for the project and the requirements for the permits.
5. The DB team shall consult with appropriate officials of the Federal, state, and political subdivision, and submit plans under the rules prescribed by those reviewing authorities. The DB team and VA shall give due consideration to the recommendations of the referenced building officials. VA will also permit inspection by the officials described above during the construction period in accordance with the customary schedule of inspections in the locality of the building construction. Such officials shall provide VA with a copy of the schedule before construction begins or give reasonable notice of their intention to inspect before conducting an inspection.
6. The DB team shall provide prompt, written notification to the Contracting Officer concerning conflicts with, or recommended deviations from codes, laws, regulations, standards, and opinions of review officials as described above. No work altering the scope of this contract shall be undertaken prior to receipt of written approval from the Contracting Officer.
7. No action may be brought against the DB team or VA and no fine or penalty may be imposed for failure to carry out any of the previously described recommendations of Federal, state, or local officials. VA and its contractors, including A/E, shall not be

required to pay any amount for any action taken by a state or political division of a state in carrying out functions described in this article, including reviewing plans, carrying out on-site inspections, issuing permits, and making recommendations.

8. The DB team shall advise the Contracting Officer of any variances with the applicable Department of Labor, Occupational Safety and Health Standards, for occupancy requirements.

J. Quality Assurance/Quality Control:

1. To reduce design errors and omissions, the DB team shall develop and execute a QA/QC plan that demonstrates the project plans and specifications have gone through a rigorous, thorough review and coordination effort.
2. Within 2 weeks of receipt of Notice to Proceed, the DB Team will submit a detailed QA/QC plan describing each QA/QC task that will be taken during the development of the various design submission packages and the name of the DB Team member responsible for QA/QC.
 - a. Upon its completion each task shall be initialed and dated by the responsible DB Team member.
 - b. A 100% completed QA/QC plan shall be submitted with the final construction document submission package.

D2. Construction Period Submittals

- A. The DB contractor shall distribute a total of 6 sets of the approved construction documents prepared by the DB Team to the VA and CPIS AE, as directed by the VA Project Manager.
- B. Other submittals - The DB team shall submit test results, certificates, manufacturer's instructions, manufacturers field reports, etc. as required by the contract documents, to the VA PM and CPIS AE.
- C. Project as-built drawings - The DB team will maintain a set of construction documents (field as-built drawings) to record actual construction changes during the construction process as required by the contract documents. The project as-built drawings will be available for review by the VA Project Manager at all times.
- D. Shop drawings and submittals - The DB A/E shall check government furnished and/or the DB construction contractor's shop drawings, detail drawings, schedules, descriptive literature and samples, testing labor-laboratory reports, field test data and review the color, texture and suitability of materials for conformity with the contract

Documents and construction documents. The DB A/E shall recommend approval, disapproval, or other suitable disposition to the VA PM. The VA PM will have final approval authority. The DB AE shall evaluate the submittals with reference to any companion submittals that constitute a system. When necessary, the DB A/E will request the DB Construction Contractor to submit related components of a system before acting on a single component. Should this procedure be inappropriate, the DB A/E shall review all prior submittals for related components of the system before acting on a single component. The DB A/E may be required to hold joint reviews with the VA technical staff and /or the CPIS AE on complicated system submittals. The DB A/E shall notify the VA Project Manager (PM) in writing of any and all deviations from the requirements of the construction documents that he has found in the submittals.

D3. Site Visits and Inspections

During the construction period the DB A/E shall make periodic visits to the project site as part of the QC/QA process. The Contracting Officer (CO), Project Manager (PM) or COR may also request visits for special purposes. Only registered architects and engineers thoroughly familiar with the project may make these site visits. The Contracting Officer (CO) or Project Manager (PM) has the prerogative to determine the professional discipline(s) required for any visit. The DB A/E shall observe the construction and provide a site report. The site inspection report which includes the purpose of the inspection, items reviewed and recommendations shall be furnished to the Contracting Officer (CO), Project Manager (PM) and COR within three work days following the site visit date.

D4. Project Close-Out

The DB team shall comply with the requirements in the contract documents for submission of final contract documents: record drawings, manuals, and other documents as noted.

Record Documents: See VA Program Guide PG-08-15, Volume D, "for A/E submission Requirements for National Cemetery projects" (<http://www.cfm.va.gov/til/nca.asp>). The Record Document shall be based on changes made during construction and existing conditions that differed from those known at the time construction documents were prepared, the DB/A/E shall revise construction documents to reflect conditions at the completion of construction. Record documents shall incorporate information gathered from the following sources:

- a) Contractor's field set of as-built documents annotated to show changes made during construction.
- b) Drawings and instructions issued during construction as responses to Requests for Information (RFIs) or supplemental instructions.
- c) Change Orders.
- d) Substitutions.

Submission Requirements

- a) Complete set of drawings, hard copy and electronic (AutoCAD and associated files and PDFs)
- b) Project Manual. (PDF and hard copy)
- d) Warranties. (PDF and hard copy)

See below for Record Drawing Distribution:

- Cemetery – Full size bond
- District Engineer – Full size bond & (CD/DVD of CAD files and PDFs)
- VA Project Manager – Full size bond, Full size Mylar & (CD/DVD of CAD files and PDFs)

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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. Provide all professional services, labor, materials, tools, equipment, and design-build services necessary for preparing, a Master Plan for the site, design development and construction documents for Phase 1 and .and Construction of the phase 1. The Design-Build Contractor shall, completely prepare site for construction operations, furnish labor and materials and perform work for the construction of Phase 1. Work also includes but is not limited to: master plans, design, geotechnical investigation, surveying, design reviews, master plan reviews, concept reviews, demolition and removal of existing structures, alterations, clearing, grubbing, cut and fill, earth work, grading, building construction, landscape, walls, roads, curbs, installation of pre-placed double depth concrete crypts, oversize crypts, private vaults, in-ground cremains, columbarium, installation of niche covers, utilities, storm drainage, ornamental fencing, dignified entrance features, pedestrian paving, landscape planting and turf, site furnishings, electrical, mechanical, irrigation, certain other items and consulting with Wyoming State Historic Preservation Office (SHPO).
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. N/A
- D. Before placement and installation of work subject to tests by testing laboratory retained by the contractor, the Contractor shall notify the Resident Engineer/Contracting Officers Technical Representative (RE/COTR) in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the RE/COTR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

- F. Prior to commencing work, general contractor shall provide proof that a OSHA certified “competent person” (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Training:
 - 1. All employees of general contractor or subcontractors shall have the 30-hour OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP
 - 2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. Work includes general construction, alterations, roads, walks, grading, drainage, irrigation, crypt placement, electrical work, and necessary removal of existing structures and construction and certain of other items.

CLIN 1: Provide Master Planning for the site, including associated master plan documents and plans.

CLIN 2: Design-Build Phase 1 for installation of 320 Niche Columbarium, install 400 pre-placed Crypts, install 40 oversized crypts, 320 in-ground cremains plots, 40 plots for private vaults, including the construction of associated walks, landscaping, drainage, signage (both site and wayfinding), water and electric infrastructure, irrigation, and dignified entrance feature. The well shall be used for the irrigation system. Niche covers shall be government-supplied but contractor-installed. Design shall be per NCA Criteria on the VA website on the Technical Information Library.

CLIN 3: Purchase and deliver to site 400 pre-placed crypts, 40 oversized vaults, 3 lid lifting devices, and 10 crypt lids (for each crypt size).

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT; Additional sets of solicitation material may be made by the Contractor, at Contractor's expense.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor's employees shall not enter the project site without an appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days' notice to the RE/COTR so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
3. No photography of VA premises is allowed without written permission of the RE/COTR.
4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the RE/COTR..

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the RE/COTR for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.

E. Motor Vehicle Restrictions

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

1.5 FIRE SAFETY

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

1. American Society for Testing and Materials (ASTM):
E84-2009a.....Surface Burning Characteristics of Building Materials
2. National Fire Protection Association (NFPA):
10-2010.....Standard for Portable Fire Extinguishers

- 30-2008..... Flammable and Combustible Liquids Code
- 51B-2009 Standard for Fire Prevention During Welding, Cutting and Other
Hot Work
- 70-2008..... National Electrical Code
- 241-2009..... Standard for Safeguarding Construction, Alteration, and
Demolition Operations
- 3. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1926..... Safety and Health Regulations for Construction
- B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to RE/COTR/Cemetery Director for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractor's beginning work, they shall undergo a safety briefing provided by the General Contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc. Documentation shall be provided to the RE/COTR that individuals have undergone the Contractor's safety briefing.
- C. Site and Building Access: Maintain free and unobstructed access to emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with RE/COTR/Cemetery Director.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to RE/COTR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.

- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with RE/COTR. Designate Contractor's responsible project-site fire prevention program manager to permit hot work.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to RE/COTR.
- L. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- N. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the RE/COTR. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the RE/COTR and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the RE/COTR, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the RE/COTR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the RE/COTR. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads. **(FAR 52.236-10)**

- D. Working space and space available for storing materials shall be as shown on the drawings.
- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Provide unobstructed access to the Cemetery areas required to remain in operation.
 - 3. Where access by Cemetery personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements and at the discretion of the RE/COTR. All such actions shall be coordinated with the Utility Company involved:
 - a. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- G. Phasing: To insure such executions, the Contractor shall furnish the RE/COTR with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, the Contractor shall notify the RE/COTR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to the Cemetery Director, RE/COTR and Contractor.
- H. The Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Cemetery's operations will not be hindered. The Contractor shall permit access to Department of Veterans Affairs personnel through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Cemetery operations will continue during the construction period.
- I. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, 2.1m (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 25mm (one inch) above grade. Remove the fence when directed by RE/COTR.

- J. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by RE/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 RE/COTR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the RE/COTR, and Cemetery Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
 2. The Contractor shall submit a request to interrupt any such services to RE/COTR, and Cemetery Director, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. The Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Cemetery. Interruption time approved by the Cemetery 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 RE/COTR.
 5. In case of a contract construction emergency, service will be interrupted on approval of RE/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.
- K. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the RE/COTR.
- L. Coordinate the work for this contract with other construction operations as directed by RE/COTR. This includes the scheduling of traffic and the use of roadways.
- M. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the RE/COTR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the interment services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period:
 1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.
 2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the RE/COR the site in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by to the COR. This report shall list:
 1. Existing condition.
 2. Shall note any discrepancies between drawings and existing conditions at site.

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

1.8 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 1. Reserved items which are to remain property of the Government are identified by attached tags as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by RE/COTR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.

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

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site which are not to be removed and which

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

- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the RE/COTR may have the necessary work performed and charge the cost to the Contractor. **(FAR 52.236-9)**
- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate NCA Central/Cemetery) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
 - 1. Designating areas for equipment maintenance and repair;
 - 2. Providing waste receptacles at convenient locations and provide regular collection of wastes;

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

1.10 RESTORATION

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

1.11 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 geotechnical information is by TTL, Associates.

- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.
- C. A copy of the soil report will be made available for inspection by bidders upon request to the Contracting Officer.
- D. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.12 PROFESSIONAL SURVEYING SERVICES

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

1.13 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the RE/COTR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the RE/COTR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the RE/COTR 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 center lines for each building and/or addition to each existing building, lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established

for each such structure and/or addition, roads, parking lots, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.

- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the RE/COTR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, and particularly as work progresses from floor to floor, the Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the RE/COTR before any major items of concrete work are placed. In addition, the Contractor shall also furnish to the RE/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/or addition.
 2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines of grave plot documentation.
 5. Lines of elevations of all swales and interment areas.
 6. Lines and elevations of roads, streets and parking lots.
 7. Lines and elevations of top of pre-placed crypts.
 8. Lines and elevations of grade over pre-placed crypts.
 9. Northing/Easting coordinate locations of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
- E. Upon completion of the work, the Contractor shall furnish the RE/COTR with reproducible drawings, in Autocad form, at the scale of the contract drawings, showing the finished grade on

the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

- F. 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".

1.14 AS-BUILT DRAWINGS

- A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, which will include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the RE/COTR's review, as often as requested.
- C. The Contractor shall deliver two approved completed sets of as-built drawings to the RE/COTR within 15 calendar days after each completed phase and after the acceptance of the project by the RE/COTR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.15 USE OF ROADWAYS

- A. For hauling, use only established public roads and roads on Cemetery property and, when authorized by the RE/COTR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at the Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, the Contractor may construct them immediately to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at the time set for completion of such buildings or parts thereof.

1.16 TEMPORARY TOILETS

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

provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

- B. Contractor may have for use of the Contractor's workmen, such toilet accommodations as may be assigned to the Contractor by the Cemetery . The Contractor shall keep such places clean and be responsible for any damage done thereto by the Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive the Contractor of the privilege to use such toilets.

1.17 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the RE/COTR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available the contractor shall supply power via portable generators at own expense.
- F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Cemetery water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at RE/COTR's discretion) of use of water from the Cemetery's system.
- G. Fuel: Natural and LP gas required for burner cleaning, normal initial burner-burner setup and adjusting, and for performing the specified burner tests will be furnished by the Government. Fuel required for prolonged burner setup, adjustments, or modifications due to improper design or operation of burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.18 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the RE/COTR. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply; air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a burner installation. Efficient and acceptable burner operation depends upon the coordination and proper operation of fuel, combustion air, controls, and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.19 INSTRUCTIONS

- A. The Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the RE/COTR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: the Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system; shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the RE/COTR and shall be considered concluded only when the RE/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 RE/COTR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.20 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery
- C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery
- D. Notify RE/COTR in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
 - 1. Immediately upon delivery of equipment, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. The Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.21 RELOCATED ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.

- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the RE/COTR.
- C. Suitably cap existing service lines, such as water, drain, gas, air, and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.22 CONSTRUCTION DIGITAL IMAGES

- A. During the construction period through completion, furnish Department of Veterans Affairs with _____ views of digital images, including one color print of each view and one Compact Disc (CD) per visit containing those views taken on that visit. Digital views shall be taken of exterior and/or interior and aerial photographs as selected and directed by RE/COTR (RE). Each view shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) and the images will be a minimum of 2272 x 1704 pixels for the 200x250mm (8x 10 inch) prints and 2592 x 1944 pixels for the 400x500 mm (16 x 20 inch) prints, as per these specifications:
 - 1. Normally such images including aerial photographs of the site will be taken at monthly intervals. However, the RE/COTR may also direct the taking of special digital images at any time prior to completion and acceptance of contract. If the number of trips to the site exceeds an average of one per month of the contract performance period then an adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 00 72 00, GENERAL CONDITIONS.
 - 2. In event a greater or lesser number of images than specified above are required by the RE/COTR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- B. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.

- C. Prints shall be made on 200 x 250 mm (8 by 10 inch) regular-weight matte archival grade photographic paper and produced by a process with a minimum of 300 pixels per inch (PPI). Prints must be printed using the commercial RA4 process (inkjet prints will not be acceptable). Photographs shall have 200 x 200 mm (8 by 8 inch) full picture print with no margin on three sides and a 50 mm (2 inches) margin on the bottom for pre-typed self-adhesive identity label to be added by RE/COTR. It is required that the prints are professionally processed so the quality will meet or exceed that of the same size print made with a film camera. Prints must be shipped flat to the RE/COTR.
- D. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% or the original with no loss of information. File names shall contain the date the image was taken, the Project number and a unique sequential identifier. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- E. In case any set of prints are not submitted within five days of date established by RE/COTR for taking thereof, the RE/COTR may have such images/photographs taken and cost of same will be deducted from any money due to the Contractor.
- F. Aerial Photographs: Submit aerial photographs at one-month intervals during the entire construction period. The first aerial photo shall be taken just prior to the start of construction and then at one-month intervals. The final aerial photograph shall be taken at full project completion during a growing season when lawns are green and not dormant.

1.23 PROJECT HEALTH AND SAFETY PLAN

- A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:
 - 1. Organizational structure (including Responsible Persons)
 - 2. Site Characterization and Job Hazard Identification
 - 3. Site Control and Security
 - 4. Training
 - 5. PPE
 - 6. Heat Stress⁹
 - 7. Spill Containment
 - 8. Decontamination

9. Emergency Response

10. Confined Spaces

11. Trench Safety

-- E N D --

SECTION 01 32 16.15 PROJECT SCHEDULES

PART 1- GENERAL

1.1 DESCRIPTION

- A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), 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 Contracting Officer's representative.
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.
- 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, subsection 1.3 of this Section will apply.

1.3 CONTRACTOR'S CONSULTANT

- A. The Contractor shall submit a qualification proposal to the VA Contracting Officer 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. Representative samples of prior construction projects for which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
- B. The Contracting Officer 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 shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all Project Schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look ahead report. The Contracting Officer will identify the five different report formats that the Contractor shall provide.
- B. The Contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also responsible for the accurate and timely submittal of the updated Project Schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA will report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the Contracting Officer, to correct errors which affect the payment and schedule for the project.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review: color-coded Project Schedule on sheets of paper 30 x 42 inches and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget

amount, early start date, early finish date, late start date, late finish date and total float.

Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. **The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

- D. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.
- E. 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 requirements of this section.

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 COTR'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, floor, or building, to another area, floor, 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 Contracting Officer's representative 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.
 2. The planned number of shifts per day.
 3. The number of hours per shift.
- 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 Contracting Officer's representative. 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 Contracting Officer's approval of the Project Schedule.

- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA 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 monthly update of the Project Schedule.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the Contracting Officer's representative and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the Contracting Officer's representative 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. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly Project Schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COTR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COTR. After each rerun update, the resulting electronic Project Schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly Project Schedule update requirements and shall be submitted to the COTR within fourteen (14) calendar days of completing the regular schedule update. **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. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**
- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. 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. This schedule coordination meeting will occur after each monthly Project Schedule update meeting utilizing the resulting schedule reports from that schedule update. 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 monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
 - 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 - 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 - 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer's representative 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. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.
 - C. Contracting Officer's approval for the revised Project Schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
 - D. The cost of revisions to the 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 Contracting Officer's representative 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 month by month basis.

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

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

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

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

Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

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

(Architect-Engineer)

(A/E P.O. Address)

(City, State and Zip Code)

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

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SECTION 01 42 19 REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29

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

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS

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

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
811 Vermont Avenue, NW - Room 462
Washington, DC 20420

Telephone Number: (202) 461-8217

Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS

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

AA	Aluminum Association Inc. http://www.aluminum.org
AABC	Associated Air Balance Council http://www.aabchq.com
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.aashto.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADC	Air Diffusion Council http://flexibleduct.org

AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org
AITC	American Institute of Timber Construction http://www.aitc-glulam.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.ari.org
ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org

ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	Brick Institute of America http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CRA	California Redwood Association http://www.calredwood.org

CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
DHI	Door and Hardware Institute http://www.dhi.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EEI	Edison Electric Institute http://www.eei.org
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.et1.com
FCC	Federal Communications Commission http://www.fcc.gov
FDOT	Florida Department of Transportation http://www.dot.state.fl.us
FPS	The Forest Products Society http://www.forestprod.org
GANA	Glass Association of North America http://www.cssinfo.com/info/gana.html/
FM	Factory Mutual Insurance http://www.fmglobal.com
GA	Gypsum Association http://www.gypsum.org

GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org
ICBO	International Conference of Building Officials http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org.org
NBS	National Bureau of Standards See - NIST
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org

NHLA	National Hardwood Lumber Association http://www.natlhardwood.org
NIH	National Institute of Health http://www.nih.gov
NIST	National Institute of Standards and Technology http://www.nist.gov
NLMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org
NPA	National Particleboard Association 18928 Premiere Court Gaithersburg, MD 20879 (301) 670-0604
NSF	National Sanitation Foundation http://www.nsf.org
NWWDA	Window and Door Manufacturers Association http://www.nwwda.org
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.portcement.org
PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PEI	Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com

PTI	Post-Tensioning Institute http://www.post-tensioning.org
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Door Institute http://www.steeldoor.org
IGMA	Insulating Glass Manufacturers Alliance http://www.igmaonline.org
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
TCA	Tile Council of America, Inc. http://www.tileusa.com

TPI	Truss Plate Institute, Inc. 583 D'Onofrio Drive; Suite 200 Madison, WI 53719 (608) 833-5900
UBC	The Uniform Building Code See ICBO
UL	Underwriters' Laboratories Incorporated http://www.ul.com
ULC	Underwriters' Laboratories of Canada http://www.ulc.ca
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Road, P.O. Box 23145 Portland, OR 97223 (503) 639-0651
WRCLA	Western Red Cedar Lumber Association P.O. Box 120786 New Brighton, MN 55112 (612) 633-4334
WWPA	Western Wood Products Association http://www.wwpa.org

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SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T27-06..... Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006)..... Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-01 (R2004)..... The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2003)..... Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-01 (R2004)..... Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02(R2006)..... Density of Soil In-Place by the Sand-Cone Method
- C. American Society for Testing and Materials (ASTM):
- A325-09..... Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-09..... Definitions for Mechanical Testing of Steel Products
 - A490-08..... Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-08..... Making and Curing Concrete Test Specimens in the Field
 - C33-08 Concrete Aggregates
 - C39/C39M-05..... Compressive Strength of Cylindrical Concrete Specimens
 - C109/C109M-08..... Compressive Strength of Hydraulic Cement Mortars

C138-08	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-08	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-08	Slump of Hydraulic Cement Concrete
C172-08	Sampling Freshly Mixed Concrete
C173-08	Air Content of freshly Mixed Concrete by the Volumetric Method
C330-05	Lightweight Aggregates for Structural Concrete
C567-05	Density Structural Lightweight Concrete
C780-08	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-09	Sampling and Testing Grout
C1064/C1064M-08	Freshly Mixed Portland Cement Concrete
C1077-08	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-07	Compressive Strength of Masonry Prisms
D698-07	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143-07	Piles Under Static Axial Compressive Load
D1188-07	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-07	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-05	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

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

E. American Welding Society (AWS):

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

- A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor, must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the Contracting Officer COTR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the Contracting Officer COTR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.
1. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.

2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D3740.
 5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
 6. Laboratories engaged in non-destructive testing (NDT) shall meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by RE/COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of RE/COTR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to RE/COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE/COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the RE/COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material

and recommend to RE/COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide // full time // part time // observation of fill placement and compaction and field density testing in building areas and provide // full time // part time // observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with // AASHTO // T99/T180 // Method A // // ASTM // D698 // D1557 // Method A // ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D2922 // AASHTO T238 // wherever possible. Field density tests utilizing ASTM D1556 // AASHTO T191 //, or // ASTM D2167 // shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the RE/COTR before the tests are conducted.
 - a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.

- e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
 - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to RE/COTR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by RE/COTR.

3.3 LANDSCAPING

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
- 1. Test for organic material by using ASTM D2974.
 - 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to RE/COTR.

3.4 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
- 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with FDOT.
 - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with FDOT.
 - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.
- B. Asphalt Concrete:

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

3.5 SITE WORK CONCRETE

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

3.6 CONCRETE

- A. Batch Plant Inspection and Materials Testing:
 1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COTR.
 2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/COTR.
 3. Sample and test mix ingredients as necessary to insure compliance with specifications.
 4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
 5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.
- B. Field Inspection and Materials Testing:
 1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
 2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if

- the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. // After good concrete quality control has been established and maintained as determined by RE/COTR make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. // Label each cylinder with an identification number. RE/COTR may require additional cylinders to be molded and cured under job conditions.
 4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
 5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:

- a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.

- c. Provide the Contractor and the RE/COTR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
- 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
 - 1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by RE/COTR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 - 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 - 3. Furnish certified compression test reports (duplicate) to RE/COTR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.7 REINFORCEMENT

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

- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.8 ARCHITECTURAL PRECAST CONCRETE

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

3.9 MASONRY

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

3.10 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. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
 - i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
 - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to RE/COTR.

3.11 TYPE OF TEST

Approximate
Number of
Tests
Required

A. Earthwork:

Laboratory Compaction Test, Soils:

/(AASHTO T180)/(AASHTO T99)/(ASTM D1557)/(ASTM D698)/

Field Density, Soils (AASHTO T191, T205, or T238)

Penetration Test, Soils

B. Landscaping:

Topsoil Test

C. Aggregate Base:

Laboratory Compaction, // (AASHTO T180)// /(ASTM D1557)//

Field Density,/(AASHTO T191)// /(ASTM D1556)//

Aggregate, Base Course

Gradation (AASHTO T27)

Wear (AASHTO T96)

Soundness (AASHTO T104)

D. Asphalt Concrete:

Field Density, (AASHTO T230)//ASTM D1188//

Aggregate, Asphalt Concrete

Gradation (AASHTO T27)

Wear (AASHTO T96)

Soundness (AASHTO T104)

E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31)

Compressive Strength, Test Cylinders (ASTM C39) _____

Concrete Slump Test (ASTM C143) _____

Concrete Air Content Test (ASTM C173) _____

Unit Weight, Lightweight Concrete (ASTM C567) _____

Aggregate, Normal Weight:

Gradation (ASTM C33) _____

Deleterious Substances (ASTM C33) _____

Soundness (ASTM C33) _____

Abrasion (ASTM C33) _____

Aggregate, Lightweight

Gradation (ASTM C330) _____

Deleterious Substances (ASTM C330) _____

Unit Weight (ASTM C330) _____

Flatness and Levelness Readings (ASTM E1155) (number of days) _____

F. Reinforcing Steel:

Tensile Test (ASTM A370) _____

Bend Test (ASTM A370) _____

Mechanical Splice (ASTM A370) _____

Welded Splice Test (ASTM A370) _____

G. Masonry:

Making and Curing Test Cubes (ASTM C109) _____

Compressive Strength, Test Cubes (ASTM C109) _____

Sampling and Testing Mortar, Comp. Strength (ASTM C780) _____

Sampling and Testing Grout, Comp. Strength (ASTM C1019) _____

Masonry Unit, Compressive Strength (ASTM C140) _____

Prism Tests (ASTM C1314) _____

H. Inspection:

Technical Personnel (Man-days) _____//

I. Technical Personnel: (Minimum _____ months)

1. Technicians to perform tests and inspection listed above. Laboratory will be equipped with concrete cylinder storage facilities, compression machine, cube

molds, proctor molds, balances, scales, moisture ovens, slump cones, air meter, and all necessary equipment for compaction control.

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SECTION 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely affect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Affect other species of importance to humankind.
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

1.2 DEFINITIONS OF POLLUTANTS

- A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
- C. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.
- E. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and require a permit to discharge water from the governing agency.
- F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.
- G. Sanitary Wastes: Domestic Sanitary Sewage.

1.3 QUALITY CONTROL

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

1.4 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328..... Definitions, Waters of the United States.
- C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): <http://www.epa.gov/owow/>
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response: <http://www.epa.gov/epaoswer/osw/laws-reg.htm>
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website: <http://www.epa.gov/superfund/index.htm>
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage: <http://www.epa.gov/pcb/>
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page: <http://www.epa.gov/ebtpages/airmobilesources.html>
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website: <http://www.epa.gov/fedsite/cd/asbestos.html>
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities
 - 10. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: <http://endangered.fws.gov/>
 - 11. National Historic Preservation Act

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

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

1.5 SUBMITTALS

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

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer/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 Resident Engineer/COTR // for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - i. ensuring adherence to the Environmental Protection Plan.
 - ii. Manifesting hazardous waste to be removed from the site.
 - iii. Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - d. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

- e. Procedures to provide environmental protection that complies with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, // stream crossings, // material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.// Include as part of an Erosion Control Plan approved //by the District Office of the U.S. Soil Conservation Service// and/or mandated state agency,// and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the Resident Engineer/COTR shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.6.PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the duration of this contract. Confine construction activities to areas defined by construction limits, the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, land forms, wetlands or wetland buffers without prior approval from the Resident Engineer/COTR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.

1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Mark/fence/protect monuments, works of art, and markers prior to construction. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
 - a. Protect trees and shrubs to remain on site to protect from damage per contract details.
 - b. All damage to existing trees and shrubs shall be immediately repaired by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
 - a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local //____// (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
 - b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer/COTR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING short form.
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain temporary

- erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
6. Manage and control borrow and spoil areas on Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
 7. Protect adjacent areas from despoilment by temporary excavations and embankments.
 8. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 10. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer/COTR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
 3. Monitor water areas, wetlands and wetland buffers affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list protected species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted

on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the Florida State Statutes and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer/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 6:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the Resident Engineer/COTR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
 - a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

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

- b. Provide soundproof housings or enclosures for noise-producing machinery.
 - c. Use efficient silencers on equipment air intakes.
 - d. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - e. Line hoppers and storage bins with sound deadening material.
 - f. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 75 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighted sound level of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the

Resident Engineer/COTR noting any problems and the alternatives for mitigating actions.

- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition as approved by the Resident Engineer/COTR. Cleaning shall include off-cemetery disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 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. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

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

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

1.6 APPLICABLE PUBLICATIONS

Publications listed below form a part of this specification to the extent referenced.

Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

- A. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.7 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

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

3.3 REPORT

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

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SECTION 02 41 10 DEMOLITION AND SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- H. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. 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 Resident Engineer. 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 Resident Engineer's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS,.

1.4 UTILITY SERVICES

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

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
- B. Erosion Control: Contractor shall provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent

properties and walkways. Contractor shall install silt fence and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.

- C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.
- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 6 inches. Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 1 inch in diameter, and without weeds, roots, and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 - 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Division 2 Section 02900, "Landscape Work" for soil amendments required prior to spreading topsoil.
 - a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
 - 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the Architect.
- E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
 - 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.

- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the threat of erosion is gone by either around surface stabilizer or lawn "grow-in" is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. Completely demolish and remove 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 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Resident Engineer. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.
- D. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Resident Engineer. When Utility lines are encountered that are not indicated on the drawings, the Resident Engineer shall be notified prior to further work in that area.

3.2 CLEAN-UP

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Resident Engineer. Clean-up shall include off the Cemetery Property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 TOLERANCES

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

1.4 REGULATORY REQUIREMENTS:

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

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced.
Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117R-06 Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002) Proportions for Normal, Heavyweight, and Mass Concrete
 - 211.2-98(R2004) Proportions for Structural Lightweight Concrete
 - 301-05 Specification for Structural Concrete
 - 305R-06 Hot Weather Concreting

- 306R-2002 Cold Weather Concreting
- SP-66-04 ACI Detailing Manual
- 318/318R-05..... Building Code Requirements for Reinforced Concrete
- 347R-04 Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
 - A185-07..... Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
 - A615/A615M-08 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - A996/A996M-06 Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 - C31/C31M-08..... Making and Curing Concrete Test Specimens in the Field
 - C33-07 Concrete Aggregates
 - C39/C39M-05..... Compressive Strength of Cylindrical Concrete Specimens
 - C94/C94M-07 Ready-Mixed Concrete
 - C143/C143M-05 Standard Test Method for Slump of Hydraulic Cement Concrete
 - C150-07 Portland Cement
 - C171-07 Sheet Material for Curing Concrete
 - C172-07 Sampling Freshly Mixed Concrete
 - C173-07.Air Content of Freshly Mixed Concrete by the Volumetric Method
 - C192/C192M-07 Making and Curing Concrete Test Specimens in the Laboratory
 - C231-08 Air Content of Freshly Mixed Concrete by the Pressure Method
 - C260-06 Air-Entraining Admixtures for Concrete
 - C330-05 Lightweight Aggregates for Structural Concrete
 - C494/C494M-08 Chemical Admixtures for Concrete
 - C618-08 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - D1751-04.Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D4397-02	Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
E1155-96(2008)	Determining F_F Floor Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS

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

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- P. Liquid Densifier/Sealer: 100 percent active colorless aqueous siliconate solution.
- Q. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or

vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than (4000 psi).
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

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

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

- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following tables:

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

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

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

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

2.4 BATCHING & MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.
 3. Mixing structural lightweight concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
 - 1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 - 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
 - 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.
- D. Construction Tolerances:
 - 1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
 - 2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT

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

3.3 VAPOR BARRIER

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

3.4 PLACING CONCRETE

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of Resident Engineer before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Resident Engineer.

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 Resident Engineer.

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 Resident Engineer, 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. Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.
- B. Slab Finishes:
 - 1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
 - 2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.

3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.
5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs	Unshored suspended slabs
Specified overall value F_F 25/ F_L 20	Specified overall value F_F 25
Minimum local value F_F 17/ F_L 15	Minimum local value F_F 17

3.9 SURFACE TREATMENTS

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
- 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 APPLIED TOPPING

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

3.11 PRECAST CONCRETE ITEMS

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

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SECTION 03 48 21
PRECAST CONCRETE BURIAL CRYPTS
(Double Depth Lawn Crypt)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work 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, sub-base 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 easily retrieve and lower the inside shelf without 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 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. Excavation and Backfill: Section 31 20 11 EARTHWORK.
- B. Materials Testing and Inspection during Fabrication and Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

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 to certify that the units conform to specified requirements.
- C. Installation Qualifications: Regularly engaged for at least three years in installation of pre-cast concrete similar to this project.
- D. Fabricate crypts to the interior dimensions described below. Replace or repair units that do not comply with the individual dimensions and tolerances.
- E. Prior to or in the initial stage of crypt production, furnish at the site two perimeter crypts, a single interior crypt, and the proposed shelf removal tool to demonstrate quality of construction of crypts and conduct on-site buried crypt load testing to include removal and replacement of the inside shelf. Commence production of crypts only after submittal approval and on-site load testing has been scheduled for witnessing by the NCA Crypt Specialist.
- 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. Crypt wall sections at support slots for the inside shelf may be of lesser thickness.
 - 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 a center point load of 6,000 lbs prior to burial, passage of a wheel axle load of 12,000 lbs after burial, and a 3-foot tall pile of excavated material on top of or adjacent to buried crypts.
3. The Contractor shall submit to the NCA inspector 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 and tag certified wire rope lifting devices for removing the lid. No chain lifting devices allowed.
5. 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, non-deteriorating, and have a ½ inch gap from all shelf edges to the crypt wall. Provide tools that Owner can easily retrieve and install the shelf from ground level without entering the crypt and demonstrate said tool at the crypt buried load testing.
6. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning ½ inch down from top.
7. The design of casket risers shall allow the casket to rest ¾ inch above the inside floor of the crypt and above the top of the inside shelf in order to aid in casket lowering straps removal. In addition, rests location shall not exceed 21 inches from crypt centerline.
8. There shall be a minimum of two 1" diameter drain holes in the bottom at opposite ends of each crypt to allow for complete water drainage.

9. The crypt outside lifting wire shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire once crypt has been installed.

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 Test: 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 following loading conditions:

1. 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, whichever is greater. The soil will be compacted to density along the sides (usually 95%) and reduced density over the lid, both as shown on the plans. An axle load of 12,000 lbs. will then be passed over the covered crypts for a minimum of 10 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 lids removed to allow careful examination inside and outside. The crypts must not show any signs of stress or cracking.
2. Concurrent with Confined Loading, the inside shelf of the interior crypt shall be loaded with one worker with a minimum weight of 200 lbs. Worker shall walk on individual supports to confirm structural integrity and load bearing capability. Worker shall adhere to all safety regulations while performing test. Upon uncovering and load removal, the shelf shall be removed by the proposed removal tool and the shelf must not show any signs of stress, cracking or deflection.

1.4 ALLOWABLE TOLERANCES

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 0.030 inches in width are cause for crypt rejection by the NCA inspector. With evidence of fiber or steel reinforcement, any cracking 0.030 or lesser width that does **not** extend thru wall is acceptable. Any cracking 0.016 inch or lesser that extends thru wall is acceptable. All other cracks are cause for rejecting crypts that shall be repaired or removed and replaced at no cost to VA.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, Contractor shall furnish to the Owner and the NCA Crypt Specialist the following:
 1. Samples: deliver to the site for testing and inspection:
 - a. Two perimeter crypts and one interior crypt.
- B. Submit a detailed concrete Mix Design of Self Consolidate Concrete (SCC) with a **15% minimum requirement** of a cement substitute of fly ash and/or other pozzalons.
- C. Submit 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.
- D. Submit Product Design Data:
 1. Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.
 2. Loadings for Design Calculations:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads specified.

- c. Other loads specified for units as applicable.
- d. Deflection of precast members.
- e. Product test reports:
 - 1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the Resident Engineer (NCA inspector) immediately after the strength tests have been completed. The tests shall be as specified herein.
 - 2) Prior to backfilling over crypts and at contractor expense, the NCA inspector may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.
 - 3) Based on failed testing, the NCA inspector may request more frequent testing to ensure quality of the product and pozzalons content is present, again at contractor expense.
- 3. Manufacturer's Literature and Data:
 - a. Each type of anchorage, angle, and fastener.

1.6 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 wire 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. Coordinate the manufacture, delivery, storage and installation of the units with related work.

1.8 GUARANTEE

- A. After erection, completed work will be, subject to terms of Article, GUARANTEE in Section 01 00 00, GENERAL CONDITIONS, except guarantee period is extended to five years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Precast Concrete: All crypts 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 shall contain a minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids. All to be in conformance to 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.

D. Paint:

1. Use commercial Concrete & Garage Floor Epoxy Acrylic Paint for crypt concrete lid & inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal.

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 cracks not within tolerances 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. 90% 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 NCA inspector.
2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.

2.3 TESTING AND INSPECTION

- A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including the removal of lids, number painting inside crypts, and replacement of the lids for inspection by the Resident Engineer. The NCA inspector 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. A single verification test of fly ash in the crypt concrete mix required at the discretion of the NCA inspector.

3.2 GENERAL LAYOUT CONTROL

- A. A professional registered Land Surveyor 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.
 1. Verify by survey, grading of subgrade and aggregate base for proper installation of units.
 2. Verify by testing, compaction of prepared subgrade and subbase.
 3. Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.4 HANDLING, INSTALLTION AND PAINTING

- A. Handling:
 1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, 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 crypt installation and prior to backfill, the contractor shall remove lids with the specified lifting apparatus for crypt inspection by the NCA inspector 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 short wall, both at the headstone end. Numbers shall be permanent paint as specified and twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application **within 10 seconds** of surface cleaning. After completion of inspection and marking, the Contractor shall replace the lids. Any damage to lids or crypts will be the responsibility of the contractor.

3.5 PROTECTION OF WORK

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

3.6 REPLACEMENT AND REPAIR

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

3.7 BACKFILLING AND CRYPT FIELD PROTECTION

- 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 pea gravel (rounded) fill per gradation into gaps between crypts leaving no voids. Use rodding to assure no bridging occurs and void areas are eliminated. No sand allowed. At NCA's discretion, a cut aggregate substitute of same gradation may be approved with demonstration that filling gaps between crypts leaves no voids.

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

- D. Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of 2 inches of identification sand, soil to specified level, and 4 inches of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% standard proctor density.
- E. No equipment over the crypts should exceed crypt design loads as specified herein (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over or along side crypts unless impact loads are shown not to exceed crypt design loads.
- F. Immediately during crypts install, contractor to mark the crypt field edges with temporary driven 5-foot tall lathes & signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state **"12,000-lb axle load maximum. Keep 10 yards away"** Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.
- G. Finish grading and prepare topsoil as indicated on plans.
- H. The contractor shall not store or stockpile any stone, sand, backfill or any other material over 4-feet high within ten (10) yards of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE shall be inspected by the RE for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.
- I. The contractor shall not allow any vehicle that exceeds a 12,000-lb axle load, 6000-lb wheel load or equivalent pressure per square inch to traverse or park within ten (10) yards of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the RE shall be inspected by the RE for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance will be by NCA inspector.

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SECTION 03 48 24 PRE-CAST CONCRETE COLUMBARIUM UNITS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 RELATED DOCUMENTS

- A. Section 31 20 11, EARTH MOVING
- B. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM) for Cast-in-place concrete work.
- C. Section 04 20 00, UNIT MASONRY for stone work.
- D. Section 07 92 00, JOINT SEALANTS, Materials and Workmanship for sealant application.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Prior to commencement of work, Contractor shall submit documentation regarding the experience of his precast concrete supplier in the design and manufacture of Precast Concrete structures and custom units.
- B. Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.
- C. Codes and regulations of the Federal, State and County authorities shall apply.
- D. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.
- E. Before starting production of precast concrete Columbarium Units, furnish at the site, two complete Precast Concrete Columbarium Units, to demonstrate quality of construction. Commence production of Columbarium Units only after written approval has been obtained from the Contractor.
- F. Design Criteria:
 - 1. The Columbarium Units shall be of the following type, style, and size:
 - a. Type: Precast concrete, reinforced.
 - b. Size: Interior and exterior dimensions as indicated on plans.
 - 2. Columbarium top shall be capable of structurally supporting imposed service live load of no less than 240 Kgs./Square Meter (50 lb./ ft²), and dead loads based on stone veneer thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.
 - 3. The Contractor shall submit to the Resident Engineer for review and approval 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer.

1.4 MANUFACTURER / INSTALLER QUALIFICATIONS

- A. Precast concrete columbarium units shall be product of manufacturer / installer who has a minimum of 3 years experience in fabrication and erection of the precast concrete columbarium units similar in material design and extent to that indicated on the drawings and specified herein.

- B. Supply and Installation of fastener system shall be by a product manufacturer and installer, both whom have had a minimum of 3 years experience in installation of similar design as indicated on the drawing.
- C. Installation of niche fronts will be performed by those companies who have had 3 years experience in installation of similar design as indicated in the drawings and specified herein.

1.5 ALLOWABLE TOLERANCES

- A. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
 - 1. Variation of anchors and fasteners from dimensions specified.....3 mm.(1/8")
 - 2. Variation in overall dimensions of precast element (height and width)3 mm.(1/8")
 - 3. Maximum differential between adjacent units in erected position..... 6 mm.(1/4")
 - 4. Variation in thickness of precast panels and elements..... 3 mm.(1/8")
 - 5. Maximum vertical differential between adjacent columbarium units in installed position.....3mm.(1/8-inch)

1.6 SUBMITTALS

- A. In accordance with Division 1 Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
 - 1. Samples: Submit sample of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:
 - a. Stainless Steel Angle
 - b. Stainless Steel Bolt, Nut and Washers
 - c. Tamper Proof Stainless Steel Bolt
 - d. Stainless Steel Rosette
 - e. Stainless Steel Expansion Anchors, Bolts and pins
 - f. Stainless Steel Ferrule loop insert.
 - g. Shims
 - h. Exposed front of columbarium with coating applied (If coating is required).
 - i. Adhesives and grouts.
 - 2. Shop Drawings: Complete shop and erection drawings of all precast concrete columbarium units, showing all dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other

trades, joint treatment, joint alignment coordinated with cap stone joints, and other work required for a complete installation. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer.

3. Production Drawings:

- a. Elevation view of each structural element.
- b. Planametric view of unit.
- c. Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
- d. Lifting and erection inserts.
- e. Dimensions and finishes.
- f. Method of transportation.
- g. Method of erection and handling.

4. Manufacturer's Literature and Data:

- a. Each type of Concrete Fastener, including adhesive and anchor devices.
- b. Instructions for final cleaning
- c. Concrete stain/coating, including color charts of manufacturers standard color palette (If applicable for this project.)

5. Certificates: Manufacturers qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.

1.7 DELIVERY, STORAGE

- A. Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

- A. Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting

and other related work in connection with erection of precast concrete columbarium unit work. See Shop Drawing section for details regarding the coordination of work.

1.9 GUARANTEE

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

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below from 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.):
- QQ-S-766C (5)..... Steel Plates, Sheets, and Strip-Corrosion Resisting
- QQ-W-423B..... Wire, Steel, Corrosive-Resisting
- TT-S-00227E (3) Sealing Compound Elastomeric Type, Multi-Component
(For Caulking, Sealing, And Glazing In Building And Other
Structures)
- TT-S-00230C (2).....Sealing Compound: Elastomeric Type, Single Component (For
Caulking, Sealing and Glazing In Building and Other
Structures)
- C. American Concrete Institute (ACI) Publications:
- ACI 533.3R-70.....Fabrication, Handling And Erection of Precast Concrete.
- D. American Society for Testing Materials (ASTM) Standards:
- A36/A36M-08.....Structural Steel
- A82/A82M-07Steel Wire, Plain, for Concrete Reinforcement
- A185/A185M-07Welded Steel Wire Fabric for Concrete Reinforcement.
- A615/A615M-08b.....Deformed and Plain Billet-Steel Bars for Concrete
Reinforcement.
- C33-08.....Concrete Aggregates
- C150-07Portland Cement
- E. American Welding Society (AWS) Publications:
- AWS D1.1-90.....Structural Welding Code
- AWS D1.4-80.....Welding Reinforcing Steel

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER/DESIGN

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

2.2 COARSE AGGREGATE

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

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

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

2.4 PORTLAND CEMENT

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

2.5 STRUCTURAL STEEL

- A. ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

- A. ASTM A185, galvanized.

2.7 STEEL WIRE REINFORCEMENT

- A. ASTM A82, cold drawn.

2.8 REINFORCING STEEL

- A. ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS GALVANIZED STEEL ITEMS

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

2.10 MARBLE NICHE COVERS

- A. Marble niche covers shall be furnished by the Government and delivered to the site on pallets and shall be of size, type, finish and quantities required for this project. Contractor and Government representatives shall inspect the niche covers upon delivery to the site. The general quantity and condition shall be observed and an adequate count

to cover all the installed columbarium units, plus required spares shall be verified, once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer.

2.11 NICHE COVER ATTACHMENT HARDWARE

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

2.12 BACK-UP MATERIAL

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

2.13 BOND BREAKERS IF USED

- A. Type and material recommended by sealant manufacturer.

2.14 SEALING COMPOUND IF USED

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

2.15 FABRICATION

- A. Precast concrete columbarium units shall NOT be: fabricated, delivered or incorporated in the work until samples have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.
 - 1. Concrete for precast columbarium units shall have minimum compressive strength of 34.5 MPa (5,000 psi) at 28 days.
 - 2. Provide additional steel reinforcing as required for casting, handling and erection loads.
 - 3. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
 - 4. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain thorough compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.

- a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - b. All fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling to precast concrete columbarium units, after fabrication, shall not be acceptable.
5. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
6. Finish: Exposed faces shall have smooth finish, unless otherwise noted. The face of the units shall be processed by the manufacturer, following removal from the forms to insure that the discoloration and blemishes on the niche faces are removed before shipping to the site.
 - a. Back side of single columbarium units, with back exposed to view shall have surface finish as indicated on the drawings.
 - b. Specified surface finish for the exposed back of the columbarium units shall be applied during the appropriate time of fabrication and curing. Seal coating of exposed back of units shall be applied as per manufacturer's recommendations.
7. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

2.16 STAIN AND FINISH EXPOSED EDGES

- A. Finish for all exposed faces and edges of columbarium units shall be coated with a color coat suitable for cured concrete, which has been used successfully on at least one columbarium project for a National Veteran Cemetery. Color and texture to be approved by Owners Designated Representative prior to application of coating. Manufacturer's literature and color charts shall be submitted as part of the submittal process as well as the listing of previous project(s).
- B. Anti-graffiti coating system. Furnish and install a permanent two coat anti-graffiti coating system, matte type finish (non-gloss), designed to be applied on concrete and brick surfaces and to provide a minimum life, as indicated in the manufacturer's literature, of 10 years. The coating system shall be clear.

PART 3 - EXECUTION

3.1 HANDLING AND INSTALLATION

- A. Before beginning installation, inspect work of other trades in-so-far as it effects the work of this Section. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improper installed units.
1. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

3.2 SETTING

- A. Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter. Exposed surfaces of units shall either be protected by anti-graffiti coating at the manufacturer, or shall be protected until accepted by the VA following installation. Units that have been damaged on exposed surfaces by graffiti, when not coated in advance shall be rejected and removed from the site. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealants shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.

3.3 SEALING OF JOINTS

- A. Where shown and/or where ever required to make the work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
1. Workmanship shall be in accordance with Division 1 Specification Sections.

3.4 CLEANING

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

3.5 REPLACEMENT AND REPAIR

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

3.6 FINISHING OF EXPOSED EDGES AND FACES

- A. Apply coating to complete, cleaned exposed concrete edges as per manufacturers standard specifications and recommendations.

3.7 INSTALLATION OF NICHE COVERS

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

----- E N D -----

SECTION 03 48 26
CONCRETE MEMORIAL WALL UNITS

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // --- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

SPEC WRITER NOTES:

1. Modify the following paragraphs to indicate whether the memorial wall is to be a precast concrete product, manufactured offsite, and set into place on a foundation, or whether it memorial wall is to be cast-in-place concrete.
2. Coordinate these specifications with the drawings, details and notes for either the precast concrete or cast-in-place method of construction, depending upon factors like project location, availability of quality manufacturer or quality of the labor force, and discussion with the PM.

1.1 DESCRIPTION

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

SPEC WRITER NOTES:

1. Modify, add or delete, the items of work indicated in the following paragraph to reflect the project specific work.

1.2 RELATED WORK

- A. Cast-in-place concrete work: Section 03 30 00, CAST-IN-PLACE CONCRETE.
B. Workmanship for sealant application- Section 07 92 00, JOINT SEALANTS.
C. Memorial Wall Cap - Section 04 72 00, CAST STONE MASONRY.
D. Decorative Gravel-Section 32 90 00, PLANTING.

E. Installation of memorial wall markers: Section 04 73 10, MEMORIAL WALL MARKERS.

F. Plaster Finish: Section 09 24 00, PORTLAND CEMENT PLASTERING

SPEC WRITER NOTES:

1. Modify the following by selecting the appropriate paragraph "A" for the selected method of construction and delete the other.

1.3 MANUFACTURER / INSTALLER QUALIFICATIONS

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

//A. Cast-in-place concrete wall units shall be constructed by a company that has at least three years of experience in constructing similar cast-in-place installations with the same or higher quality and installation tolerances as for this work. The Company that is to perform the work for the construction of the memorial wall concrete core, to which the attachment hardware is to be installed, shall demonstrate compliance with the qualifications through submittal of adequate and acceptable documentation in the submittal process.//

1.4 ALLOWABLE TOLERANCES

A. Manufacturing and installation tolerances shall be as follows:

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

1.5 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project // local/regional materials // low-emitting materials, // recycled content, // certified wood // _____// requirements.

- B. Blended Cement: It is the intent of this specification to reduce CO₂ emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
1. Copies of concrete design mixes for all installed concrete.
 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 3. Quantities in cubic yards of each installed concrete mix.
- C. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, please visit <http://www.biopreferred.gov/>.

1.6 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserve/tools/cpg/products/>
 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.7 SUBMITTALS

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

1. Samples: Submit sample of all fastening systems and mounting hardware including, but not limited to, the following:

SPEC WRITER NOTES:

1. Modify, add or delete, the items of work indicated in the following if other than the Stainless Steel Sinner Bros. attachment is to be used.
2. Modify as needed to include all of the materials to be used in the installation of the wall marker attachment and installation hardware, including the products to be used to attach to the concrete core, when cast in place anchors are not being utilized.
 - a. Stainless Steel Angle (rosette plates of varying sizes depending on position of Government provided //marble//granite// wall markers on memorial wall- see drawings).
 - b. Stainless Steel Bolt and Washers
 - c. Stainless Steel Spring Plate
 - d. Tamperproof Stainless Steel Bolt
 - e. Stainless Steel Rosette
 - f. Stainless Steel Expansion Anchors and Bolts
2. Shop Drawings: Complete //fabrication// and installation drawings of all //precast//cast-in-place// concrete memorial wall units, showing all dimensions, sizes of units, and details of construction, //form bracing// installation and relation to adjoining work, joint locations and details, reinforcements, anchorage, attachments, inserts, location of all predrilled sleeves (see paragraph "Fabrication" in Part 2) and other trades, joint treatment, finishes, and other work required for a complete installation.
3. Manufacturer's Literature and Data:
 - a. Each type of fastener or anchorage
 - b. Instructions for final cleaning
 - //c. Coating and/or sealers//
4. Certificates:
 - //a. Manufacturers qualifications specifying precast concrete memorial wall units meet the requirements of ACI 533.3R as specified.//
 - //b. Manufacturers qualifications regarding performance of similar acceptable work.//
 - c. Installers qualification.

SPEC WRITER NOTES:

1. Delete the following two paragraphs and renumber if memorial wall is to be cast-in-place and not precast concrete.

1.8 //DELIVERY, STORAGE

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

1.9 //COORDINATION

- A. Coordinate the manufacture and installation of precast concrete memorial wall units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete memorial wall units to the work of other trades, //or other adjoining units,// in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete memorial wall unit work.//

1.10 GUARANTEE

- A. Guarantee //precast//cast-in-place// concrete memorial wall unit work, including: //anchorage,//joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling and after erection, for a period of not less than one year.

1.11 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

B. Federal Specifications (Fed.Spec.):

QQ-S-766C (5)	Steel Plates, Sheets, and Strip-Corrosion Resisting
QQ-W-423B	Wire, Steel, Corrosive-Resisting
TT-S-00227E (3)	Sealing Compound Elastomeric Type, Multi-Component (For Caulking, Sealing, And Glazing In Building And Other Structures)
TT-S-00230C (2)	Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing In Building and Other Structures)

C. American Concrete Institute (ACI) Publications:

ACI 533.3R-70	Fabrication, Handling And Erection of Precast Concrete.
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D. American Society for Testing Materials (ASTM) Standards:

A36/A36M-12	Structural steel.
A82/A82M-07	Steel Wire, Plain, for Concrete Reinforcement
A185/A185M-07	Welded Steel Wire Fabric for Concrete Reinforcement.
A615/A615M-12	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
C33/C33M-13	Concrete aggregates.
C 150/C150M-12	Portland Cement.

E. American Welding Society (AWS) Publications:

AWS D1.1/D1.1M-10	Structural Welding Code
AWS D1.4/D1.4M-11	Welding Reinforcing Steel

SPEC WRITER NOTES:

1. Modify the following as needed based upon which method of construction for the concrete core of the memorial wall is to be used.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE

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

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

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

2.3 PORTLAND CEMENT

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

2.4 WATER

- A. Water shall be clean, fresh and potable.

2.5 STRUCTURAL STEEL

- A. ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

- A. ASTM A185, galvanized.

2.7 STEEL WIRE REINFORCEMENT

- A. ASTM A82, cold drawn.

2.8 REINFORCING STEEL

- A. ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS STAINLESS STEEL ITEMS

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

2.10 BACK-UP MATERIAL

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

2.11 BOND BREAKERS

- A. Type and material recommended by sealant manufacturer.

2.12 SEALING COMPOUND

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

SPEC WRITER NOTES:

1. Modify the following if other than the NCA standard Stainless Steel Rosettes are to be used. Confirm the type to be used with the project manager.

2.13 ROSETTES

- A. To be produced from sheet goods like or similar to #316 stainless steel as manufactured by Aeon Manufacturing Co. Inc., Harbor City, CA. Thickness to be 2.5 mm (0.100 inch). Die stamp, producing an eight-petal flower pattern. Luster finish. 25 mm (1") in diameter with slight convex; center hole of 5.5 mm (0.218"), concentric to outer edge, with shoulder recess of 10 mm (0.400") in diameter and 1 mm (0.035") in depth. Rosettes shall match existing in place at the site in color, finish and design.

SPEC WRITER NOTES:

1. Select from the following paragraphs on cap material, based upon the type selected, following direction from the PM. Delete the ones not being used.

//2.14 CAST STONE MASONRY

- A. Cast stone shall meet the requirements of Section 04 72 00 CAST STONE MASONRY.//

//2.14 NATURAL STONE CAPS

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

2.15 DECORATIVE GRAVEL

- A. See Section 32 90 00, PLANTING

2.16 CONCRETE FOOTINGS

- A. See Section 03 30 00, CAST-IN-PLACE-CONCRETE

SPEC WRITER NOTES:

1. Select the paragraph below based upon the method of construction for the memorial wall concrete core. Delete the paragraph that is not used.

//2.17 PRECAST FABRICATION

- A. Memorial wall units shall be of size and form as indicated on the plans.
- B. Concrete for precast memorial wall units shall have minimum compressive strength of 35 MPa (5,000 psi) at 28 days.
- C. Provide additional steel reinforcing as required for casting, handling and erection loads.
- D. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
- E. Precast memorial wall units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
- a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - b. All fastener location holes, including those for anchoring of units and attachment of memorial wall markers, shall be field drilled for anchor bolts.

SPEC WRITER NOTES:

1. Modify or delete the following two paragraphs as needed, and renumber accordingly, if the design for the memorial wall has the concrete core fully covered with markers and filler strips.
- F. Cement, aggregate, and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
- G. Architectural Finish: Exposed faces shall have smooth finish, rubbed with a fine abrasive or stone hone to create a cast stone like finish, uniformly smooth. Use ample water during rubbing to prevent working up a lather of mortar or changing texture of concrete. There shall be no air bubble marks or other such imperfections visible on the surface.
- H. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

//2.17 CAST-IN-PLACE CONSTRUCTION

- A. Cast-in-place concrete shall be constructed within the tolerances indicated on the drawings and in accordance with Section 03 30 53, (Short Form) CAST-IN-PLACE CONCRETE.
- B. The concrete shall be constructed with high strength concrete mix using aggregate no larger than 75mm (3/4") to facilitate the field drilling for the marker anchorage devices. The mix design shall be a minimum of 35 MPa (5000 psi).//
- C. Submit details for the mix design and finish for the concrete core of the memorial wall, onto which the anchor system for the memorial wall markers and filler strips are to be attached. Sufficient materials shall be submitted to fully demonstrate the product to be delivered, and the finish and construction tolerances to be maintained.
- D. Provide a mockup of the portions of the memorial wall to be above finished grade, and demonstrate the materials and methods for attachment of the memorial wall markers. An approved mockup is required prior to the actual field installation of the cast in place memorial wall elements.

PART 3 - EXECUTION

3.1 CONCRETE FOOTINGS

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

SPEC WRITER NOTES:

1. Delete the following paragraph and renumber when the concrete core for the memorial wall is Cast-in-place.

//3.2 HANDLING AND INSTALLATION

- A. Before beginning installation, inspect work of other trades insofar as it affects the work of this Section. Commencing installation of precast concrete memorial wall units will be construed as acceptance, as suitable, of such work of other trades. Precast Memorial wall units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete memorial wall units against staining and other damage. Reinstall, realign and otherwise correct improperly installed units.
1. Accurately place and securely anchor precast concrete memorial wall units to adjoining construction in accordance with approved shop and installation drawings.//

3.3 SETTING

- A. Concrete footings (pads) for memorial wall(s) shall be constructed to meet all structural requirements to meet local soil and climate conditions and the weight and dimensions of the memorial wall(s) being supported by the respective footing.
- B. Joints shall be filled with sealant. Surfaces and other joints for precast concrete memorial wall units shall be cleaned of all dust, dirt and other foreign matter. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealant shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances that are likely to cause staining shall be removed from joints. Where two units are butted together, alignment shall be precise so that a smooth continuous line is produced.
- C. //Cast stone//Precast Architectural//Natural Stone// caps shall be installed on top of the memorial wall(s). A urethane caulking adhesive

shall be in place prior to setting the capping. Two (2) anchor pins shall be placed between the concrete core for the wall and the caps to secure the caps on top of the wall. The cap lengths shall be such that the joints between the caps align with the memorial wall markers as indicated on the drawings. The cap installation shall follow the details on the drawings.

- D. Place decorative gravel to the line and grade as indicated on the drawings. See Section 32 90 00, PLANTING.

3.4 SEALING OF JOINTS

- A. Where shown and where required for either the precast or cast-in-place installation, to make the work watertight furnish and install backer rod and sealant in the joints where indicated on the drawings. Joints shall be cleaned and primed with manufacturer recommended primer, and the joints shall have backer rod installed as recommended by the manufacturer, with the recommended width to depth ratio according to the sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
- B. Workmanship shall be in accordance with Section 07 92 00, JOINT SEALANTS.

3.5 CLEANING

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

3.6 REPLACEMENT AND REPAIR

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

- - -END- - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for construction of masonry unit walls.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
1. Concrete masonry units, when exposed in finish work.
 2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
- C. Shop Drawings:
1. Special masonry shapes.
 2. Drawings, showing reinforcement, applicable dimensions.
- D. Certificates:
1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 2. Indicating that the following items meet specification requirements:
 - a. Solid and load-bearing concrete masonry units, including fire-resistant rated units.
 3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
- E. Manufacturer's Literature and Data:
1. Anchors, ties, and reinforcement.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A82-02..... Steel Wire, Plain, for Concrete Reinforcement
- A615/A615M-04 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- C90-03 Load-Bearing Concrete Masonry Units
- C744-04 Prefaced Concrete and Calcium Silicate Masonry Units.

- D1056-00 Flexible Cellular Materials - Sponge or Expanded Rubber
- D2240-04 Rubber Property - Durometer Hardness
- D3574-03 Flexible Cellular Materials-Slab, Bonded, and Molded
Urethane Foams

- F1667-03..... Fasteners: Nails, Spikes and Staples

C. Masonry Industry Council:

All Weather Masonry Construction Manual, 2000.

D. Federal Specifications (FS):

- FF-S-107C Screws, Tapping and Drive

E. Brick Industry Association - Technical Notes on Brick Construction (BIA):

- 11-1986 Guide Specifications for Brick Masonry, Part I
- 11A-1988..... Guide Specifications for Brick Masonry, Part II
- 11B-1988..... Guide Specifications for Brick Masonry, Part III Execution
- 11C-1984 Guide Specification for Brick Masonry Engineered Brick
Masonry, Part IV
- 11D-1988 Guide Specifications for Brick Masonry Engineered Brick
Masonry, Part IV continued

F. Masonry Standards Joint Committee; Specifications for Masonry Structures (ACI 530.1-99/ASCE 6-99/TMS 602-99) (MSJC).

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
 - 1. Unit Weight: medium weight
 - 2. Sizes: Modular
 - 3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.

2.2 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.3 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.
- B. Joint Reinforcement:
 - 1. Form from wire complying with ASTM A82.
 - 2. Galvanized after fabrication.

3. Width of joint reinforcement 40 mm (1-5/8 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement in rolls is not acceptable.
6. Joint reinforcement that is crimped to form drip is not acceptable.
7. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.
8. Ladder Design:
 - a. Longitudinal wires deformed 5 mm (0.1875 inch) diameter wire.
 - b. Cross wires 4 mm (0.1483 inch) diameter.

2.4 ACCESSORIES

- A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Box Board:
 1. Mineral Fiber Board: ASTM C612, Class 1.
 2. 25 mm (1 inch) thickness.
 3. Other spacing material having similar characteristics may be used subject to the Resident Engineer's approval.
- C. Masonry Cleaner:
 1. Detergent type cleaner selected for each type masonry used.
 2. Acid cleaners are not acceptable.
 3. Use soapless type specially prepared for cleaning brick.
- D. Fasteners:
 1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
 2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
 3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

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

2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.2 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:
 1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
- C. Maximum variation from level:
 1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
- D. Maximum variation from linear building lines:
 1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
 1. Minus 6 mm (1/4 inch).
 2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
 1. Accurate to minus 0 mm (0 inch).
 2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Tooling Joints:
 1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
 2. Tool while mortar is soft enough to be compressed into joints and not raked out.
 3. Finish joints in exterior CMU with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
- D. Wall, Furring, and Partition Units:
 1. Lay out field units to provide for running bonding of walls and partitions, with vertical joints in second course centering on first course units unless specified otherwise.
 2. Align head joints of alternate vertical courses.
 3. Use no piece shorter than 100 mm (4 inches) long.
 4. Use not less than 100 mm (4 inches) nominal thick masonry for free standing furring unless shown otherwise.

- E. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

3.4 REINFORCEMENT

A. Joint Reinforcement:

1. Use as joint reinforcement in CMU wythe of combination stone and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
2. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
3. Joint reinforcement is required in every course of stack bond CMU masonry.

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and bond beam horizontal reinforcement.
2. Use grade 60 bars if not specified otherwise.
3. Bond Beams:
 - a. Form Bond beams of load-bearing concrete masonry units filled with 25 MPa (3000 psi) masonry grout and reinforced with 2-#13m (#4) steel rods top and bottom unless shown otherwise.
 - b. Brake bond beams only at expansion joints and at control joints, if shown.

3.5 CONCRETE MASONRY UNITS

A. Kind and Uses:

1. Provide special concrete masonry shapes as required, including bond beam units, sash units, and corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Provide a 6 mm (1/4 inch) open joint for caulking between, exterior walls, concrete work, and abutting masonry partitions.

8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes shown.
12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
13. Steel reinforcement in place at the time of grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
17. Set horizontal reinforcement in a full bed of grout or concrete.
18. Splice reinforcement or attach reinforcement to dowels by placing in contact and wiring together or by placing the reinforcement within 1/5 of the required bar splice length.
19. Stagger splices in adjacent reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
21. Cavity and strip horizontal reinforcement may be placed as the masonry work progresses.
22. Rake joints 6 to 10 mm (1/4 to 3/8 inch) deep for pointing with colored mortar when colored mortar is not full depth.

3.6 POINTING

- A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.
- B. Wipe off excess mortar from joints of glazed masonry units with dry cloth.

- C. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise.

3.7 GROUTING

A. Preparation:

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts with masonry units.
3. Verify reinforcing bars are in cells of units or between wythes as shown.

B. Placing:

1. Place grout by hand bucket, concrete hopper, or grout pump.
2. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
3. Do not slush with mortar or use mortar with grout.
4. Interruptions:
 - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.
 - b. Grout from dam to dam on high lift method.
 - c. A longitudinal run of masonry may be stopped off only by raking back one-half a masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.

C. Low Lift Method:

1. Consolidate by puddling with a grout stick during and immediately after placing.
2. Grout the cores of concrete masonry units containing the reinforcing bars solid as the masonry work progresses.

D. High Lift Method:

1. Do not pour grout until masonry wall has properly cured a minimum of 72 hours.
2. Place grout in one continuous operation.
3. Complete in one day with no interruptions greater than one hour sections of a wall between control barriers.
4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into the preceding lift to close any shrinkage cracks or separation from the masonry units.

3.8 CLEANING AND REPAIR

A. General:

1. Clean exposed masonry surfaces on completion.

2. Protect adjoining construction materials and landscaping during cleaning operations.
3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and re-point.
4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Concrete Masonry Units:

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

- - - E N D - - -

SECTION 04 42 10
NATURAL STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cut Indiana limestone for columbarium stone caps and accessories.

1.2 RELATED WORK

- A. Cast-in-place concrete: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Setting and Pointing Mortar: Section 04 05 13, MASONRY MORTARING
- D. Joint Sealant and Application: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Provide samples of:
 - a. Limestone for stone cap, three (3) material samples, minimum 2"x8"x8" to show range in quarry.
 - b. One Columbarium stone cap, half width x 4 inches, with dimensions and finish per the finished work including edges, drip slots, and sandblasted and colored lettering.
- C. Shop Drawings:
 - 1. Each stone cap piece showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing, shim and mortar locations, stone cap piece dimensions and sizes.
 - 2. For any stone caps, the approved shop drawings must indicate which surfaces will be exposed in the final installation.
 - 3. Setting drawings with setting mark.
 - 4. Shop drawing showing stone cap text.
 - 5. Lifting Devices:
 - a. Submit design details for lifting devices.
 - b. Lifting devices are required for all stone cap stones.
 - c. Design lifting devices that function to safely lift stone cap stones by contacting the stones on the bottom finished edges, so the units can be set into position without causing any marking or

NATURAL STONE MASONRY

damage to the stones. Lifting devices shall be in accordance with Indiana Limestone Handbook.

- D. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- E. Installer Qualifications: Provide documentation of requirements specified herein.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All stone shall be received and unloaded at the site with care in handling to avoid damaging or soiling.
- B. Store stone under waterproof covers on planking clear of ground. Stone shall be stored clear of the ground on non-staining skids (cypress, white pine, poplar, or yellow pine without an excessive amount of resin). Chemically treated wood should not be used. DO NOT use chestnut, walnut, oak, fir, and other woods containing tannin.
- C. Protect from handling, dirt, stain, and water damage.
- D. Mark production units with the identification marks as shown on the shop drawings.
- E. Package units and protect them from staining or damage during shipping and storage.
- F. Provide packaging and lifting devices from the manufacturer that are designed to permit the installer easy removal for inspection, or to handle the stone for installation without causing damage to the units.
- G. Provide an itemized list of product to support the bill of lading.

1.6 WARRANTY

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

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

- 1. Indiana Limestone Handbook (current edition); Indiana Limestone Institute

1.8 QUALITY ASSURANCE

- A. Fabricator:
 - 1. Member in good standing of the Indiana Limestone Institute.

NATURAL STONE MASONRY

2. Must provide documentation demonstrating a minimum of five years' experience fabricating limestone.

B. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting limestone.
2. Provide written handling and installation procedures that will be followed for the installation of the work for stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of stone units that have been damaged on any edges or faces that will be visible in the final installation, including drip slots.
4. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to sealing of joints.

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

1.9 FABRICATION TOLERANCES

- A. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- B. Length of units must not deviate by more than length 3 mm (/360 or + 1/8 in.), whichever is greater, not to exceed 6 mm (+ 1/4 in.) Maximum length of any unit must not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.

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- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of unit, 3 mm (1/8 in.), on unformed sides of unit, 9 mm (3/8 in.) maximum deviation.
- E. Stone cap underside (exposed to view overhang) shall be finished to match top and sides of cap (regarding finish, texture & color); drip slots shall be straight and consistent in depth and width; stone cap pieces that do not meet these requirements will be rejected.

1.10 MOCK-UP

- A. Provide full size unites for use in construction of columbarium walls. Mockup samples become the standard of workmanship for the project.
- B. Coordinate the size and location for the mockup wall(s) with the CO/COR; mockup wall(s) cannot become part of the final project work.
 - 1. Mockup size: 1 full size five-niche section with full size pier and 1 full size four-niche double section columbarium unit (double sided) with end cap. Both complete with CMU backup, stone cap, stone veneer, mortar, joint sealants, identification panel, text, and all masonry accessories.
 - 2. The contractor shall modify the mockup as needed until acceptance by the CO/COR at no additional expense to the Government.
- C. Demonstrate the construction tolerances for the construction of the foundations, as well as the quality of the exposed edges and the finish of the final exposed surfaces.
- D. Demonstrate the options for color selection for sealant, grout, etc. on the mockups so they can be judged against the various possible materials and their colors and finishes.
- E. Install precast niche units and demonstrate the construction tolerances, finish, placement of adjoining units, joints, surface treatment, attachment hardware, installed niche, rosette bolt alignment, washers, pins, shims, weep vents, backer rod and joint sealant.
- F. Install stone veneer to illustrate field pattern and color range of stone, field cutting of units where required, and color and tooling of mortar joints. Use stone units from random pallets of units delivered on site. Include reinforcing, ties, and anchors.
- G. Install stone caps, including the placement of shims, the alignment of the joints in relationship to the columbarium unit joints, marker placement, backer rod, joint sealant, weep vents, flashing, joint size,

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and any other elements needed to demonstrate the quality of the final product installation.

- H. When there are options or selections to be made for the final installation, the mockup must demonstrate the multiple options available for selection as the final product and installation.
- I. Mockup shall remain in place throughout finish stonework until contractor is directed to remove it by the CO/COR.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive stone components by field measurements before production.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS

2.1 LIMESTONE

- A. All limestone specified or shown on drawings shall be Indiana Oolitic Limestone, as quarried in Lawrence, Monroe, and Owen Counties, Indiana, meeting the standards of the Indiana Limestone Handbook and ASTM C 568.
- B. Stone shall have a smooth finish.
- C. Color: Buff
- D. Grade: Standard
- E. Chipping on edges or surfaces of stone caps, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be removed and replaced with new units.
- F. All stone shall be cut accurately to shape and dimensions and full to the square, with jointing as shown on approved drawings. All exposed faces shall be dressed true. Beds and joints shall be at right angles to the face, and joints shall have a uniform thickness as shown on drawings.

2.2 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.3 DAMPPROOFING

- A. Dampproofing shall be cement-based, waterproof coating compatible with Indiana Limestone: Thoroseal, Tamoseal, or approved equal.

2.4 SHIMS

- A. Shims or setting pads shall be resilient, nonferrous, non-rusting.

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2.5 FLASHING

- A. EPDM thru-wall flashing, 40 Mils complying with ASTM D4637/4637M
- B. 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.

2.6 WEEP TUBE

- A. Clear round plastic weep tube manufactured from Medium Density Polyethylene, with stainless steel filter. Plastic tube shall be 3/8 inch outside diameter, 1/4 inch inside diameter, 4 inches long.

2.7 STONE PAINT

- A. For painting sandblasted text. Use Lithochrome stone paint or similar product designed for exterior stone monument application. Color: charcoal or dark brown.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check stone for damage, coloration, finish, and fit prior to installation. Do not set unacceptable units.

3.2 TEXT

- A. Sandblast and paint labels to match existing.

3.3 SETTING TOLERANCES

- A. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.
- B. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.4 JOINTING

- A. Joint Materials:
 - 1. Mortar, Type N, ASTM C270. Limit fine aggregate size to less than 3/8" diameter.
 - 2. Use a full bed of mortar at all bed joints.
 - 3. Leave all joints with exposed tops or under relieving angles open for sealant.
 - 4. Leave head joints in stone cap and projecting components open for sealant.
- B. Location of Joints:
 - 1. As shown on shop drawings.
 - 2. At control and expansion joints unless otherwise shown.

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3.5 DAMPPROOFING

- A. All unexposed faces of limestone stone caps, including interior faces of stones at joints, shall be coated with a cementitious dampproofing material per the Indiana Limestone Handbook.
- B. Apply dampproofing per manufacturer's instructions, including number of coats and curing requirements.

3.6 SETTING

- A. Preparation
 - 1. When necessary, before setting in the wall, all stones shall be thoroughly cleaned on all exposed surfaces by washing with fiber brush and soap powder, followed by a thorough drenching with clear water.
- B. Mortar Bed Setting:
 - 1. Drench units with clean water prior to setting.
 - 2. Fill dowel holes and anchor slots completely with silicone sealant.
 - 3. Setting pads shall be placed under stone cap stones in same thickness as joint, and in sufficient quantity to avoid squeezing mortar out. Shims or setting pads shall not create point loads on the stones.
 - 4. Set units in full bed of mortar containing water repellent.
 - 5. Rake mortar joints to receive backer rod and sealant.
 - 6. Remove excess mortar from unit faces immediately after setting.

3.7 JOINT PROTECTION

- A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.
- B. All cornice, stone caps, projecting belt courses, other projecting courses, steps, and platforms (in general, all stone areas either partially or totally horizontal) should be set with unfilled vertical joints. After setting, insert properly sized backup material or backer rod to proper depth, and gun in sealant.
- C. Prime ends of units, insert properly sized backing rod at the correct depth and install required sealant.

3.8 PROTECTION, REPAIR AND CLEANING

- A. During construction, tops of walls shall be carefully covered at night, and especially during any precipitation or other inclement weather.
- B. At all times, walls shall be adequately protected from droppings.
- C. Whenever necessary, substantial wooden covering shall be placed to protect the stonework. Nonstaining building paper or membrane shall be

used under the wood. Maintain all covering until removed to permit final cleaning of the stonework.

- D. The stone shall be washed with fiber brushes, mild soap powder or detergent and clean water or approved mechanical cleaning process. Cleaning shall not damage adjacent materials.

- - - E N D - - -

SECTION 04 43 00
NATURAL STONE VENEER

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between //____// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. Use this section for both reinforced and unreinforced masonry construction or where steel bar reinforcement is used in cells of hollow masonry units, bond beams, lintel units, and between wythes of unit masonry in engineered design which is similar to reinforced concrete construction.
4. Follow Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602), Brick Industry Associations "Technical Notes on Brick Construction" and National Concrete Masonry Association "TEK Manual for Concrete Masonry Design and Construction".

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

SPEC WRITER NOTES:

1. Modify this section and delete items that are not applicable.
- A. Cast-in-place concrete //columbarium/memorial wall// complexes:
Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Precast Memorial Wall Units: Section 03 48 26, PRECAST CONCRETE MEMORIAL WALL UNITS.
- D. Mortars // and grouts //: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- E. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- F. Cavity insulation: Section 07 21 13, THERMAL INSULATION.
- G. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- H. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

I. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

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

B. Samples:

1. Stone Veneer, sample, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of stone, bond, and proposed mortar joints.

2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.

C. Certificates signed by stone source, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies; indicate that the stone veneer meets specification requirements.

D. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.

2. Reinforcing bars.

SPEC WRITER NOTES:

1. For small projects verify use of Paragraph SAMPLE PANEL with the Project Manager.
2. For projects with burial shrine elements, columbarium and/or memorial walls, the sample for the installation of the Natural Stone Veneer must be part of the constructed mockup for the respective element. Coordinate the specifications for veneer to include jointing, termination of stone against caps in horizontal surfaces, termination of veneer on corners of piers and columns and termination of veneer against vertical concrete (whether precast or cast in place), and termination against filler strips. The mockups must demonstrate all of the conditions for veneer placement abutting the other surfaces of the shrine elements.
3. Modify the specifications to coordinate with the drawings regarding the elements, relationships, materials and quality of workmanship to be demonstrated within the constructed mockup(s).

1.4 SAMPLE PANEL

- A. Before starting masonry, lay up a sample panel as specified:
 - 1. Use stone units from random pallets of units delivered on site.
 - 2. Include reinforcing, ties, and anchors.
 - 3. Provide a 1.2m x 1.8m (4 feet x 5 feet) panel.
- B. Use sample panels approved by RE/COR for standard of workmanship of new masonry work.
- C. Use sample panel to test cleaning methods.

1.5 WARRANTY

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

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

- 1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
- 2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

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

A82/A82M-07	Steel Wire, Plain, for Concrete Reinforcement
A153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A951/A951M-11	Steel Wire for Masonry Joint Reinforcement
C97/C97M-09	Absorption and Bulk Gravity of Dimension Stone
C99/C99M-09	Modulus of Rupture of Dimension Stone
C119-11	Standard Terminology Relating to Dimension Stone
C170/C170M-09	Compressive Strength of Dimension Stone
C568/C568M-10	Limestone Dimension Stone
C615/C615M-11	Granite Dimension Stone
C616/C616M-10	Quartz-Based Dimension Stone
C880/C880M-09	Flexural Strength of Dimension Stone

C1242-12ae1	Selection, Design, and Installation of Dimension Stone Attachment Systems
C1353-09	Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform, Double-Head Abraser
C1515-11	Cleaning of Exterior Dimension Stone, Vertical and Horizontal Surfaces, New or Existing
C1528-12b	Selection of Dimension Stone
D1056-07	Flexible Cellular Materials - Sponge Expanded Rubber
D7089-06	Determination of the Effectiveness of Anti- Graffiti Coating for Use on Concrete, Masonry, and Natural Stone Surfaces by Pressure Washing

C. Masonry Industry Council:

All Weather Masonry Construction Manual, 2000

D. International Masonry Industry All Weather Council (IMIAC):

Recommended Practices and Guide Specification for Cold Weather Masonry
Construction

1.7 PRE-INSTALLATION CONFERENCE

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

SPEC WRITER NOTES:

1. Edit Stone Products below for type of stone being used on project. Add size grade, color, finish. Insert names of varieties and producers or distributors as basis design for acceptable products. Whenever possible, match existing should be used with specific location to match indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE STONE PRODUCTS

//A. Limestone Veneer: Meet ASTM C568, Classification: //[I Low-Density]// [II Medium-Density]// [III High-Density]//.

1. Face Size: As indicated.

2. Color Range, finish, manufacturer/producer//insert//.
- //A. Granite Veneer: Meet ASTM C615.
 1. Face Size: As indicated.
 2. Color Range, finish, manufacturer/producer//insert//.
- //A. Quartz Based Stone: Comply with ASTM C616, Classification //I Sandstone//II Quartzitic Sandstone//III Quartzite//.
 1. Face Size: As indicated.
 2. Color Range, finish, manufacturer/producer//insert//.
- //A. Other //insert type// Stone Provide sound natural stone as follows:
 1. Maximum Absorption per ASTM C97: //Insert value// percent.
 2. Minimum Compressive Strength per ASTM C170: //Insert value//.
 3. Minimum Flexural Strength per ASTM C880: //Insert value//.
 4. Minimum Modulus of Rupture per ASTM C99: //Insert value//.
 5. Face Size: As indicated.
 6. Color Range, finish, manufacturer/producer//insert//.

2.2 REINFORCEMENT AND ANCHORAGES

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply paragraphs below, unless otherwise indicated.
 1. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but at least 16mm (5/8 inch) cover on outside face. Outer ends of wires are bent 90 degrees and extend 50 mm (2 inches) parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 100 mm (4 inches).
- D. Adjustable Masonry-Veneer Anchors:
 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 445 N (100 lbf) load in both tension and compression without deforming or developing play in excess of 1.3 mm (0.05 inch).
 2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

- a. Anchor Section: barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
- b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 4.8 mm (0.188 inch) diameter, Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.3 ACCESSORIES

- A. Joint Sealant: Refer to Section 07 92 00.
- B. Nailing Strips: Western softwood, preservative treated, sized to masonry joints.
- C. Weep Holes: Leave-out of full head mortar joints.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Strips, full-depth of cavity and 250 mm (10 inches) wide, with dovetail shaped notches 175 mm (7 inches) deep that prevent mesh from being clogged with mortar droppings.
- E. Mortar: Refer to Section 04 05 13.
- F. Expansion Joint Fillers: ASTM D1056 Class RE-11.

SPEC WRITER NOTES:

- 1. Review need for dampproofing applied to back of limestone or quartz-based stone panels with cavity space.

- G. Cementitious Dampproofing: Cementitious formulation nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

SPEC WRITER NOTES:

- 1. Add requirements or reference to anti-graffiti coatings as applicable to project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other Sections of work are properly sized and located.

- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Verify items provided by other Sections of work are properly sized and located.
- B. Establish lines, levels, and coursing; protect from disturbance.
- C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- D. Scaffolding: Provide, erect, maintain, move, and finally remove scaffolding and staging required for masonry installation. Construct and maintain scaffolding in compliance with applicable ordinances, laws, rules and regulations. Scaffolding must be sufficiently substantial to support workmen, and necessary materials and equipment. Provide adequate guard rails for protection of property, workmen, and passerby.
- E. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

SPEC WRITER NOTES:

- 1. Add coating for back of limestone or quartz-based stone panels as applicable for project.
- F. Coat stone with dampproofing to extent indicated below:
 - 1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
 - 2. Stone Extending Below Grade: Beds, joints, back surfaces, and face surfaces below grade.
 - 3. Allow dampproofing to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.

3.3 COURSING

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

3.4 PLACING AND BONDING

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

3.5 TOLERANCES

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

3.6 REINFORCEMENT AND ANCHORAGES

- A. Attach wall ties to wall studs (or other solid and secure framing members) for veneer construction at maximum 400 mm (16 inches) oc vertically and 400 mm (16 inches) oc horizontally. Place at maximum 200 mm (8 inches) oc (or every third course) each way around perimeter of openings, within 300 mm (12 inches) of openings.
- B. Anchor stone veneer to unit masonry with metal veneer anchors as follows:
 - 1. Secure wire anchors by inserting pintles into eyes of masonry wall reinforcement projecting from horizontal mortar joints.
 - 2. Embed anchors in veneer mortar joints to within 25 mm (1 inch) of face.

3.7 MASONRY FLASHINGS

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

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

3.8 LINTELS

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

SPEC WRITER NOTES:

- 1. Confirm weep locations.

3.9 WEEPS AND VENTS

- A. Install weep holes in veneer at 600 mm (24 inches) on center horizontally above through-wall flashing, above shelf angles, and at bottom of walls.

3.10 CONTROL/EXPANSION JOINTS

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

3.11 BUILT-IN WORK

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

3.12 CUTTING AND FITTING

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

3.13 CLEANING

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

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

SPEC WRITER NOTES:

- 1. ASTM D7089 relates to effectiveness of anti-graffiti coatings.

- E. Comply with ASTM C1515// and D7089//.

3.14 PROTECTION

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

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SECTION 04 73 00
COLUMBARIUM NICHE COVERS

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // --- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

SPEC WRITER NOTES:

1. Modify the following sub-paragraph 2 to coordinate with the drawings and follow the direction of the PM for indicating the number of spares.

1.2 DESCRIPTION

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

1.3 INSTALLER QUALIFICATIONS

- A. Installation of columbarium niche covers will be performed by those companies who, through an approved certification process, have

demonstrated previous experience in installation of similar design as indicated in the drawings and specified herein.

1.4 RELATED WORK

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

1. Section 03 48 24: PRECAST CONCRETE COLUMBARIUM UNITS, the precast concrete niche units with: niche cover mounting hardware assemblies (installed); and niche cover attachment hardware assemblies (provided for use to attach the Government provided niche covers). Four each of the niche cover mounting hardware assemblies shall be furnished and installed for each precast concrete niche opening. Four each of the niche cover attachment hardware assemblies shall be provided for each precast niche opening, to be used to mount the approved government niche covers as indicated and on the drawings.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // _____// requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, please visit <http://www.biopreferred.gov/>.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 NICHE COVERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

- A. Niche covers that have been inspected and accepted as being in compliance with manufacturing tolerances for size, hole size and placement, perpendicularity, finish, and product stone quality shall be furnished by the Government and delivered to the site on pallets. They shall be of size, type, manufacturing, finish and quantities required for this project. The covers shall be delivered to the site Freight on Board (FOB) and the Contractor shall be responsible to offload and secure them at the job site. The general quantity and condition shall be observed and an adequate count to cover all the installed

columbarium units, plus required spares shall be verified by the Contractor prior to accepting the units and performing the offloading operations. Note any shipping damage and reject any damaged covers before the delivery truck leaves the site. Once satisfied, take ownership of the acceptable covers, as all being approved as meeting the government specifications and being suitable for installation at this project. Once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer/Contracting Officer's Representative (RE/COR).

3.2 INSPECTION

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

3.3 NICHE COVER ATTACHMENT HARDWARE

SPEC WRITER NOTES:

- 1. Modify the following depending upon whether the rosette is to be stainless steel or bronze.

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

3.4 INSTALLATION

- A. Installation of the government provided niche covers shall include all materials, manpower, tools and equipment required to receive the approved government provided niche covers from the manufacturer, and handle them as necessary and perform whatever work is needed to result

in the successful installation of one niche cover for every precast concrete niche space created for this project.

- B. The niche covers shall be installed so as to create a visual straight line along the top of the row of covers agreed to by the Resident Engineer as the primary visual vertical reference line in the installation. The covers shall be spaced achieve, as close as possible, the intended design spacing, taking into consideration the allowable fluctuations in the manufacturing tolerances for the government provided niche covers.
- C. The niche cover attachment assemblies shall be installed so that the threaded end of the tamperproof screw is inserted into the threads of the spring clip on the mounted angle bracket behind each of the mounting holes in the niche covers. This should result in the head of the screw being parallel with the face of the niche cover. The threaded hole in the spring clip shall be fully visible when looking through the mounting hole in the niche cover to the respective spring clip behind the hole. The position of the spring clip shall be adjusted so the threaded tamperproof screw will enter the threaded hole in the spring clip and that the attachment assembly can be tightened to secure the cover in the intended position. To achieve this installation, the angle brackets shall be adjusted to be the correct height from the niche wall so the hole in the spring clip can have the respective tamper proof screw inserted and tightened. To achieve the proper positioning of the spring clips, the angle brackets shall be adjusted in their position, or the hole in the angle bracket through which the tamper proof screw passes when tightened into the spring clip, shall be enlarged as necessary to allow the adjustment of the spring clip to align with the hole in the niche cover so the tamper proof screws through the individual rosettes can each be inserted and tightened using the threaded spring clip. Only correct installations of the tamperproof screws, inserted into the threads of the spring clip and being tightened are acceptable. The head of the tamperproof screw shall be snugged up tight against the rosette, and shall be seated against the rosette, which occurs when the tamperproof screw is approximately perpendicular to the face of the niche cover.

3.5 CLEANING AND PROTECTION

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

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SECTION 04 73 10
MEMORIAL WALL MARKERS

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // --- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

SPEC WRITER NOTES:

1. Modify the following sub-paragraph 2 to coordinate with the drawings and follow the direction of the PM for indicating the number of spares.

1.2 DESCRIPTION

- A. Work Included: Provide labor and materials necessary to complete the work of this Section, including but not limited to the following:
1. The Department of Veterans Affairs (VA) shall furnish memorial wall markers for installation in the memorial wall(s) to be constructed by the Contractor. This specification section provides all work necessary for the Contractor to accept, handle, store, move and install one approved blank memorial wall marker for each of the memorial wall marker sites in the new memorial wall(s).
 2. The number of approved government provided spare memorial wall markers for this project to be accepted, offloaded and stored at the designated location is //indicated on the drawings//(fill in the number as directed to by the PM)____//.

1.3 INSTALLER QUALIFICATIONS

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

1.4 RELATED WORK

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

1. Section 03 48 26: CONCRETE MEMORIAL WALL UNITS, the //precast//cast-in-place//concrete memorial wall units with: memorial wall marker mounting hardware assemblies (installed); and memorial wall marker attachment hardware assemblies (provided for use to attach the Government provided memorial markers). The memorial marker mounting hardware assemblies shall be furnished and installed at the corners of the memorial markers, whether they adjoin other markers, filler strips, or are a shadow box concrete installation. Refer to the drawings for specific details. A memorial wall marker attachment hardware assembly will secure the corner of each approved government provided memorial wall marker, as shown on the drawings.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // ____// requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, please visit <http://www.biopreferred.gov/>.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MEMORIAL WALL MARKERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

- A. Memorial wall markers that have been inspected and accepted as being in compliance with manufacturing tolerances for size, perpendicularity, finish, and product stone quality shall be furnished by the Government and delivered to the site on pallets. They shall be of size, type, manufacturing, finish and quantities required for this project. The markers shall be delivered to the site Freight on Board (FOB) and the Contractor shall be responsible to offload and secure them at the job site. The general quantity and condition shall be observed and an adequate count to cover all the intended memorial wall marker locations, plus required spares, shall be verified by the Contractor prior to accepting the units and performing the offloading operations. The Contractor shall note any shipping damage and reject any damaged

markers before the delivery truck leaves the site. Once satisfied, the Contractor shall take ownership of the acceptable markers, as all being approved as meeting the government specifications and being suitable for installation at this project. Once the memorial markers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer/Contracting Officer's Representative (RE/COR).

3.2 INSPECTION

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

3.3 MEMORIAL WALL MARKER ATTACHMENT HARDWARE

SPEC WRITER NOTES:

1. Modify the following depending upon whether the rosette is to be stainless steel or bronze.
2. Modify the following depending upon whether there are to be plaques attached to the markers, or whether they are to be engraved.

- A. Hardware for attachment shall be specifically designed for attaching markers that will be //engraved//have plaques installed//. The hardware is designed to be recessed or totally hidden, except for the rosettes at the corners of the markers and the hardware visible through the cracks between the individual markers, or //filler strips//concrete shadow box edge//. The hardware allows for the removal of an individual marker //for engraving//for installation of the plaque if pins are used//, without having to remove multiple markers. The material for the attachment hardware shall be verified to be compatible with //stainless steel rosettes and rosette attachment screws//bronze rosettes and rosette attachment screws//, without adverse reactions during the submittal process. The hardware provided shall not cause staining on the markers. The marker attachment hardware shall only be visible when looking in the cracks between or adjoining the markers, and shall be installed being recessed from the face of the markers. The marker attachment hardware shall be suitable for the project installation using //precast//cast-in-place// memorial wall installation(s). The shop drawing and submittal process, shall be used to indicate that the installation of the memorial wall markers is in

compliance with design and installation as indicated in the drawings. The submittal, shop drawings and narrative of the work to be performed and coordinated shall clearly indicate how the work is to be coordinated, from the installation of the memorial wall concrete core to the completed installation of the memorial wall markers in the finished memorial wall(s). The attachment hardware shall be suitable for a permanent installation, out of doors, be suitable for the indicated loads, and shall produce the finish installation as indicated on the contract drawings.

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

3.4 INSTALLATION

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

3.5 CLEANING AND PROTECTION

- A. Memorial wall markers shall be shop cleaned at the time of fabrication. After installation, carefully clean the markers, removing all dirt stains, and all other incident defacements.
 - 1. Stiff bristle fiber brushes may be used, but the use of wire brushes or acid-type cleaning agents and other solutions which may cause discoloration is expressly prohibited. Fabricator should be

contacted regarding the use of any cleaners and must approve of them before use.

2. Protection of Finished Work: All markers that are installed as part of the work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

B. Clean up area of excess material and debris.

- - - E N D - - -

SECTION 10 14 00
EXTERIOR SIGNAGE

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete all SPEC WRITER NOTES from final specification.
3. Delete between //----// if not applicable to project. Also delete any other items not applicable to project in the section and renumber the paragraphs.
4. Modify so paragraph headers do not get separated from body of text across page breaks. Table headers shall be duplicated across page breaks when the table gets split.
5. Spec Writer shall modify these specifications to reflect the signage design for the project site. New signage will match the existing unless directed otherwise by the PM.
6. Spec Writer shall coordinate the specifications with the drawings and indicate a specific location for each of the various sign types to be used for the "match existing" conditions.
7. Spec Writer shall edit the following paragraph to correspond to the project requirements.
8. Spec Writer shall coordinate specifications and drawings so the new sign system is in compliance with Section 12 - National Cemetery Signs, in the VA Signage Design Guide (SDG), unless specifically directed otherwise by the Project Manager.
9. Spec Writer shall modify this entire specification section as necessary, if the new signage is to match the existing signage at the Cemetery and the existing signage is NOT in full conformance with the SDG.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the work required to furnish and install the indicated and specified exterior cemetery site signage systems, including, but not limited to, posts//, and mow strips//.
- B. Signs shall be products of manufacturers regularly engaged in manufacturing signs of types specified.

SPEC WRITER NOTES:

1. Spec Writer shall edit the following list of sign types to reflect the types applicable to this project.
2. Delete unused types or add new and renumber accordingly.
3. There are between one and three different styles and/or materials that can be used for mounting the various sign types indicated. The spec writer shall indicate clearly in the specifications or on the drawings, without causing conflicting information, which type of mounting style and materials are to be used for each sign type to be included in the project. If the type and material are not consistent throughout the project for the specific sign type, then the types of mounting and materials shall be based upon the specific sign location.

C. Signs included are as follows:

1. Information/Regulation
2. You Are Here Map
 - a. Horizontal
 - b. Vertical
3. Traffic Regulatory
 - a. Low Profile
 - b. Tall
4. Post and Panel
 - a. One Line of Text
 - b. Two Lines of Text
 - c. Three Lines of Text
5. Pylon Street Signs
6. Flag Type Street Signs
7. Tall Flag Type Street Signs
8. Pylon Section Marker
9. Faucet Post with Sign Panel
10. Standard Granite Section Marker
11. Wall Signs - Small
12. Incised Letters
13. Dimensional Letters//, seals//, //and //emblems//.
14. Pylon Handicapped Sign

1.2 RELATED WORK

- A. Post Setting Excavation, Material, Backfill, Section 31 20 00, EARTH MOVING.
- B. Concrete Bases for posts: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE
- C. Cast Stone Masonry Posts: Section 04 72 00 CAST STONE MASONRY.

SPEC WRITER NOTES:

- 1. Delete paragraph D except where existing granite posts are to be used for new signage.

//D. Granite Posts: Shall match the existing. When granite is selected for a new installation, the selection and specifications shall be based upon the other uses for the product within the facility and the posts shall match the indicated products elsewhere on the site.//

- E. Flower Watering Station piping, appurtenances and mounting: Section 32 30 00 SITE FURNISHINGS.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Sign manufacturer shall regularly and presently manufacture signs similar to those specified as one of their principal products. Sign manufacturer shall submit qualifications demonstrating a minimum of three years of experience manufacturing the qualifying signs and shall, if possible, demonstrate the successful manufacturing of exterior site signs installed at one or more State or National Veteran Cemeteries.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // _____// requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, please visit <http://www.biopreferred.gov/>.

1.5 SUBMITTALS

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

- B. Samples: Submit //3// sets. One set to the Contractor, one set to the Resident Engineer or Contracting Officer's Representative (RE/COR) and one set to the A/E Designer. The Contractor shall provide submittal documents that indicate each of the sign types, mounting types and materials to be used for the various combinations to be used for this project. Submittal materials shall indicate the location(s) for the various sign types including their mounting.
1. Post & panel sign mock-up, not less than 200 mm by 250 mm (8" by 10"), shall be constructed and submitted, showing typical color, texture and fonts shown on Contract Drawings. Mock-up shall show typical fabrication methods, including panel to post(s) connection. Sample shall be capable of demonstrating how the face panels can be removed, for repair or replacement, from the mounted location between the posts, for a two post sign system. Mock-ups of all other sign systems for post mounted signs shall be capable of demonstrating how the sign panels are to be removed and replaced from the posts, or mounting support system attached to the posts, without moving the posts. Post, other than concrete or stone types, shall include typical post cap secured with tamperproof screws. Top surface of the sign panel shall not contain screws or metal joints that could trap or allow water to enter the sign assembly.
 2. Square tube post, 150 mm (6") minimum length, showing typical color and finish. Attachments for the sign panels shall be provided to demonstrate the complete signage system materials and functionality.
 3. Aluminum samples showing full range of finish colors available.
 4. Cast Metal Letter, of the style, size and finish indicated
 5. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.
 6. Sample of typeface, arrow and symbols in a typical full size layout.
 7. Directory panels and frames, with letters and symbols, each type.
- C. Shop Drawings: All signs showing material, finish, colors, size of members, details of construction, letter spacing, size and type, numbers, symbols or image details, and mounting details. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes. The details of construction shall clearly show how the sign is to be disassembled to replace the entire sign or just one side panel, where applicable.

- D. //Full size layout template of the cast lettering shown on the entry wall, showing pin locations and letter spacing of all words. Approved template shall be used during the actual installation of the lettering.//
- E. Full size layout in full color of the Sign Panels.
- F. Manufacturer's Literature and Data (Mark literature to indicate items proposed to be furnished): Signs, each type. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions. Manufacturer's recommendations for mounting the Sign Panels shall be provided.
- G. Manufacturer's Certificates: Provide certification from the coating installer, indicating exactly what they did to prepared the aluminum as and applied the coating(s) to the specified thickness(es). The certification shall indicate that the coating has been installed according to specific and identified contract specifications and/or approved submittal materials so it is absolutely clear what was done.
- H. //Sample(s) shall be submitted of sign(s) of sufficient size to show the full scaled features of each of the sign types, including frame, mounting, panels, panel mounting, sign mounting facilities, lettering, color and texture. All aluminum signs shall have full exterior Powder Coated finish, with color and quality as specified herein.//

1.6 DELIVERY AND STORAGE

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

SPEC WRITER NOTES:

- 1. Modify the following Paragraph as required, following discussion with the Project Manager.

1.7 WARRANTY

- A. Sign Manufacturer shall guarantee the text and symbols applied to the powder coated aluminum for //a period of one year//an extended warranty period of five years// following //final acceptance of the project//acceptance of the exterior signage system work//. A warranty inspection shall be performed no later than one year following //project final acceptance//acceptance of the exterior signage system

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work// and the Contractor shall be responsible for removing and replacing any text and/or symbols identified, during the inspection, that have started to fade, chip, peel or otherwise fail. The Contractor shall remove and replace any sign panel faces with new, where the applied lettering, or the paint system itself, is causing damage to, or failure of, the paint system. All work to produce replacement sign panels with new lettering and/or paint system shall be provided at no cost to the Government, as part of the Warranty work for the signage system.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

- B. Americans with Disabilities Act - 1990, as amended and in effect as of 01-01-2009

- C. Federal Highway Administration:

Manuals on Uniform Traffic Control Devices for Street and Highways - Single Post Traffic Regulatory Signs.

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

B209-10	Aluminum and Aluminum-Alloy Sheet and Plate
B221-12	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
B449-93(2010)e1	Standard Specification for Chromates on Aluminum

- E. American Architectural Manufacturer's Association (AAMA):

AAMA 2605-05	Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels.
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- F. Federal Specifications (Fed. Spec.):

MIL-P-8184F	Plastic Sheet, Acrylic, Modified.
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10 14 00 - 6

A-A-59502

Plastic Sheet, Polycarbonate

SPEC WRITER NOTES:

1. Spec writer should use the information in Paragraph G to complete the specifications and drawings for the Exterior Signage for this project, and then delete the paragraph as it isn't applicable for the Construction Documents.

G. //VA Signage Design Guide:

Section 12 National Cemetery Signs -

[//](http://wbdg.org/ccb/VA/VASIGN/signage12.pdf)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum, Extruded: Fed. Spec. QQA-200-9, alloy 6063-T5, applicable as material.
- B. Aluminum, Sheet and Plate: ASTM B209
- C. Aluminum, Extrusions and Tubing: ASTM B221
- D. Zinc Chromate Primer: Fed. Spec. TT-P-645.

SPEC WRITER NOTES:

1. Modify, or delete the following paragraphs as required according to the project specific conditions for the Exterior Signage.
2. Coordinate this specification with the drawing details and avoid conflicting information. Where necessary, because there is more complete and detailed information provided, indicate that the drawing details take precedence over the specifications.

2.2 SIGNAGE GENERAL

- A. Signs shall be of type, size and design shown on the drawings and as specified.
- B. Signs shall be complete with lettering, framing, and related components for a complete sign installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Verify all dimensions and conditions shown by the drawings. Resident Engineer and/or Contracting Officer's Representative (RE/COR) is to be notified of any discrepancy in drawing(s), in field directions or conditions, and/or of any changes required for any such related construction details.

EXTERIOR SIGNAGE

- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. Warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

SPEC WRITER NOTE:

1. Unless specifically directed otherwise, by the Project Manager, spec writer shall select from the options indicated herein below as preferred Type Styles of the NCA.
2. Variation from the preferred type styles requires approval of the Project Manager.

2.3 SIGN STANDARDS

A. Typography:

1. Type Style: //Optima Bold//Times Roman Bold//New Times Roman Regular//. Initial caps or and lower case as indicated in Site Signage Plan, unless otherwise indicated.
2. Arrow: See graphic standards in drawings.
3. Letter spacing: See graphic standards on drawings.
4. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only. Text to be installed on specific signs shall be as submitted, reviewed and finally approved in shop drawings processed as submittal materials.

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

SPEC WRITER NOTES:

1. Where site has Flower Watering Stations (FWS) using "Victor Stanley" fixtures the sign color selected shall match, unless specifically directed otherwise by the Project Manager.
 2. Spec Writer shall modify the following based upon acceptance of recommendations by the Project Manager.
1. Aluminum sign system color scheme shall have the background color of sign panels and the aluminum posts as powder coated matching

// "Victor Stanley" // bronze/dark-brown//dark green//black// (identify color by standard color numbering system)//.

SPEC WRITER NOTES:

1. Spec Writer shall modify the following paragraphs to match the specific project conditions.
2. Coordinate the sign type designations indicated in the specifications with those on the drawings.
3. Modify Paragraph A and delete between //...// and insure that the sign designations for the project are coordinated between these specs and the drawings and use the appropriate signage designations following the VA Signage Design Guide, as indicated.

2.4 SIGNS TYPES

- A. General: //The exterior sign system shall be comprised of sign type families that are derived from the 10 Types developed in Chapter 12 - National Cemetery Signs, of the VA Signage Design Guide (SDG). The sign designations used herein follow those in the SDG. An example sign designation, to identify what each of the elements is designated to represent is "NC-07.01 A - m1". "NC" Designates a National Cemetery sign. "07" the two digit numbers identify a particular sign type. "01" the two digit number following the period identifies a specific sign size within the sign type. "A" the letter designates a specific sign configuration, version and/or layout for graphics. "m1" the letter and number designates the post family and style. "c1" denotes concrete family with square insert style; "c2" denotes concrete family with round insert style; "m1" denotes metal family with square style; and "m2" denotes metal family with rectangular style. All of the above is duplicated herein, originally from the graphical indications in the SDG. //The basic sign designations for this project are indicated as follows:

SPEC WRITER NOTES:

1. Modify the following list of sign types to be specific for the project being constructed. Delete and renumber the items, do not renumber the sign types from those in the SDG.
 2. Modify the number of size designations for each sign type to be correct for this specific project, and be consistent with the drawings.
1. NC-01 - Information/Regulations Signs, three size designations.

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2. NC-02 - You Are Here Maps Signs, two size designations.
 3. NC-03 - Traffic Regulatory Signs, two size designations.
 4. NC-04 - Post and Panel Signs, three size designations.
 5. NC-06 - Pylon Street Signs, three size designations.
 7. NC-07 - Pylon Section Marker, three size designations.
 8. NC-08 - Wall Sign - Small, one size designation.
 9. NC-09 - Incised Letters, one size designation.
 10. NC-10 - Dimensional Letters/Seal, one size designation.
 11. NC-11 - Dimensional Seal, one size designation.
- B. Location, layout and construction details for the all of the project exterior signs shall be found in the Construction Drawings. Refer to the signage details for the specific sign panel sizes, text and graphic sizes as well as the layout and content for the text and images for the respective individual signs.

2.5 TEXT AND GRAPHICS

SPEC WRITER NOTES:

1. Modify the following as required based upon the coordination with the information provided on the drawing, details and notes regarding the specific sign sizes, locations, orientation, and messages.
 2. The preparation of the surfaces to which the text and graphics are to be applied, as well as the method of application, are critical to meeting or exceeding the manufacturer's published life expectancy for the applied text and graphics.
 3. Spec Writer shall modify to require that the Contractor provide documentation that demonstrated that the surface preparation and application of the text and graphics are to be performed as recommended by the manufacturer to maximize the life expectancy of the applied materials on the signage.
- A. There are multiple Message Layout types for some of the different size signs within the same type of sign. See the drawing layout and detail drawings for the specifics of the locations for the signs, as well as the size, types, materials and messages for the individual signs for the project.
1. Surface applied letters, numbers and graphics shall be of a published quality and life expectancy equal to or exceeding that for

reflective white opaque Engineering Grade 3M™ Scotchlite™ vinyl, unless otherwise noted. //Color shall match existing.// //Color shall be selected from the manufacturer's standard color selection, during the submittal process.// Font Type Style shall be as indicated in Paragraph "SIGN STANDARDS" as approved during the submittal process.

- B. All text and graphics for the exterior signage shall be provided in detailed submittal information. Each sign face shall be represented in scaled drawings, with exact font, letter style, font, letter spacing, graphics being shown. Only signs and or sign faces approved in the submittal process shall be manufactured.

2.6 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members shall be true. Assemble so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces shall be smooth flat and without oil-canning, free of rack and twist. Maximum variation from true plane of surface shall be plus or minus 0.4mm (1/64 inch). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Members shall have square turns and corners sharp, and curves shall be true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.

- I. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, peeling, foreign matter and other imperfections.
- J. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. All contact surfaces fit tight and even without forcing or warping components.
- K. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- L. Completed sign installations shall not have any exposed openings so insect nesting inside of signs will be prevented.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the RE/COR & forwarded to contractor.
- N. Final sign fabrication shall not proceed until samples and shop drawings detailing the sign system as it will be installed, have been submitted and approved during the submittal process.

2.7 PROTECTION OF ALUMINUM

SPEC WRITER NOTES:

- 1. Coordinate the signage details to ensure that all fasteners for the aluminum signs are stainless steel, or otherwise in compliance.

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze or other metals compatible with aluminum by one of the following:
 - 1. Painting the dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - 2. Placing an approved caulking compound, or a non-absorptive tape, or gasket between the aluminum and the dissimilar metal.

SPEC WRITER NOTES:

- 1. Coordinate the following note with the construction details on the drawings.

- B. Paint aluminum in contact with or built into mortar, concrete, or other masonry materials with bituminous paint or zinc chromate primer.

SPEC WRITER NOTES:

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1. Spec writer shall discuss the design of the aluminum sign posts with the Project Manager. The size for the posts indicated in these specifications comes from those in the signage design guide and may not be appropriate for the wind loading conditions at this project site. The sizes in the design guide are just recommendations for aesthetic issues and are not based upon specific design wind load conditions for a specific project location.
2. The project designer shall determine if the size of the posts as indicated herein are adequate for the project location, as well as the agreed to operational and replacement requirements. Provide recommendations to the Project Manager of the element sizes and the design wind loads, and confirm in writing the agreed to loads and sizes for this project.
3. Modify the sizing of the signage elements in the following paragraphs and in the drawings, as required. The indicated size for the posts and frame elements shall be as determined by structural engineering design. The design wind speed for this project location shall be as agreed, following recommendation by the designer and acceptance by the Project Manager.

2.8 DOUBLE-POST-PANEL SIGNS

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

1. Metal post signs:
 - a. The posts, frame and panel(s) that make up the metal post sign system shall be constructed of an aluminum tubing system with approved post caps. Posts and frame elements for supporting the panels at individual sign locations shall be sized using the minimum sizes, as indicated herein, or as indicated on the drawings, with the drawing sizes taking precedence. The minimum size for the metal posts, if not indicated in the drawings, shall be 50 mm x 100 mm x 3 mm (2-inch by 4-inch by 1/8").
 - b. The minimum size for the tubular aluminum frame system, if not indicated in the drawings, shall be 25 mm x 25 mm x 3 mm (1-inch

x 1-inch x 1/8-inch) with the 3 mm(1/8 - inch) aluminum panels anchored to the tubing, with all corners mitered and welded and ground smooth. When the sign panel system is mounted to the posts, there shall be no openings for insects to enter. Mounting holes for attaching the sign panel and frame to the posts shall be pre-drilled before the coating system is applied. The entire sign panel and frame system shall be coated with the submitted and approved powder coating system, as indicated herein or on the drawings. The sign panels shall be secured to the frame system with tamperproof screws and each panel face shall be removable, without removing the sign system from the posts.

- c. Sign panel assembly shall be constructed with extruded aluminum support channels and fasteners that secure a removable powder-coated aluminum sign panel assembly. Aluminum sign panel faces shall be 3 mm (1/8") minimum thick. The design for the sign panel system shall be such that the sign panels can be removed and replaced, if damaged, without having to move the posts that secure the sign panel assembly. The sign panel assembly shall be constructed so there are no gaps or holes in the assembly that could let insects enter and construct nests or otherwise become a nuisance. The top of the sign panel assembly shall be constructed such that it is water tight from above and shall not have unsealed joints where water can collect or enter the assembly. The sign configuration and mounting shall be as depicted in the drawings.
- d. Lettering shall be as indicated on the applicable "Site Details" type of Drawing(s).
- e. Exposed fasteners shall be aluminum, tamper-proof type, and shall be colored to match the color for the sign panels.
- f. Finishes of exposed aluminum surfaces:
 - 1) Pretreatment: Before the finish is applied, a five-stage pretreatment must be applied to assure maximum adhesion and corrosion resistance:
 - a) Stage 1: High alkaline cleaner to prepare the surface
 - b) Stage 2: Water rinse
 - c) Stage 3: Combination of chromic, phosphoric and hydrofluoric acids that produce the chrome-phosphate

conversion coating for maximum adhesion and corrosion resistance.

- d) Stage 4: Water rinse
- e) Stage 5: Water rinse
- 2) Coating: The coatings for the metal signs shall produce results that meet or exceed the testing results indicated in AAMA 2605-05. After pretreatment, the metal is dried and paint is then applied. The aluminum shall have an electrostatically applied baked-on flexible acrylic finish that meet or exceeds industry standard tests, achieving a 75 - 125 micron (3.0 - 5.0 mil) thickness, super-tough finish with maximum exterior durability and superior adhesion characteristics. Color as indicated on the drawings and approved submittal.
- 3) Tests:
 - a) AAMA 2605-05 (covers Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels)
 - b) ASTM D2247 (Humidity resistance of 1,000 hours)
 - c) ASTM B117 (Salt spray resistance of 1,000 hours)
 - d) Accelerated weathering for 500 hours under Method 6152 of Federal Test Method 141 shall show no adhesion loss, with only slight fading, chalking and water staining.
 - e) Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for one year in Florida facing south at a 45 degree angle.
 - f) Minimum hardness of 2H using ASTM D3363.
 - g) Color of exposed portions of fastenings shall match sign panel being attached.

SPEC WRITER NOTES:

- 1. Coordinate the specifications and drawings regarding the concrete posts, and unless specifically directed otherwise by the Project Manager, the information in the contract documents shall match the details in the SDG.

2. Concrete post signs:

- a. The posts shall be precast concrete with the face for mounting the metal frame and panel(s) being smooth and flat. The precast concrete posts shall be of the required height (to be imbedded in the ground and extending above finished grade as indicated on the

drawings), and shall be //140 mm x 140 mm (5 1/2" x 5 1/2")//190 mm x 190 mm (7 1/2" x 7 1/2") with the concrete detailing as indicated on the drawings. Concrete posts are to be manufactured according to the concrete specifications for Cast Stone Masonry, detailed as indicated. The precast concrete posts shall be installed and the sign panels mounted as indicated in the drawings, or as approved in the submittal materials, see paragraph below. The Concrete post signs shall be installed at the locations indicated on the drawings.

SPEC WRITER NOTES:

1. Modify the following and adjust the sizes of the frames in the drawings and herein below, based upon the design for the sign elements as indicated above.
- b. The minimum size for the tubular aluminum frame system, if not indicated in the drawings, shall be 25 mm x 25 mm x 3 mm (1-inch x 1-inch x 1/8-inch) with the 3 mm(1/8 - inch) aluminum panels anchored to the tubing, with all corners mitered and welded and ground smooth. When the sign panel system is mounted to the posts, there shall be no openings for insects to enter. Mounting holes for attaching the sign panel and frame to the posts shall be pre-drilled before the coating system is applied. The entire sign panel and frame system shall be coated with the submitted and approved powder coating system, as indicated herein or on the drawings. The sign panels shall be secured to the frame system with tamperproof screws and each panel face shall be removable, without removing the sign system from the posts.
3. Insulating sleeves, gaskets, bolts and concrete anchors shall be provided and signs anchored to sign posts generally as indicated on the drawings and specifically as submitted and approved on the shop drawings as meeting or exceeding the drawing requirements.

2.9 SINGLE-POST TRAFFIC REGULATORY SIGNS

- A. Signs shall be constructed of square tubular galvanized steel post with an aluminum plate sign panel.
- B. Sign panel shall be a 2 mm (0.080") aluminum plate with surface applied reflective vinyl traffic regulatory decals. Panel, text & graphics shall comply with the Department of Transportation, Manual for Uniform Traffic Control Devices in color, shape, proportions, text and symbols.

Panel shall mechanically fasten to support post with tamper resistant fasteners. Onsite "STOP" signs shall use all caps, unless specifically directed otherwise by the Project Manager.

- C. Posts shall be a minimum thickness of 2.5 mm (12 gauge) finished as specified on the Drawing Detail(s).

2.10 FLAG TYPE STREET SIGNS

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

2.11 ELECTRONIC READERBOARD SIGN

- A. Outdoor, weatherproof, computer controlled LED display sign fully encased in its own aluminum frame, approximately 700 mm (28") high by 1600 mm (64") long, by approximately 200 mm (8") deep.
- B. Sign shall contain its own fan system to control heat and humidity in sign. Provide at least 75 mm (3") clearance below fan covers and fresh air intakes for proper circulation of air through the sign.
- C. LED Display:
 - 1. Rated 100,000 hours
 - 2. 128 x 48 pixel Red Lamp
 - 3. Full matrix display capable of presenting text in multiple character heights.
 - 4. Pixel luminance shall be viewable in direct sunlight.
- D. Message Capacity: Shall be such that a minimum of 60 different messages can be stored and scheduled to be displayed according to time and date.
- E. Connectivity to the controlling government PC shall be accomplished by RS232 or RS485 cable, phone modem, Ethernet or fiber optic line //and shall be compatible with existing computer control system for the previous electronic readerboard sign.//
- F. Electrical requirements:
 - 1. Input voltage: 120V
 - 2. Input Frequency: 60 Hertz

SPEC WRITER NOTES:

- 1. Modify the following to match the project conditions and delete if not applicable.

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2. Adjust the mounting requirements for the various plaques and emblems after discussion with the Project Manager.
NOTE: There have been project where the bronze seal on the front entry have been stolen. Either mount the bronze plaques so they are in a recessed installation (where the back edge of the plaque isn't accessible), or insure that there are two or more mounting pins that are installed through the wall or pier, with washer and nut installed recessed on the back side, with the back side connection being recessed and covered over with appropriate patching material.
3. Modify to provide information for the sign types to be provided for this project.

2.12 BRONZE PLAQUES - SERVICE EMBLEMS - SEALS

- A. Furnish and install the Bronze Plaques, Emblems and Seals as indicated on the contract drawings. Bronze elements shall be cast of a lead free tin bronze, such as C900300 (Navy "G" Bronze) or similar alloy approved by the VA. The Bronze elements shall be BAS relief casting based upon the //VA Drawing// electronic graphic image included in the contract drawings// previously approved and used casting mold// as submitted and approved.
- B. BAS relief castings shall be of uniform quality and condition, free from injurious blow holes and porosity, cracks and other defects and not warped or distorted, well finished, free from burrs, sharp edges, scratches and defects that may affect appearance or service ability. Casting shall not be repaired, plugged, welded or burned. Finish to be detailed, hand chased for true alignment, filed, belt polished, sides ground smooth, raised surfaces and borders to be polished and buffed to a bright satin finish, background textures to be reverse medium pebble background, fine pebble background, moss as cast. Bronze to be chemically oxidized to a statuary medium color and finish with one coat of clear protective exterior metal lacquer. Fasteners to be corrosion resistant metal compatible with material or casting. Details for the size, thickness, content, and mounting for the Bronze signage elements shall be as indicated on the contract drawings and as described as follows:"

1. Service Emblem Plaques - The five bronze service emblem plaques shall be of the sculpted BAS relief style. The five emblems include

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one of each military branch: Army, Navy, Air Force, Marines and Coast Guard. Examples of previously accepted BAS relief sculpted casting molds are available at the manufacturer, United States Bronze, 811 Second Avenue, Hyde Park, NY 11040, telephone 516-352-5155, as a basis of design. Shop drawings, as well as samples of material showing color, texture and border, and photos of sculpted molds of all sculpted BAS relief elements shall be submitted for approval prior to fabrication.

SPEC WRITER NOTE:

1. Adjust the mounting requirements and attachment method as appropriate for the substrate to which the bronze castings are to be attached to insure adequate security. Coordinate final design with the Project Manager.
 - a. Plaques shall be provided with four threaded bosses, 13 mm x 50 mm (1/2" x 2") nominal size. Space as shown on Contract Drawings. Contractor shall provide threaded bronze bolts, 13 mm x 50 mm (1/2" x 2") nominal size to fit treaded bosses.
2. Department of Veteran Affairs Bronze Seal - Shall be of the sculpted BAS relief style with the size and graphics //matching that of previously approved seals//as provided in the VA Graphic files// and as approved during the submittal review and approval process. The size, location and attachment for the seal shall be as indicated on the construction drawings, with the seal between 600mm and 1200mm (2 and 4 feet) in diameter.
3. Gettysburg Address Plaque (Government Provided) - Shall be mounted as indicated on the contract drawings. The size and configuration of the plaque shall be generally as indicated on the contract drawings, with the final configuration, and mounting to be as submitted and approve during the submittal review process.

2.13 PYLON STREET SIGNS

- A. Signs shall be non-illuminated posts with street name messages directed specifically to vehicles. They shall be metal or concrete, with location, materials, color, messages and configuration as indicated on the Drawings. Position sign to provide vehicles and pedestrians with a clear unobstructed view of the sign, or position according to the drawings, if so indicated. Unless indicated differently on the drawing details, the signs shall be as follows:

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SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the detail information provided on the drawing details and notes.
2. If drawing details indicate the information below in a) and b) then delete the paragraphs and renumber.

1. Metal Signs

- a. //150mm x 150mm x 1200mm (6" x 6" x 4') above finished grade, and depth as indicated on the drawings (minimum depth for bottom of concrete holding the sign shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//
- b. //Metal thickness shall be 3mm (1/8") minimum aluminum with top piece secured with tamper-proof screws or other method as approved in the submittal process.//
- c. Submit a sample sign at least 300mm (12-inches) in length with all manufacturing methods and elements indicated, including color and finish as well as lettering, for review and approval.
- d. Color and material for the background and lettering shall be //the same as for the other signs//match the FWS facilities//be powder coated color to be determined during submittal//.
- e. Provide a //precast concrete//cast-in-place concrete// mow collar that is:
 - 1) Reinforced and free floating from the sign
 - 2) As detailed on the drawings
 - 3) Submitted and approved during the submittal process

SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the detail information provided on the drawing details and notes.
2. If drawing details clearly indicate the information below in paragraphs "a thru e" then delete the corresponding paragraph(s) and renumber.

2. Concrete Signs

- a. //190mm x 190mm x 1200mm (7.5" x 7.5" x 4') above finished grade, and depth as indicated on the drawings (minimum depth of concrete holding the sign shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//

- b. //The style for the posts shall have //rectangular//round// ends cast into the four sides of the post. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.//
- c. //The text panel shall be 3mm (1/8") thick powder coated aluminum //with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating//. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.//
- d. //The dimensions for the aluminum text panels shall be 89mm (3.5") wide with the text being 63mm (2.5") in height. The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete posts, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete sign post with the aluminum text panel, as complete. The approximate height for the aluminum text panels is 900mm (3'). Dimensions shown on detailed construction drawings shall take precedence over these specifications.//
- e. //The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors. //The text panels shall be furnished without mounting holes and shall be attached to the concrete with a permanent exterior adhesive designed for securing metal to concrete, as submitted and approved.//
- f. Posts shall be manufactured in accordance with Section 04 72 00 Cast Stone Masonry using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the post, minimum of 300mm (12") in length, during the submittal process. Submit shop drawings indicating all

dimensions and tolerances, as well as reinforcing. An acceptable sample must be obtained prior to manufacturing the units.

- B. The approved shop drawings and sample(s) of the complete pylon street sign shall be the basis for manufacturing and assembly.

2.14 PYLON SECTION MARKERS

- A. Pylon section markers are non-illuminated type with messages directed specifically at vehicles and pedestrians. Markers can present a maximum of three characters on a side, as indicated in the drawing details. Position each marker to provide vehicles and pedestrians with a clear unobstructed view of the marker, or locate and orientate according to the drawings, where so indicated. Unless indicated differently on the drawing details, the markers shall be as follows:

SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the detail information provided on the drawing details and notes.
2. If drawing details indicate the information below in a) and b) then delete the paragraphs and renumber.

1. Metal Markers

- a. //200mm x 200mm x 400mm (8" x 8" x 1'-4") above finished grade, and depth as indicated on the drawings (minimum depth for bottom of concrete holding the marker shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//
- b. //Metal thickness shall be 3mm (1/8") minimum aluminum with top piece secured with tamper-proof screws or other method as approved in the submittal process.//
- c. Submit a sample marker at least 300mm (12-inches) in length with all manufacturing methods and elements indicated, including color and finish as well as lettering, for review and approval.
- d. Color and material for the background and lettering shall be //the same as for the other signs//match the FWS facilities//be powder coated color to be determined during submittal//.

SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the information provided on the drawing details and notes.
2. If drawing details clearly indicate the information below in paragraphs "a thru e" then delete the corresponding paragraph(s) and renumber.

2. Concrete Markers

- a. //190mm x 190mm x 400mm (7.5" x 7.5" x 1'-4") above finished grade, and depth as indicated on the drawings (minimum depth of concrete holding the sign shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//
- b. //The style for the markers shall have //rectangular//round// ends cast into the four sides of the marker. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.//
- c. //The text panel shall be 3mm (1/8") thick powder coated aluminum //with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating//. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.//
- d. //The dimensions for the aluminum text panels shall be 95mm (3.75") wide with the text being 75mm (3") in height. The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete pylon section markers with the aluminum text panel, as complete. The approximate height for the aluminum text panels is 178mm (7"). Dimensions shown on detailed construction drawings shall take precedence over the specifications.//
- e. //The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors. //The text panels shall be furnished without mounting holes and shall be attached to the concrete with a permanent exterior adhesive designed for securing metal to concrete, as submitted and approved.//
- f. Pylon Section Markers shall be manufactured in accordance with Section 04 72 00 Cast Stone Masonry using reinforced wet cast

concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, minimum of 300mm (12") in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. An acceptable sample must be obtained prior to manufacturing the units.

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

SPEC WRITER NOTES:

1. Modify the following and select the appropriate Paragraph "A". Delete the remaining.

2.15 GRANITE SECTION MARKERS

- A. //Details for the Granite Section Markers are to be as indicated on the drawings and associated notes.//

- A. //Granite Section Markers shall match existing.//

- A. //Granite Section Markers shall have honed smooth inscription face and all other surfaces shall be smooth saw cut finish. All corners and edges including 50mm (2") below ground shall be rounded to 10mm (3/8") radius. Dimensions and graphics details are as follows:

1. Dimensions:

- a. Height above finished grade - 600mm (2').
- b. Width and Depth of the Marker - 150mm (6").
- c. Beveled sign face - 150mm (6") wide x 200mm (8") high on the angled surface.
- d. Top edge of beveled sign face from back edge of marker - 50mm (2").
- e. Bottom edge of beveled sign face from top of marker - 175mm (7").
- f. Bottom of marker below finished grade - 600mm (2') with concrete setting bed around the granite extending to max frost depth area or 6" below granite minimum, whichever is greater total depth.

2. Graphics:

- a. "SEC" shall be engraved letters; 38mm (1 1/2") ht., 5mm (3/16") depth, 5mm (3/16") stems & bars, located with bottom edge 57mm (2 1/4") from top of the beveled face; text for section ID numbers shall be as shown on the drawings, approved by the RE/COR & be engraved 50mm (2") ht., 5mm (3/16") depth, 10mm (3/8") stems &

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bars, and bottom edge 165mm (6 1/2") from top of the beveled face.//

- B. Granite Section Markers shall be of materials that match those existing on the site, or are as approved by Memorial Program Services (MPS) for use as niche covers.

2.16 FAUCET POST WITH SIGN

- A. Faucet posts with signs are non-illuminated pylon style with attached message and graphic decals. The decals are mounted directly on the metal post on a separate metal panel attached to the concrete post.
- B. The posts contain and/or are used to mount the water pipe and the spigot at the Flower Watering Stations. Details for the water pipe, appurtenances, and mounting are included in the related Section 32 30 00 SITE FURNISHINGS.
- C. The posts shall be metal or concrete, with location, materials, color, messages and configuration as indicated on the Drawings. Position sign to provide pedestrians with a clear unobstructed view of the sign, or position according to the drawings, if so indicated.

SPEC WRITER NOTES:

1. Modify the following and select the appropriate Paragraph "1". Delete the remaining.
1. //Details for the Faucet Posts with Signs are as indicated on the drawings and associated notes.//
 1. //Faucet Posts and Signs shall match existing.//
 1. //Unless indicated differently on the drawing details, the faucet posts with signs shall be as follows:

SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the detail information provided on the drawing details and notes.
 2. If drawing details indicate the information below in 1) and 2) then delete the paragraphs and renumber.
- a. Metal Faucet Posts
- 1) //200mm x 200mm x 710mm (8" x 8" x 2'-4") above finished grade, and depth as indicated on the drawings (minimum depth for bottom of concrete holding the marker shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//

- 2) //Metal thickness shall be 3mm (1/8") minimum aluminum with top piece secured with tamper-proof screws or other method as approved in the submittal process.//
- 3) Submit a sample marker at least 300mm (12-inches) in length with all manufacturing methods and elements indicated, including color and finish as well as lettering, for review and approval.
- 4) Color and material for the background and lettering shall be //the same as for the other signs//match the FWS facilities//be powder coated color to be determined during submittal//.

SPEC WRITER NOTES:

1. Modify the following paragraphs based upon the information provided on the drawing details and notes.
2. If drawing details clearly indicate the information below in paragraphs 1) thru 6) then delete the corresponding paragraph(s) and renumber.

b. Concrete Faucet Posts

- 1) //190mm x 190mm x 710mm (7 1/2" x 7 1/2" x 2'-4") above finished grade, and depth as indicated on the drawings (minimum depth of concrete holding the sign shall be //600mm (2')//900mm (3')//maximum frost depth for the location//). Drawing details shall take precedence.//
- 2) //The style for the markers shall have //rectangular//round// ends cast into the four sides of the marker. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.//
- 3) //The text panel shall be 3mm (1/8") thick powder coated aluminum //with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating//. The color and finish shall be as approved in the submittal process and shall match the other aluminum signs.//

- 4) //The dimensions for the aluminum text panels shall be 95mm (3 3/4") wide with the symbol being 75mm (3") in height and 30 mm (1 1/4") from top of text panel to the top of the symbol. The text height shall be 19mm (3/4"). The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete pylon section markers with the aluminum text panel, as complete. The approximate height for the aluminum text panels is 400mm (1'-3 3/4"). Dimensions shown on detailed construction drawings shall take precedence over the specifications.//
- 5) //The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors. //The text panels shall be furnished without mounting holes and shall be attached to the concrete with a permanent exterior adhesive designed for securing metal to concrete, as submitted and approved.//
- 6) Concrete Faucet Posts shall be manufactured in accordance with Section 04 72 00 Cast Stone Masonry using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, minimum of 300mm (12") in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. The shop drawings and sample shall include the details space for the pipes, appurtenances, and spigot as well as room for assembly and attachment to produce the fully functional FWS spigot assembly as specified. An acceptable sample must be obtained prior to manufacturing the units.

SPEC WRITER NOTES:

1. Modify the following paragraphs by selecting the applicable paragraph "D" and deleting the other based upon the information provided on the drawing details and notes.

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

2.17 INCISED LETTERS

- A. Incised letters shall be cast into wall panels. The lettering shall be as indicated on the design drawings.
- B. Lettering text content, size, location and style shall be as shown on the design drawings and as approved in a submittal reviewed and approved during the shop drawing submittal and review process.
- C. Unless otherwise noted on the drawings and details, the font for the incised lettering shall be New Times Roman Regular. Color and staining inside of the incised lettering shall be as indicated on the drawings.
- D. Incised lettering shall be sized and depth as follows for the size lettering indicated on the drawings:
 - 1. 200mm (8") lettering - 13mm (1/2") deep.
 - 2. 250mm (10") lettering - 19mm (3/4") deep.
 - 3. 300mm (12") lettering - 25mm (1") deep.

SPEC WRITER NOTES:

- 1. Delete the following paragraph if all of the information is provided in the drawing details and notes. Modify to coordinate with the drawings and renumber as applicable.

2.18 //CONCRETE MOW COLLARS OR STRIPS//

- A. Reinforced concrete mow collars shall be provided for all new single elements in this Specification Section, where they are to be located in lawn areas and are not connected to another adjoining element. For all elements that are connected to another adjoining element, like double post signs, provide a continuous reinforced concrete mow strip. The requirements for the collars and strips are as follows:
 - 1. Reinforced and free floating, concrete not in contact with the element.

- a. //As detailed on the drawings//
- b. Submitted and approved during the submittal process
- c. Separated from the element with expansion joint material the fill depth of the concrete.
- d. Closed steel rebar, with overlap at joint, 50mm (2") minimum distance from surrounding earth.
- e. Minimum 10mm (#3) diameter rebar as enclosing the element or elements approximately 50mm (2") inside the perimeter of the concrete. On the strips, there shall be an additional bar in the middle between the elements that extends to within 50mm (2") from the closest parts of the adjoining elements.
- f. Cast-in-place concrete shall be same as for other flatwork elements.
- g. Construct the collars and/or strips to be 25mm (1") above finished grade at the junction with the lawn, and with a slope up toward the element(s) and or middle, for drainage, of 13mm (1/2") to 19mm (3/4").

SPEC WRITERS NOTES:

- 1. Modify the following as appropriate by selecting the applicable paragraph "A" based upon the coordination between the drawings and specifications.

2.19 DIMENSIONAL LETTERS

- A. //Dimensional Letters shall be individually mounted on the provided substrate material. The location, alignment, letter configuration, size, font, material and finish shall be as indicated on the Drawings.//
- A. //Cast dimensional metal letters shall be surface mounted tight to the wall unless otherwise noted//. //Letters to be mounted to other than flat surfaces, like stone masonry veneer walls with irregular shaped and faced stones, and with random joints shall be mounted based upon the wall construction. Before manufacturing the letters, a full sized template of the letters, with correct size and spacing, shall be placed on the wall at the correct location and temporarily secured. The letter template shall be marked for each letter indicating where the joints are located immediately below the letter placement. The marking of the template is to locate where the relatively flat portions of the stones are below the letters so the pins can be manufactured and installed out of the joints between the stones. The template with the

joint locations (or flatter portions of the stones) shall be provided to and/or used by the letter manufacturer so the pin placement supporting the individual letters can be adjusted and placed so the pins do not extend into the joints below the letters during the installation of the letters.// //Lettering shall be Times New Roman Regular with layout, font, style, size and spacing as indicated on the Drawings.//

B. Unless otherwise indicated on the drawings, dimensional lettering shall be sized and depth as follows for the size lettering indicated on the drawings:

1. 200mm (8") lettering - 38mm (1 1/2") deep.
2. 250mm (10") lettering - 50mm (2") deep.
3. 300mm (12") lettering - 64mm (2 1/2") deep.

SPEC WRITER NOTES:

1. Modify the following to indicate the specific requirements for the project for the features indicated below.

C. Materials, color, and finish for the individual letters shall be as indicated.

SPEC WRITER NOTES:

1. Coordinate the following section with the details on the drawings.
2. Modify or delete the following paragraph depending upon the completeness of the drawings, details and notes.
3. Modify paragraph C to be appropriate for the project, and approved by the PM.

2.20 VERTICAL/HORIZONTAL YOU ARE HERE MAP

A. Each graphic panel shall be sized to fit onto the designated double faced post and panel sign with the sign panel and posts as indicated on the drawings. The maximum size for the sign panel shall be 900mm x 1200mm (3' x 4') or as indicated on the drawings, either horizontal or vertical as shown on the drawings, based upon the image to be displayed. The overall sign height shall be 1800mm (6').

B. Graphics for these panels shall be as indicated on the drawing details and final graphics will be provided by the designer prior to the submittal process.

SPEC WRITER NOTES:

1. Spec Writer shall review the products available and their published performance as far as life expectancy

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and shall select the appropriate number of years, using the longest possible life expectancy.

- C. Graphic process shall be performed by a manufacturer that regularly produces similar products using materials, colors and sizes as indicated, and has performed this work for a minimum of three years. The graphics process shall produce sign panels that are curable, UV resistant, have crisp colors, shall not delaminate, be designed so surfaces scratches do not remove or damage the graphics, have been used for similar signs that have been exposed to the elements while mounted tipped up from horizontal to facilitate viewing, and have performed without failure for long periods of time. The longer the performance life of comparable products used elsewhere, the better. Minimum acceptable performance of similar signs shall be //5//10//15//20// years or more. Samples of the graphic sign panel, with the colors and detail that will be provided for the final sign shall be submitted, reviewed, modifications made as required, and eventually approved if fully compliant, prior to the signs being manufactured. The graphics process shall //match existing//be //surface applied reflective vinyl for text//, //map is surface silkscreened on the //powder coated aluminum//porcelain enamel// panel //large format "printer/plotter" print on vinyl with UV resistant ink and clear UV resistant overcoat//.
- D. Colors for the graphic image shall be white and necessary colors to create the map as indicated in the graphic file provided by the design A/E.

SPEC WRITER NOTES:

1. Modify or delete the following paragraph depending up the use in the project, and whether all of the details for the sign are clearly indicated on the design drawings, details and notes.

2.21 //TRAFFIC REGULATORY - TALL//

- A. Sign faces shall be 450mm x 300 mm (1'-4" x 12") and shall be mounted so the bottom of message panel is 2.1m (7'-0") above finished grade.
- B. //These signs shall match existing.//
- B. //The background color for the signs shall //match existing//be as selected from the Signage Design Guide (SDG) color chart during the submittal process//be as indicated on the drawings// insert the desired color from the SDG during the spec editing//.

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- C. Text and graphics shall be white surface applied vinyl of same material used for the text on the other signs.
- D. The post for mounting the message panels shall be //as indicated on the drawings//50mm (2") square extruded aluminum with powder coating //black//dark bronze//.

SPEC WRITERS NOTES:

- 1. Modify or delete the following paragraphs based upon the sign type for the project and the completeness of the details for this sign type on the drawings, details and notes.

2.22 //FLAG TYPE STREET SIGN//

- A. Message types for the signs shall be //Layout A//Layout B//Layout C//with respective lengths of //900mm (3')//760mm (2'6")//600mm (2'-0")// with text 50mm (2") in height centered in the 150mm (6") height panel dimension and starting 75mm (3") from the left edge of the message panel.
- B. The layout types for the signs as well as the text to be included in the respective sign panels shall be //as indicated on the drawings//as provided prior to the submittal process for the sign text with Layout A size being included in the bid//.

SPEC WRITER NOTES:

- 1. Select and edit the applicable paragraph "C" delete the others and edit as applicable.
- C. //Sign post types shall be extruded aluminum 100mm (4") square and //1200mm (4')//1800mm (6')// in height above finished grade. Color shall be created using a powder coated system, like that used by Victor Stanley for their benches or receptacles, //designer - select from SDG color chart//black//dark bronze// powder coated.//
- C. //Sign post types shall be concrete as specified in 04 30 00 Cast Stone Masonry concrete in two sections as follows:
 - 1. Overall sign post height shall be 1200mm (4'), with lower portion being 960mm (3'-2") in height and 140mm (5 1/2") square and upper portion being 250mm (10") in height and 100mm (4") square with flat top.
 - 2. The lower portion of the post shall be cast with a decorative recessed panel on each side of the post. The indent panels shall be 70mm (2 3/4") wide and 660mm (2'-2") high starting 75mm (3") below the top of the lower portion of the sign.

3. Edges of the posts shall be beveled with 75mm (3/4") bevels to create flat side faces 100mm (4") wide.
 4. The 75mm (3/4") bevels shall go around the top of the lower portion of the post create a flat surface onto which the upper portion 250mm (10") high shall be cast.
 5. The concrete post shall be reinforced as needed to prevent cracking, or other failure, if an external load is applied to the message panel sufficient to bend the panel. Design for the reinforcement shall be by a structural engineer// provided by the concrete manufacturer//provided by the project designer with details as indicated on the drawings//.
- C. //Sign post type shall be a combination concrete and metal in three different sections as follows:
1. Overall sign post height shall be 1800mm (6'), with lowest portion being 960mm (3'-2") in height and 140mm (5 1/2") square and middle portion being 600mm (2') in height and 100mm (4") square with flat top, with the upper portion being 50mm (2") square aluminum being set into the top of the 100mm (4") square middle section.
 2. The lowest portion of the post shall be cast with a decorative recessed panel on each side of the post. The indent panels shall be 70mm (2 3/4") wide and 660mm (2'-2") high starting 75mm (3") below the top of the lower portion of the sign.
 3. Edges of the lowest section of the posts shall be beveled with 75mm (3/4") bevels to create flat side faces 100mm (4") wide.
 4. The 75mm (3/4") bevels shall go around the top of the lowest portion of the post create to create a flat surface onto which the upper portion 600mm (2') high sharp cornered precast concrete section shall be cast.
 5. The lower two sections of the concrete post shall be reinforced as needed to handle the loads and attachment of the upper metal portion and the message panel, to prevent cracking, or other failure, if an external load is applied to the message panel sufficient to bend the panel. Design for the reinforcement shall be by a structural engineer// provided by the concrete manufacturer//provided by the project designer with details as indicated on the drawings//.
 6. The metal portion of this sign and its metal attachments shall have powder coated color system, like that of Victor Stanley for their

benches or receptacles, that shall be //designer - select from SDG
color chart//black//dark bronze// powder coated.//

- D. The message layout panels for all of these signs shall be assembled 50mm (2") down from the top of the sign post, regardless of the post type. They shall have the corners eased with a 6mm (1/4") radius.
- E. All of the construction details, including but not limited to, attachments, mounts, reinforcement, finish, texture, color, text, graphics shall be submitted as part of samples and shop drawings for the signs and shall be reviewed, modified as needed, until they are approved, before the actual signs are approved for manufacturing.

2.23 PYLON HANDICAPPED SIGN

- A. Pylon style signs shall be powder coated aluminum with powder coating system like that used by Victor Stanley for their benches and receptacles. The color shall be Handicapped Blue with a white handicapped symbol, and sized to be 50mm (2") deep, 150mm (6") wide, and 1500mm (5') above finished grade.
- B. Submit shop drawing showing the details of the physical pylon, the coating system as well as the colors and graphics as part of the submittal process.

PART 3 - EXECUTION

SPEC WRITER NOTES:

- 1. Modify the following paragraphs to be coordinated with the information indicated in the Drawings. Make sure that all of the items indicated herein below related to installation are clearly indicated in the drawings or specifications and that there is not conflicting information, or duplication of information.

3.1 INSTALLATION

- A. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist and set parallel or perpendicular as required to line and plane the surface.
- B. Signs shall be installed with direct burial of post into concrete as shown on Contract Drawings. Depth of posts shall be such that the bottom of the concrete surrounding the posts is at least below the frost, or as indicated in the drawings, whichever is the greater depth.
- C. Protect aluminum in contact with dissimilar metals or mortar as specified in Paragraph "PROTECTION OF ALUMINUM".

- D. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
- E. Provide anchoring devices and fasteners as shown and as necessary for securing signs to construction as specified.
- F. Utilize approved layout template for the installation of the cast metal lettering on the entry wall. Pins shall be securely anchored as detailed. Face of all lettering shall be in a constant plane, while at the same time minimizing the distance between the back of the letters and the stone wall. Maintain a minimum gap as detailed between the back of the letter and the face of the stone wall.
- G. Verify that behind or beneath each sign location there are no utility lines, or other buried infrastructure elements, that will be affected by installation of signs. Any damage during installation of signs to utilities, or other buried infrastructure will be the sole responsibility of the Contractor to correct and repair.
- H. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.
- I. ELECTRONIC READER BOARD SIGN INSTALLATION
 - 1. Extend separate 2" power and communication wire electrical conduits from location of existing electronic reader board sign conduits where shown to location of new electronic reader board sign. Replace or extend all existing power and communication wiring as required from Public Information Building to location of new electronic reader board sign. Verify power and communication wiring requirements with sign manufacturer.
 - 2. Install concrete footing and architectural precast concrete base to support electronic reader board sign. Verify sign location with Cemetery Director and Resident Engineer. Install sufficient anchors in concrete in accordance with sign manufacturer's instructions to support sign and wind loads. Verify architectural precast concrete base dimensions with sign manufacturer.
 - 3. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves

- to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
4. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
 5. Install new reader board sign in accordance with sign manufacturer's written instructions.
 6. Conduct on-site sign maintenance and operation training session with cemetery personnel. Schedule session in advance to meet cemetery personnel schedules.
- J. Furnish and install concrete collars and/or mow strips, with reinforcing to prevent cracking as well as expansion joints around the posts, or other elements of this section installed in the lawn areas, to allow for movement due to frost action. The mow strips shall be set so they are parallel to the finished grade around the sign posts, so mowers can drive around them without hitting the concrete, or going into a depression.
- K. Sign message panels shall be mounted using tamper-proof mechanical fasteners that are coated and colored to match the message panels.
- L. Install permanent caps on top of all aluminum posts.
- M. Mounting details and materials shall be provided as samples during the submittal process, and complete demonstration of all of the installation features, materials and methods shall be provided during the submittal process.

SPEC WRITER NOTES:

1. Modify the following as required to make the plaque installation match the details on the drawings and produce the intended mounting that addresses the substrate and provides the security desired for the mounting, following the discussion with the Project Manager.

3.2 PLAQUE INSTALLATION

- A. Install plaques as detailed on Contract Drawings and as follows:
1. For all plaques, a 25 mm (1-inch) diameter hole shall be drilled in the unit masonry or stone to receive the mounting pins. The plaque/emblems shall be attached with non-shrink grout placed into the holes with the plaques/emblems being set when the mortar is wet. Contractor shall hold the plaques until the mortar has set. The

plaques shall be set no more than 6 mm (1/4 inch) from the mounting substrate and shall be set plumb. A template of the mounting pins shall be made for each installation and the locations transferred to the masonry or stone substrate and locations approved by the owner's designated representative before the mounting holes are drilled.

2. Provide samples and drawings indicating all details of the installation as part of the submittal process. Submittals shall be revised and resubmitted until approved, and installation shall not proceed without approved submittals and/or samples.

3.3 CLEANING

- A. After installation, all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

3.4 PROTECTION

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

- -END- - -

SECTION 10 75 00
FLAGPOLES

SPEC WRITER NOTE:

1. Use this section only for NCA projects.
2. Delete between //----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // ____// requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Flagpole details of all parts & accessories, and list of all materials, including but not limited to: base with support plate and grounding spike, lightning kit, pole, flash collar, revolving

truck, internal halyard, cable assembly, winch detail w/lock, hooks, beaded retainer ring, counterweight, winch handle and finial ball, along with construction and installation details. Flagpole components shall match those for the main pole.

- C. Manufacturer's Literature and Data: Flagpole, base and all parts and accessories.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

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

A167-99 (R2009)	Stainless and Heat-resisting Chromium-Nickel Steel Plate, Sheet and Strip
B209-10	Aluminum and Aluminum Alloy-Sheet and Plate
B241/B241M-12	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

- C. American National Standards Institute Inc. (ANSI):

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

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of metal flagpoles and accessories, of types, size and configurations required, whose products have been is satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects having flagpole installation work similar to that required for this project.

SPEC WRITER NOTE:

1. Modify the following paragraph to describe the various flagpoles for this project. Provide the size, wind

speeds, flag size and wall thickness for each flagpole size to be provided. Wind speed shall be the minimum specified in the wind speed chart for the project location.

2. Modify these specifications and coordinate with the drawings, details and notes to ensure that the flagpole foundation has been sized according to the applicable wind load conditions for the respective flags and poles, and that the foundation design has been performed by a qualified structural engineer, based upon the soil conditions, and installation method for the flagpole.
3. The spec writer shall ensure that the design A/E has had a professional engineer do the foundation design and specify all of the size, reinforcing, and installation parameters. The drawings and specifications should be modified and coordinated to reflect the designed foundation parameters.

C. Design Criteria: Flagpole shall be designed to withstand the wind speeds and conditions indicated herein for the specific flagpole and flag sizes indicated. The 7.6 m (25 foot) flag pole shall be designed based upon a minimum sustained 160 kmph (100 mph) wind velocity and minimum wind gust velocity of 210 kmph (130 mph) when flying a flag 1.5m x 6.5m (5' x 8') in size in accordance with ANSI/NAAMM 1001-97, with the pole wall thickness being in conformance with the design standards but with a minimum wall thickness of 5mm (0.188 inches), whichever causes the stronger flagpole. The flagpole foundation(s) has/have been designed based upon applicable conditions for the project specific location of the respective flagpole.

1.7 PROTECTION AND SHIPPING

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

PART 2 - PRODUCTS

SPEC WRITER NOTE:

1. Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.

2.1 MATERIALS

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

2.2 FABRICATION

- A. Fabricate flagpole of seamless extruded aluminum tube, uniform conical taper of approximately 1 in 70, one centimeter in seventy centimeters (one inch in every 6 feet). Taper shall not exceed 50 percent of outside diameter of pole. When flagpoles are shipped in more than one section, provide self-aligning sleeves for field joint.
- B. Base: Aluminum plate or stainless steel, of stock design similar to that shown.
- C. Finial Ball: 2 mm (0.0747 inch) thick spun aluminum sphere, with seams of ball welded flush and watertight. Mount ball on threaded rod to fit truck. Diameter of ball shall be approximately same as pole butt diameter.
- D. Truck: Equip pole with extra heavy, revolving, non-fouling, ball bearing type truck with cast aluminum body and designed to accept an ornament on top.
- E. Halyards: Internal type cable assemblies. 3 mm (1/8") and/or 5 mm (3/16") stainless steel aircraft cable incorporating a stainless steel swivel, upper cable section, and flag arrangement with cable and two stainless steel quick links and two stainless steel swivel snaps. The cable assemblies shall be constructed to fit the flagpole size and flag size specified.
- F. Beaded Retainer Ring and Counterweights: Provide as recommended by manufacturer based on the pole size, flag size and design wind velocity. Provide recommended connection accessories.
- G. Internal Halyard Accessories: Furnish and install a gearless, self-locking at any point, direct drive winch that does not require welding for installation and does not require monthly application of lubrication and is attached to the pole with one stainless steel bolt on the back side of the pole. The unit shall be silver in color. Provide locking mechanism and two keys. Provide a winch handle designed for the unit. Pole shall be reinforced through the area of the winch opening by the manufacturer's standard reinforcement method.
- H. Foundation Tube: Hot dipped galvanized corrugated steel tube. Tube shall have a steel base plate and centering wedges and support plate

for connection of lightening kit. Bottom plate shall be a minimum of 5 mm (3/16") thickness.

SPEC WRITER NOTES:

1. Unless specifically directed otherwise by the PM, all of the flagpoles shall be designed and installed with the Manufacture's best lightening kit system.

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

2.3 FINISH

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

PART 3 - EXECUTION

3.1 INSPECTION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install galvanized, corrugated steel sleeve or tube of detailed length, welded to steel base plates for installation in concrete. Set base plate and Lightning Kit in place before concrete is placed. Follow the manufacturer's recommendations for the installation of the lightning kits.
- B. Install foundation plate and centering wedges for flagpole base in concrete base and fasten.
- C. Install concrete foundation work to dimensions indicated in accordance with Section 033053, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Wrap top of sleeve with two layers of asphalt felt for distance of 600 mm (2 feet) down.

- E. Install flagpole in accordance with manufacturers written installation instructions. Install pole plumb using centering wedges.
- F. Backfill and compact excavation around flagpole base in accordance with Section 312000, EARTH MOVING.
- G. Fill and thoroughly compact dry fine sand into the space between pole and steel sleeve and tamp to within 50 mm (2 inches) of top of sleeve.
- H. Remove temporary wood positioning wedges and fill upper 50 mm (2 inch) space between pole and steel sleeve with specified or manufacturer recommended waterproofing compound.
- I. Install fittings in accordance with manufacturer's written installation instructions.
- J. Check and adjust installed fittings for smooth operation of halyards.

3.2 LIGHTNING ROD

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

3.3 CLEANUP

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

- - - E N D - - -

SECTION 26 05 11 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 MINIMUM REQUIREMENTS

- A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

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

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

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within // four // eight // hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 MANUFACTURED PRODUCTS

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

1.6 EQUIPMENT REQUIREMENTS

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

1.7 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the COTR/Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the COTR/Resident Engineer. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

- E. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences. See Section 00 72 00, GENERAL CONDITIONS.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

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

1.10 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.11 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment

and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

- E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

- F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names,

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

6. Each type of light fixture specified in Section 26 51 00, INTERIOR LIGHTING or shown on the drawings.

1.12 SINGULAR NUMBER

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

1.13 PCB EQUIPMENT

- A. This project requires the removal, transport and disposal of electrical equipment containing Polychlorinated Biphenyl (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
- B. The equipment for removal is shown on the drawings.
- C. The selective demolition shall be in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1.14 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/Resident Engineer 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

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

1.2 RELATED WORK

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

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
 2. Certificates: Two weeks prior to final inspection, deliver to the // Resident Engineer // 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)
- C. National Fire Protection Association (NFPA):

70-08 National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-02 Thermoset-Insulated Wires and Cables

83-03 Thermoplastic-Insulated Wires and Cables

467-01 Electrical Grounding and Bonding Equipment

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

486C-02 Splicing Wire Connectors

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

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

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

514B-02 Fittings for Cable and Conduit

1479-03 Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING)

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

B. Single Conductor:

1. Shall be annealed copper.
2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.
2. Direct burial: 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/Resident Engineer.
2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped wires.

3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

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

2.4 WIRE LUBRICATING COMPOUND

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

2.5 FIREPROOFING TAPE

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

2.6 WARNING TAPE

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- H. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COTR/Resident Engineer.
 - 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

- A. 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.
- B. Fireproofing:
 - 1. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
 - 2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
 - 3. Secure the tape in place by a random wrap of glass cloth tape.

3.3 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.4 CONTROL AND SIGNAL WIRING INSTALLATION

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

3.5 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.

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

3.6 FEEDER IDENTIFICATION

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

3.7 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
 - 3. Do not install direct burial cables under railroad tracks.
- B. Under road and paved surfaces: Install cables in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (two inch) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
- C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.
- D. Cut the trenches neatly and uniformly:
 - 1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
 - 2. Place a 75 mm (3 inch) layer of sand in the trenches before installing the cables.
 - 3. Place a 75 mm (3 inch) layer of sand over the installed cables.
 - 4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inch) preservative impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
- F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.

G. Connections and terminations shall be submersible type designed for the cables being installed.

H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.8 EXISTING WIRING

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

3.9 FIELD TESTING

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

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SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

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

1.4 APPLICABLE PUBLICATIONS

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

- A. American Society for Testing and Materials (ASTM):
 - B1-2001 Standard Specification for Hard-Drawn Copper Wire
 - B8-2004 Standard Specification for Concentric-Lay-Stranded
Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-1983 IEEE Guide for Measuring Earth Resistivity, Ground
Impedance, and Earth Surface Potentials of a Ground
System
- C. National Fire Protection Association (NFPA):
 - 70-2008 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - 44-2005 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 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

- A. Copper clad steel, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.4 GROUND CONNECTIONS

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

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

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

2.6 GROUND TERMINAL BLOCKS

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

2.7 SPLICE CASE GROUND ACCESSORIES

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

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
 - 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. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system // // the ground bar at the service equipment .

F. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

H. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

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

M. Raised Floors: Provide bonding of all raised floor components. //See details on the drawings. //

3.4 CORROSION INHIBITORS

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

3.5 CONDUCTIVE PIPING

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

3.6 LIGHTNING PROTECTION SYSTEM

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

3.7 ELECTRICAL ROOM GROUNDING

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

3.8 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:
 - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
 - 2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
 - 3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.

3.9 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/Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 24 hours before the connections are ready for inspection.

3.10 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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SECTION 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Bedding of conduits: Section 31 20 11, EARTH MOVING.
- B. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

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

- A. Shop Drawings:
 - 1. Size and location of main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the COTR/Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):

- 70-08 National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
 - 1-05 Flexible Metal Conduit
 - 5-04 Surface Metal Raceway and Fittings
 - 6-07 Rigid Metal Conduit
 - 50-07 Enclosures for Electrical Equipment
 - 360-09 Liquid-Tight Flexible Steel Conduit
 - 467-07 Grounding and Bonding Equipment
 - 514A-04 Metallic Outlet Boxes
 - 514B-04 Fittings for Cable and Conduit
 - 514C-96 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
 - 651-05 Schedule 40 and 80 Rigid PVC Conduit
 - 651A-00 Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-07 Electrical Metallic Tubing
 - 1242-06 Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
 - TC-3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB1-07 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
 - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 - 2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
 - 3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
 - 4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
 - 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
 - 6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.

7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
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.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid aluminum conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
 - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.

- c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 4. Flexible steel conduit fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
- 5. Liquid-tight flexible metal conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 6. Direct burial plastic conduit fittings:
 - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.
- 7. 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, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1 1/2 by 1 1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR/Resident Engineer 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/Resident Engineer as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07

84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Install conduit as follows:
1. In complete runs before pulling in cables or wires.
 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 5. Mechanically and electrically continuous.
 6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
 7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 9. Conduit installations under fume and vent hoods are prohibited.
 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
 12. Do not use aluminum conduits in wet locations.
 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- C. Conduit Bends:

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

D. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR/Resident Engineer.

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 Resident Engineer/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 75 mm (3 inches) thick is prohibited.
 - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.

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

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
 1. Rigid steel or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 2. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 DIRECT BURIAL INSTALLATION

- A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
 1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
 2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.

3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
 4. Tops of conduits shall be as follows unless otherwise shown:
 - a. Not less than 600 mm (24 inches) below finished grade.
 - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
 6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 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 .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
 9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.
- B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):
1. Pre-coated rigid galvanized steel conduit in accordance with the requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.7 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.

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

3.8 MOTORS AND VIBRATING EQUIPMENT

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

3.9 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.

3.10 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the

conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2 1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

SECTION 26 05 41 UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of handholes and ducts to form a complete underground raceway system.
- B. "Duct" and "conduit", and "rigid metal conduit" and "rigid steel conduit" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

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

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.
 - 3. If necessary to locate ducts or handholes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the COTR/Resident Engineer for approval prior to construction.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR/Resident Engineer:
 - 1. Certification that the materials are in accordance with the drawings and specifications.

2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

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

A. American Concrete Institute (ACI):

Building Code Requirements for Structural Concrete

318/318M-2005 Building Code Requirements for Structural Concrete &
Commentary

SP-66-04 ACI Detailing Manual

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

C478/C478M 2009(b) Standard Specification for Precast Reinforced Concrete
Manhole Sections

C990 REV A 2008 Standard Specification for joints concrete pipe, Manholes
and Precast Box using performed flexible Joint sealants.

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

C2-2002 National Electrical Safety Code

D. National Electrical Manufacturers Association (NEMA):

RNI 2005 Polyvinyl Chloride (PVC) Externally Coated Galvanized
Rigid Steel Conduit and Intermediate Metal Conduit

TC 2 2003 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

TC 3-2004 PVC Fittings for Use With Rigid PVC Conduit And Tubing

TC 6 & 8 2003 PVC Plastic Utilities Duct For Underground Installations

TC 9-2004 Fittings for PVC Plastic Utilities Duct for Underground
Installation

E. National Fire Protection Association (NFPA):

70 2008 National Electrical Code (NEC)

F. Underwriters Laboratories, Inc. (UL):

6-2007 Electrical Rigid Metal Conduit-Steel

467-2007 Standard for Grounding and Bonding Equipment

651-2005 Standard for Schedule 40 and 80 Rigid PVC Conduit and
Fittings

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

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

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

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

PART 2 - PRODUCTS

2.1 FIBERGLASS HANDHOLES

- A. Shall be matched die molded of dark green fiberglass with approximate dimensions of 810 mm (32 inches) high, top surface of 1090 by 950 mm (43 by 37½ inches), and top opening of 810 by 660 mm (32 by 26 inches). When buried, the unit shall be capable of supporting an ultimate downward load of 2955 kg (6500 pounds) distributed over a 150 by 150 mm (6 by 6 inch) area imposed anywhere on the cover surface. Unit shall have precut 150 by 150 mm (6 by 6 inches) cable entrance at the center bottom of each side. A fiberglass weatherproof cover with nonskid surface shall be provided for each handhole. Covers shall be capable of being locked into position.

2.2 DUCTS

- A. Number and sizes shall be as shown on drawings.
- B. Ducts (concrete encased):
1. Plastic Duct:
 - a. // NEMA TC6 & 8 and TC9 plastic utilities duct // // UL 651 and 651A Schedule 40 PVC //.
 - b. Duct shall be suitable for use with 90 degree C rated conductors.
 2. Conduit Spacers: Prefabricated plastic.
- C. Ducts (direct burial):
1. Plastic duct:
 - a. NEMA TC2 and TC3
 - b. UL 651, 651A and 651B, // Schedule 40 // // Schedule 80 // PVC or HDPE.
 - c. Duct shall be suitable for use with 75 degree C rated conductors.
 2. Rigid metal conduit, PVC-coated: UL6 and NEMA RN1 galvanized rigid steel, threaded type, coated with PVC sheath bonded to the galvanized exterior surface, nominal 1 mm (0.040 inch) thick.

2.3 GROUNDING

- A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS and UL 467
- B. Ground Wire: Stranded bare copper 16 mm² (6 AWG) minimum.

2.4 WARNING TAPE:

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

2.5 PULL ROPE:

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

PART 3 - EXECUTION

3.1 HANDHOLE CONSTRUCTION AND INSTALLATION

- A. General Requirements:
 - 1. Locate handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.
- B. Access for Handholes: Make the top of frames and covers flush with finished grade.

3.2 TRENCHING

- A. Refer to Section 31 20 00, EARTH MOVING Section 31 20 11 EARTH MOVING (SHORT FORM) for trenching back-filling, and compaction.
- B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- C. Cut the trenches neatly and uniformly.
- D. For Concrete Encased Ducts:
 - 1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1200 mm (4 foot) intervals to establish the grade and route of the duct bank.
 - 2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings wherever possible.
 - 3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
 - 4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, with appropriate warning tape attached.

- E. Conduits to be installed under existing paved areas, roads, and railroad tracks that are not to be disturbed shall be jacked into place. Conduits shall be PVC-coated rigid metal.

3.3 DUCT INSTALLATION

A. General Requirements:

1. Ducts shall be in accordance with the NEC and IEEE C2, as shown on the drawings, and as specified.
2. Slope ducts to drain towards handholes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be PVC-coated galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) outside of building foundation.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be PVC-coated galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) away from edge of slab.
5. Install insulated grounding bushings on the terminations.
6. PVC-coated rigid steel conduits shall be coupled to the ducts with suitable adapters, and the whole encased with 75 mm (3 inches) of concrete.
7. PVC coated rigid steel conduit turns of direction for all duct lines shall have minimum 1200 mm (4 feet) radius in the horizontal and vertical directions. PVC conduit sweeps for all duct lines shall have a minimum 12000 mm (40 feet) radius in the horizontal and 1200 mm (4 feet) in the vertical directions. Where a 12000 mm (40 feet) radius is not possible, horizontal turns of direction shall be rigid steel.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above bottom of trench during the concrete pour. Spacer spacing shall not exceed 1500 mm (5 feet).
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, and chilled water.
10. Clearances between individual ducts:
 - a. For like services, not less than 75 mm (3 inches).
 - b. For power and signal services, not less than 150 mm (6 inches).
 - c. Provide plastic spacers to maintain clearances.
 - d. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.

11. Duct lines shall terminate as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to insure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.
14. Duct Bank Markers:
 - a. Duct bank markers, where required, shall be located at the ends of duct banks except at handholes at approximately every 60 meter (200 feet) along the duct run and at each change in direction of the duct run. Markers shall be placed 600 mm (2 feet) to the right of the duct bank, facing the longitudinal axis of the run in the direction of the electrical load.
 - b. The letter "D" with two arrows shall be impressed or cast on top of the marker. One arrow shall be located below the letter and shall point toward the ducts. Second arrow shall be located adjacent to the letter and shall point in a direction parallel to the ducts. The letter and arrow adjacent to it shall each be approximately 75 mm (2 inches) long. The letter and arrows shall be V-shaped, and shall have a width of stroke at least 6 mm (1/4 inch) at the top and a depth of 6 mm (1/4 inch).
 - c. In paved areas, the top of the duct markers shall be flush with the finished surface of the paving.
 - d. Where the duct bank changes direction, the arrow located adjacent to the letter shall be cast or impressed with an angle in the arrow the same as the angular change of the duct bank.

C. Direct Burial Duct and Conduits:

1. Install direct burial ducts and conduits only where shown on the drawings. Provide direct burial ducts only for low voltage systems.
2. Join and terminate ducts and conduits with fittings recommended by conduit manufacturer.
3. Direct burial ducts and conduits are prohibited under railroad tracks.
4. Tops of ducts and conduits shall be:
 - a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.

- b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
- 5. Do not kink the ducts or conduits.
- D. Concrete-Encased and Direct Burial Duct and Conduit Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts or conduits before backfilling trenches. Warning tape shall be preprinted with proper identification.
- E. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
- F. Duct and Conduit Cleaning:
 - 1. Upon completion of the duct bank installation or installation of direct buried ducts, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 3600 mm (12 inches) long, and shall have a diameter not less than 13 mm (1/2 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than the diameter of the duct.
 - 2. Mandrel pulls shall be witnessed by the COTR/Resident Engineer.
- G. Duct and Conduit Sealing: Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.
- H. Connections to Existing Manholes: For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.
- I. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the duct banks and remove loose concrete from the conduits before installing new concrete-encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.
- J. Partially Completed Duct Banks: During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct

bank with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (1 foot) apart. Restrain reinforcing assembly from moving during pouring of concrete.

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SECTION 26 29 21 DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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. Motor rated toggle switches: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- E. 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/COTR 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/COTR 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-06 Enclosed and Miscellaneous Distribution Equipment
Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
70-08 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
98-04 Enclosed and Dead-Front Switches
198C-06 High-Interrupting-Capacity Fuses, Current Limiting Types
198E-04 Class R Fuses
977-03 Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.1 LOW VOLTAGE FUSIBLE 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. Fuse holders for the sizes and types of fuses specified.

7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground Lugs: One for each ground conductor.
9. 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 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

2.3 LOW VOLTAGE FUSIBLE SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

- A. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, except for the minimum duty rating which shall be NEMA classification Heavy Duty (HD). These switches shall also be horsepower rated.

2.4 MOTOR RATED TOGGLE SWITCHES

- A. Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for motor rated toggle switches.

2.5 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 6 mm (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.
- B. Fusible disconnect switches shall be furnished complete with fuses.

3.2 SPARE PARTS

- A. 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 RESIDENT ENGINEER/COTR.

--- E N D ---

SECTION 31 20 11 EARTH MOVING (SHORT FORM)

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

1.2 DEFINITIONS

- A. Unsuitable Materials:
1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
 2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proof rolling, or similar methods of improvement.
 3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer's approval.
- B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trench work throughout the job site.
- C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in ASTM D698.
- D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 01 00 00, GENERAL REQUIREMENTS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Classified Excavation: Removal and disposal of all material not defined as rock.
- C. Rock Excavation:
1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).
 2. Bedded or conglomerate deposits so cemented as to present characteristics of solid rock which cannot be excavated without blasting; or the use of a modern power excavator (shovel, backhoe, or similar power excavators) of no less than 0.75 m³ (1 cubic yard) capacity, properly used, having adequate power and in good running condition.
 3. Boulders or other detached stones each having a volume of 0.4 m³ (1/2 cubic yard) or more.

1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

- A. Measurement: Cross section and measure the uncovered and separated materials, and compute quantities by the Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:
1. 300 mm (12 inches) outside of the perimeter of formed footings.
 2. 600 mm (24 inches) outside the face of concrete work for which forms are required, except for footings.
 3. 150 mm (6 inches) below the bottom of pipe and not more than the pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
 4. The outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).
- B. Payment: No separate payment shall be made for rock excavation quantities shown. The contract price and time will be adjusted for overruns or underruns in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
 - 1. Certification of rock quantities excavated.
 - 2. Excavation method.
 - 3. Labor.
 - 4. Equipment.
 - 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 - 6. Plot plan showing elevations.
- C. Furnish to Resident Engineer, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.

1.7 APPLICABLE PUBLICATIONS

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

PART 2 – PRODUCTS

2.1 MATERIALS

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

PART 3 – EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the Resident Engineer. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do not leave material within the burial profile up to 2400 mm (8 feet) below finished grade.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the Resident Engineer. Remove materials from the Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc.

Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which

are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs that are to remain, than the farthest extension of their limbs.

- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the Resident Engineer. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.
1. Cemetery Projects: Recommend that the top soil be tested for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established.
 2. 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 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Cemetery Property.
- E. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
 - 1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
 - 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.
- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel.
- C. Blasting: Blasting shall be permitted only when authorized by the Resident Engineer. Blasting shall be done with explosives of such quantity and power, and fired in such sequence and locations as to not injure personnel, damage or crack rock against which concrete is to be placed, damage property, or damage existing work or other portions of new work. The Contractor shall be responsible for damage caused by blasting operations.
- D. Building Earthwork:
 - 1. Excavation shall be accomplished as required by drawings and specifications.
 - 2. Excavate foundation excavations to solid undisturbed subgrade.
 - 3. Remove loose or soft material to solid bottom.
 - 4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
 - 5. Do not tamp earth for backfilling in footing bottoms, except as specified.
- E. Trench Earthwork:
 - 1. Utility trenches (except sanitary and storm sewer):

- a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the Resident Engineer.
2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. The bottom quadrant of the pipe shall be bedded on undisturbed soil or granular fill.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
 - c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.
- F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Testing of the soil shall be performed by the VA Testing Laboratory. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and

CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable.

Adjustments to be based on meters (yardage) in cut section only.

G. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas - 100 mm (4 inches) below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING

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

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 1800 mm (6 feet).
- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the Resident Engineer at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS

- A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by Resident Engineer before seeding or sodding operation begins.
- B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 100 mm (4 inches) of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Cemetery property. Stockpile or spread soil as directed by Resident Engineer.

1. 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. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.6 CLEAN-UP

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

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SECTION 31 23 19 DEWATERING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies performance of dewatering work required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction work to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all labor, materials, tools, equipment, power and services necessary for care of water and erosion control. Excavation work shall not begin before the approved Erosion and Sedimentation Control Plan and Storm Water Pollution and Prevention Plan (SWPPP) are in place.

1.3 REQUIREMENT

- A. Dewatering system shall be of suitable facilities with sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least // 300 mm (1 foot) // below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface and/or that localized excavations are dewatered sufficiently to conduct the work in dry conditions until the backfill has been completed at least 300 mm (1-foot) above the initial observed groundwater level .
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.

- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
 2. Erosion is controlled.
 3. Flooding of excavations or damage to structures does not occur.
 4. Surface water drains away from excavations.
 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.
- G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- E. Excavation, backfilling, site grade and utilities: Section 31 20 11, EARTH MOVING.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
 2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal. Details of the dewatering facilities, including equipment and erosion protection facilities shall be submitted. The submittal

materials shall include facilities and procedures for insuring discharge water quality in accordance with the applicable provisions of the Erosion Control Plan and/or SWPPP and/or NPDES requirements.

3. Include a written report outlining control procedures to be adopted if a dewatering problem arises.
 4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.
- C. Inspection Reports.
- D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of // 300 mm (1 foot) // below prevailing excavation surface at all times.

3.2 OPERATION

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL

- A. Dispose of water removed from the excavations in such a manner as:
 - 1. Will not endanger portions of work under construction or completed.
 - 2. Will cause no inconvenience to Government or to others working near site.
 - 3. Will comply with the stipulations of required permits for disposal of water.
 - 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
 - 1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
 - 2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
 - 3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
 - 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT

- A. Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION

- A. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage

to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES

- A. Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL

- A. Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

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

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown.

Construction shall include the following:

- B. Curb, gutter, and combination curb and gutter.
- C. Pedestrian Pavement: Walks, flower/water stations, mow strips, wheelchair curb ramps, plaza areas
- D. Vehicular Pavement: Maintenance yards
- E. Equipment Pads: irrigation field satellites and other equipment.

1.2 RELATED WORK

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

1.3 DESIGN REQUIREMENTS

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

1.4 WEATHER LIMITATIONS

- A. Placement of concrete shall be as specified under Article 3.4 E., for Cold Weather Placement and Article 3.4 D., for Cold Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Resident Engineer, 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 following:

- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Hot poured sealing compound
 - 3. Reinforcement
 - 4. Curing materials
- C. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 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):
 - M31-07 Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)
 - M55M/55M-09 Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)
 - M147-04 Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)
 - M148-05 Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)
 - M171-05 Sheet Materials for Curing Concrete (ASTM C171)
 - M182-05 Burlap Cloth Made from Jute or Kenaf
 - M213-05 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
 - T99-09 Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
 - T180-09 Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
- C. American Society for Testing and Materials (ASTM):

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

PART 2 - PRODUCTS

2.1 GENERAL

- A. Concrete shall be Type C, air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.
- D. Fiber Reinforcement-Polypropylene fibers designed for use in concrete pavement ASTM C1116 Type III 13 to 38 mm (1/2 to 1 1/2 inches) long. Use 2.27 Kg (5lbs) per .76 M³ (1 cubic yard) of concrete in batch.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.

- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.
- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

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

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.

2.6 EXPANSION JOINT FILLERS

Material shall conform to Florida Department of Transportation standards.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- 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 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
2. When the designated compacted thickness exceeds 150 mm (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 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in 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:

Test the completed subbase for grade and cross section with a straight edge.

1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (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 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 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 Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 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 Resident Engineer 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.
- C. Synthetic fiber in flatwork: Uniformly disperse in concrete mixture at a rate of not less than 5 lb/cy.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the Resident Engineer before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer 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 PAVEMENTS

- 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 CONCRETE FINISHING - GENERAL

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

3.9 CONCRETE FINISHING CURB AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain.
- H. Visible surfaces and edges of finished curb, gutter, and combination curb and gutters shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.10 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks, flower/water stations, mow strips, wheelchair curb ramps, plaza areas:
1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
 2. Brooming shall be transverse to the line of traffic.
 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.

4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
 6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- 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 5 mm (3/16 inch).

3.11 JOINTS - GENERAL

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

3.12 CONTRACTION 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 3 mm (1/8 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.

3.13 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.

3.14 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.

3.15 FORM REMOVAL

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

3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature

changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.

- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) for both coats.
 - 2. Do not allow the concrete to dry before the application of the membrane.
 - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
 - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.17 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.
 - 3. After removal of all foreign matter from the joints, seal joints as herein specified.
 - 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, 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 Resident Engineer.

3.19 FINAL CLEAN-UP

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

- - - E N D - - -

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, Pavement Sealing, Cold Milling, and Patching. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.
- B. The Contractor shall retain and reimburse a laboratory to perform said duties; or to obtain a certification from the authorized representative of the State; or to obtain certification from the asphalt paving producer. Certificate of compliance shall cover quality and gradation of aggregate base, quality and grades of asphalt course materials, and that the job-mixture meets or exceeds the State requirements.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 11 EARTH MOVING (SHORT FORM).

1.3 INSPECTION OF PLANT AND EQUIPMENT

The Resident Engineer 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

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 State Highway Department.
 - 2. Porous Asphalt and Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
 - 3. Job-mix formula.
 - 4. Data for concrete curb stops.
- C. Certifications:
 - 1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
 - 2. Asphalt cement certificate of conformance to State Highway Department requirements.
 - 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of Florida Department of Transportation Specifications (Latest Version).
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - HM29M..... Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 29th Edition and AASHTO Provisional Standards, 2009 Edition
 - MP1..... Specification for Performance Graded Asphalt
 - T 283..... Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
- C. American Society for Testing and Materials (ASTM):

- ## PART 2 - PRODUCTS

A. Aggregate base, Asphaltic base, Sealing Materials and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA COTR.

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
 - 1. Base course over 152mm(6") thick: 38mm(1-1/2");
 - 2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:

1. Maximum particle size not to exceed 25.4mm(1").
 2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 NON-WOVEN GEOTEXTILE FABRIC

- A. Fabric shall consist of needled nonwoven polypropylene fibers and meet the following properties:
1. Grab Tensile Strength (ASTM-D4632) \geq 120 lbs.
 2. Mullen Burst Strength (ASTM-D3786) \geq 225 psi
 3. Flow Rate (ASTM-D4491) \geq 95 gal/min/ft²
 4. UV Resistance after 500 hours (ASTM-D4355) \geq 70%
 5. Heat-set or heat-calendared fabrics are not permitted.
 6. Mirafi 140N, Amoco 4547, Geotex 451, or approved equal.

2.4 ASPHALTS

- A. Comply with provisions of Asphalt Institute Specification SS2:
1. Asphalt cement: Penetration grade 50/60
 2. Prime coat: Cut-back type, grade MC-250
 3. Tack coat: Uniformly emulsified, grade SS-1H

2.5 SEALER

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

- B. Where conflicts arise between this specification and the requirements in the latest version of the Florida Department of Transportation Specifications, the Florida Department of Transportation Specifications shall control.

2.6 ANCILLARY MATERIALS

- A. Herbicide; Commercial chemical for weed control, registered by EPA. Provide in granular, liquid or wettable powder form.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the Florida Department of Transportation Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
 - 2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.
- F. Herbicide Treatment: Apply herbicide according to manufacturers recommended rate and written application instructions. Apply to dry subgrade of surface of compacted aggregate base before applying paving materials.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
 - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
 - 1. Spread material in a manner that requires the least handling.

2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 COLD MILLING

- A. Clean existing pavement surface of loose or deleterious material immediately before cold milling. Remove existing asphalt pavement to grades and cross sections indicated.
 1. Mill to a depth of 50mm (2 inches).

3.8 PATCHING

- A. Hot Mix Asphalt Pavement: Sawcut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 300mm (12 inches) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing aggregate base course to provide new subgrade.
- B. Tack Coat: Apply uniformly to vertical and horizontal surfaces abutting area to receive new hot mix asphalt paving at a rate of 0.2 to 0.7 L/sq.M. (0.05 to 0.15 gal./sq. yd).
 1. Allow tack coat to cure before applying hot mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, remove spillage and clean affected surfaces.
- C. Patching: Fill excavated pavement with hot mix asphalt base mix for full thickness of patch; while still hot compact flush with adjacent pavement surface.

3.9 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.10 FINAL CLEAN-UP

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

- - - E N D - - -

SECTION 32 30 00 SITE FURNISHINGS

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Furnish and install the Gravesite Layout Markers at the specified locations.
 2. Furnish and install the Flower-watering stations, including trash receptacles, water spigot, and flower vase container and complete any required work necessary to make the water supply equipment operate using the water supply source indicated.

1.3 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
1. Section 03 30 53: CAST-IN-PLACE-CONCRETE

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
1. General: For each item specified in description of work or Part 2 - Products, provide information showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.
 2. Provide templates and rough-in measurements as required.
 3. Provide samples of full range of colors and finishes available for review and approval, prior to ordering.

1.5 REFERENCE STANDARDS

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

- A. American Society for Testing and Materials (ASTM):
B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire,
Shapes, and Tubes
- B. American Welding Society (AWS):
D1.2-97 Structural Welding Code Aluminum
- C. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 – PRODUCTS

2.1 GRAVESITE LAYOUT MARKERS

- A. General: Gravesite layout markers for this project shall consist of both Gravesite Grid Monuments and Gravesite Grid Markers.
 - 1. Gravesite grid monuments shall be comprised of a bronze survey marker (monument marker) set into a cast-in-place concrete base.
 - a. Materials:
 - 1) Monument Base: Cast-in-place concrete monument base shall be a minimum of 24.1 MPa (3,500 psi) @ 28 days, reinforced as shown on details; dimensions as shown on Contract Documents.
 - 2) Monument Marker: Domed-top, 89 mm (3 1/2") diameter, domed bronze concrete survey marker with integral locator magnet, and flared anchor post for securing to concrete.
 - 2. Gravesite Grid Markers shall be comprised of a bronze survey rebar cap (Grid Marker) set onto a No. 10 soft metric (No. 6) rebar.
 - a. Materials:
 - 1) Rebar: No. 10 soft metric (No. 6) rebar with dimension as shown on Contract Drawings.
 - 2) Grid Marker: Domed-top, 81 mm (3 1/4") diameter, forged aluminum concrete marker with plastic insulator that receives and secures, with a non-wobbly attachment, the No.10 soft metric (No. 6) rebar and isolates the bronze from the steel.
- B. Text and Cross-hairs: Text of top as shown on Contract Drawings; text all caps with height to be 4.75 mm (3/16"). Cross hairs shall be field engraved as shown on the Contract Drawings, aligned with the gravesite grid and engraved based upon Contractor-surveyed location data.

- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, those manufacturer's that can demonstrate, during the submittal process, that they have provided these products as part of successful installations matching the specifications and drawings, at a minimum of three VA National Cemeteries.

2.2 FLOWER WATERING STATIONS: GENERAL

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

2.3 TRASH RECEPTACLE

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

B. MATERIALS

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

with lightweight construction using critical molded ribs, integral handholds, and high strength materials. This style of inner liner shall minimize handling difficulty and facilitate easy emptying and storage while affording long service life.

C. REQUIRED OPTIONS

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

D. FINISHES

1. Project location has been determined to be a high salt abusive climate. Hot dip galvanizing before powder coating is required. Hot dip galvanizing will provide greater protection in salty climates but yields a slightly less smooth coating finish. All of the fabricated metal components and castings shall be hot dip galvanized.

2.4 FLOWER VASE RECEPTACLE

A. Flower vase receptacles shall match existing.

B. MATERIALS:

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

2.5 WATER SPIGOT ASSEMBLIES

- A. Water spigots shall be constructed as indicated on the drawings. The water spigot indicated on the drawings shall be an ADA compliant spigot operated with a paddle that allows the water to flow when pushed either right or left, with 2 Kg (5 lbs) of force or less. The assembly shall be installed with a pressure regulating valve and isolation valve installed in the meter box and the assembly is to be (blown out) if located in a region where the temperatures seasonally go below freezing. The spigot assembly shall contain all pipes, fittings, attachments, mounting base, and any other ancillary materials or equipment to produce a fully functional water spigot assembly, as indicated on the drawings, from the connection to the irrigation water system at the isolation valve for the spigot.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the Resident Engineer.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Gravesite Grid Monuments and Markers:
1. All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. Units will be installed in complete accordance with manufacturers' recommendations and as shown the Contract Drawings.

2. Cross-hairs on bronze monuments and marker shall be field inscribed, based upon accurate Contractor-survey: refer to Contract Drawings.

B. Flower Watering Stations:

1. Stake location of flower watering stations and obtain approval from Owner's Representative prior to forming concrete pad. Install concrete pad in accordance with 033000 – CAST-IN-PLACE CONCRETE.
2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions. Following installation of water spigot, install washed stone for splash area.
3. Install water spigot assemblies according to manufacturer's recommendations, including pipe, isolation valve, fittings, pressure reducing valve and valve boxes. All anchoring hardware shall be stainless steel. Coordinate all work with other trades.

3.4 CLEAN UP

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

- - - E N D - - -

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

SPEC WRITER NOTES: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

SPEC WRITER NOTE: This paragraph
describes the typical chain link fencing
for Cemetery projects. Adjust as required
when fencing is placed other than as
security of the
Administration/Maintenance complex for
the Cemetery. As an example, when a total
perimeter fence is installed around the
Cemetery.

1. Zinc-coated chain link fence, gates and accessories.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain
references only when specified elsewhere
in this section.

- A. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Concrete Footings: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Gate Hardware: Section 08 71 00, DOOR HARDWARE.
- D. Fence Color: Section 09 06 00, SCHEDULE FOR FINISHES.
- E. Grounding: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- F. Finish Grading: // Section 31 20 00, EARTH MOVING //, and Section 32 90 00, PLANTING //.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
 1. A121-13 - Metallic Coated Carbon Steel Barbed Wire.
 2. A392-11a - Zinc-Coated Steel Chain-Link Fence Fabric.
 3. A817-12 - Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
 4. F567-14a - Installation of Chain-Link Fence.

5. F626-14 - Fence Fittings.
 6. F668-11 - Polyvinyl Chloride (PVC) and other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
 7. F900-11 - Industrial and Commercial Swing Gates.
 8. F934-96 (R2013) - Standard Colors for Polymer-Coated Chain Link Fence Materials.
 9. F1083-16 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
 10. F1184-16 - Industrial and Commercial Horizontal Slide Gates. Federal Specifications (Fed. Spec.):
- C. American Welding Society (AWS):
1. D1.2/D1.2M-14 - Structural Welding Code - Aluminum.
- D. Federal Specifications (Fed. Spec.):
1. // FF-P-110H - Padlock, Changeable Combination //.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

SPEC WRITER NOTE: Include shop drawings
requirement for sliding gates.

- B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.
 2. // Coordinate with wall manufacturer for appropriate wall and fence construction details to withstand applicable horizontal and vertical loadings //.
- C. Manufacturer's Literature and Data:
1. Description of each product.
 2. Installation instructions.
 3. Warranty.
- D. Samples:
1. // Polymer Coated Product: 150 mm (5 inch) // long // square //, each type and color //.
 - a. // Submit quantity required to show full color // and texture // range //.
 2. Accessories: Full sized, complete assembly.
 3. Approved samples may be incorporated into work.

SPEC WRITER NOTE: Alignment Certification requirement is for property line fencing or similar purpose requiring accurate alignment.

- E. Certificates: Certify // each product complies // products comply // with specifications.
 - 1. Fence alignment.
 - 2. Zinc-coating.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer // with project experience list //.
 - 2. Installer // with project experience list //.
- G. Operation and Maintenance Data.
 - 1. Care instructions for each exposed finish product.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //
- B. Installer Qualifications:
 - 1. Regularly installs specified products.
 - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects //.
- C. Surveyor Qualifications:
 - 1. Trained and experienced to provide services typically provided by a surveyor as defined by state law in the project location.
 - 2. Registered // Licensed // professional qualified to perform survey services in the project location.
- D. Welders and Welding Procedures Qualifications: // AWS D1.1/D1.1M. // AWS D1.3/D1.3M. //

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, // color, // production run number, and manufacture date.

- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Protect products from damage during handling and construction operations.

1.8 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

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

SPEC WRITER NOTE: Specify extended manufacturer's warranties for materials only.

- B. Manufacturer's Warranty: Warrant // specified item // against material and manufacturing defects.

SPEC WRITER NOTE: Specify customarily available warranty period for specified products.

- 1. Warranty Period: Five years.

SPEC WRITER NOTE: Update Product requirements to comply with applicable requirements (Types, Grades, Class, Tables, etc.) as determined based upon design determination, following the applicable portions of NCA Facilities Design Guide.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Provide fences and gates from one manufacturer.

SPEC WRITER NOTES:
1. Comply with NCA Facilities Design Guide for sizing and spacing of materials indicated in Part 2. Provide information in specifications or on Drawings

indicating sizes and properties of products used for fencing system.
2. Follow NCA Facilities Design Guide requirement for chain link fencing system manufactured as galvanized steel, with PVC coating, color as selected during submittal process from manufacturer's standard colors.

2.2 CHAIN-LINK FENCE

- A. Materials: ASTM F1083 and ASTM A392 ferrous metals, zinc-coated.

// ASTM F668 //.

1. // ASTM A934 PVC coating system of color indicated //.

SPEC WRITER NOTE: In dry climates of Southwest States specify 340 g/m² (1.2 oz./sq. ft.) coating in Paragraph 2.2 Elsewhere specify 570 g/m² (2 oz./sq. ft.). Specify heavier coating or other material for use in salt-laden or corrosive industrial atmospheres.

- B. Chain-Link Fabric: ASTM A392 9 gage wire woven in 50 mm (2 inch) mesh.

Knuckle top and bottom selvage. Zinc-coating weight // 340 // 570 // grams/sq. m (// 1.2 // 2.0 // ounces per square foot).

- C. Post: ASTM F1083, Grade SK-40A, round, zinc-coated steel. Size and type as indicated on Drawings. Provide post braces and truss rods for each gate, corner, pull or end post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

SPEC WRITER NOTE: Except for conditions where matching existing, omit top rails for main fence, follow NCA Facilities Design Guide for details. Generally provide tension wire for top of fence and bottom rail, secured to posts with wire ties and not pipe caps intended for carrying top rails.

- D. Top Rail and Bottom Rail: ASTM F1083, Grade SK-40A, round, zinc-coated steel.

- E. Top and Bottom Tension Wires: ASTM A817 and ASTM F626, zinc-coated, with minimum coating same as fence fabric.

SPEC WRITER NOTE: Include Paragraphs F and G when barbed wire is required. See NCA Facilities Design Guide for information regarding barbed wire.

- F. // Barbed Wire Support Arms: ASTM F626, single arm type, steel or malleable iron //.
- G. // Barbed Wire: ASTM A121, zinc-coated steel wire and barbs; standard size and construction, 2.51 mm (0.099 inch) diameter line wire with 2.03 cm (0.080 inch) diameter, 2-point barbs //.

2.3 GATES

- A. Swing Gates: ASTM F900, type as indicated on Drawings. Zinc-coating weight same as fabric.
 - 1. // Gate leaves more than 2400 mm (8 feet) wide, provide intermediate members and diagonal truss rods or tubular members, free from sag or twist //.
 - 2. // Gates less than 2400 mm (8 feet) wide, provide truss rods or intermediate braces //.
 - 3. Attach fabric to frame according to manufacturer's instructions, except welding is not be permitted. Arrange latches for padlocking with padlock accessible from both sides regardless of latching arrangement. // Extend gate frame end member above top member or provide three strands of barbed wire in horizontal alignment //.

SPEC WRITER NOTE: For double gates, use subparagraph A.

- B. Chain Link Cantilever Slide Gate: ASTM F 1184, Type II, Class 2.
 - 1. Frames: ASTM B 221, aluminum, alloy and temper 6063-T6, 50 mm (2 inch) square, 1.4 Kgs/M (0.94 lb./ft.) in weight. Weld members together forming rigid one-piece frame integral with top track. Provide 2 truck assemblies each gate leaf.
 - 2. Gate Fabric Assembly: Attach fabric to frame with hook bolts and tension bars at 4 sides, maximum 375 mm (15 inches) on center.
 - a. Bracing: 9 mm (3/8") galvanized steel diagonal adjustable length truss rods, each panel.
 - b. Top Track and Rail: Extruded aluminum, enclosed combination one-piece track and rail, 6 mm (3.72 lb./ft.) in weight. Track to withstand reaction load of 900 kg (2,000 lbs.).

- c. Truck assembly: Swivel type, zinc die cast, with 4 sealed lubricant ball bearing rollers, 50 mm (2 inches) in diameter by 14 mm (9/16") in width, and 2 side rolling wheels. Mount trucks on post brackets with 22 mm (7/8") diameter ball bolts and 13 mm (1/2") shank. Truck assembly to withstand same reaction load as track.
- d. Gate Hangers, Latches, Brackets, Guide Assemblies, and Stops: Malleable iron or steel, galvanized after fabrication. Provide positive latch with provisions for padlocking.
- e. Bottom Guide Wheel Assemblies: 75 mm (3") diameter rubber wheels, and straddling bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. Attach one assembly to each guidepost.
- f. Gates Posts: ASTM F 1083 galvanized steel, 100 mm (4") OD Schedule 40 pipe, 14 Kgs/M (9.1 lb./ft.) in weight. Provide 1 latch post and 2 support posts for single slide gate.
- g. Gate Finish: PVC Vinyl Coated (except track/bottom guide wheel assemblies) 250 to 375 microns (10 to 15 mils) thick thermally fused, ASTM Class-2b, black color.

2.4 HARDWARE

- A. General: Manufacturer's standard products, installed complete.
- B. Hinges: 180 degree gate hinges per leaf.

SPEC WRITER NOTE: retain stop and keepers for double gates over 8 feet in width.

- C. // Stop and Keepers: Arrange latches with plunger-bar for locking to engage center stop. Provide keepers with mechanical device to secure free end of gate when in full open position //.

SPEC WRITER NOTE: When job specification does not have Section 08 71 00, DOOR HARDWARE, omit Subparagraph D below and substitute with Subparagraph E.

- D. Padlocks: As specified under Section 08 71 00, DOOR HARDWARE. Provide padlock chains, securely attached to gate or gate post.
- E. // Equip gate openings with padlock. Comply with Fed. Spec. FF-P-110H, Type EPC, size 50 mm (2 inch). Securely attached padlock with chain to gate or gate post. Key padlock as directed by Contracting Officer's Representative (COR) //.

2.5 CONCRETE

- A. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

2.6 ACCESSORIES

- A. General: ASTM F626, caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories.
- B. Primers:

SPEC WRITER NOTE: Retain barrier coating to separate dissimilar metals and to separate metals from cementitious materials.

- C. Barrier Coating: ASTM D1187/D1187M.
- D. Welding Materials: AWS D1.2/D1.2M, type to suit application.
- E. Galvanizing Repair Paint: MPI No. 18.
- F. Touch-Up Paint: Match shop finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.

SPEC WRITER NOTE: Retain existing fence and gate paragraph below when required.

- B. Protect existing construction and completed work from damage.
- C. Remove existing fence and gate to permit new installation.
 - 1. Retain existing fence and gate for reuse.
 - 2. Dispose of // other // removed materials.
- D. Correct substrate deficiencies.
 - 1. Fill.
 - 2. Grind.
 - 3. Level.
- E. Apply barrier coating to aluminum surfaces in contact with // dissimilar metals // and cementitious materials // to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION - // GENERAL // CHAIN LINK FENCES AND GATES //

- A. General: Comply with ASTM F567. Install products according to manufacturer's instructions // and approved submittal drawings //.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.

SPEC WRITER NOTE: Use Subparagraph B for
Property Line Fencing or similar purpose
requiring accurate fence alignment.

- B. Registered Professional Land Surveyor or Registered Civil Engineer specified in Section 01 00 00, GENERAL REQUIREMENTS, will stake out and certify fence alignment meeting requirements as indicated on Drawings.

SPEC WRITER NOTE: Use Paragraph C and D
for fence set in individual concrete
footings.

- C. Excavation: Excavate concrete-embedded items of dimensions indicated on Drawings, except in bedrock. When bedrock is encountered before reaching required depth, continue excavation to depth indicated or 450 mm (18 inches) into bedrock, whichever is less, and provide minimum 50 mm (2 inches) larger diameter than outside diameter of post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the COR.
- D. Post Setting: Install posts plumb and in alignment. Set post in concrete footings of dimensions indicated on Drawings, except in bedrock. Compact concrete free of voids and finish in slope or dome.
// Straight runs between braced posts maximum 150 m (500 feet) //.
Install posts in bedrock with non-shrink grout minimum 25 mm (one inch) around each post, free of voids and finish in slope or dome. Cure concrete and grout minimum 72 hours.

SPEC WRITER NOTE:
1. Do not use following paragraph for
perimeter and other fencing. See
NCA Facilities Design Guide for
clarification.
2. Use Paragraph below for fence set in
concrete slabs, walls, curbs, or similar
structure.

- E. Post Setting In Structures: Install post in retaining walls, curbs, concrete slabs, or similar construction with galvanized pipe sleeves set into concrete or built into masonry as indicated on Drawings. Set sleeves plumb and 13 mm (1/2 inch) above finished structure. Fill space

solidly between sleeve and post with non-shrinking grout, molten lead, or sulphur, and finish.

- F. Post Caps: Snugly fit exposed ends of post with caps. Install caps to accommodate top rail. Install post caps according to manufacturer's instructions and as indicated on Drawings.
- G. Supporting Arms: Install supporting arms according to manufacturer's instructions and as indicated on Drawings.

SPEC WRITER NOTE: Modify Paragraph H
according to NCA Facilities Design Guide
for placement of top rails and bottom
rails.

- H. Top Rails and Bottom Rails: Install rails before installing chain link fabric. // Pass top rails through intermediate post supporting arms or caps as indicated on Drawings // Install expansion couplings (rail sleeves) spaced according to manufacturer's instructions. Install expansion couplings over expansion joints in wall when fence is on top of wall.

SPEC WRITER NOTE: Modify following
paragraph to indicate method of
attachment for top tension wire, and
exclude use of top rail caps.

- I. // Top // and Bottom // Tension Wire //: Install and pull taut tension wire before installing chain-link fabric.
- J. Accessories: Install accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, for complete fence installation, with fabric taut and attached to posts, rails, and tension wire.
- K. Touch up damaged factory finishes.
 - 1. Repair galvanized surfaces with galvanized repair paint.

3.3 FABRIC

- A. Pull fabric taut and secure with wire ties or clips to // top rail // bottom rail // and tension wire // close to both sides of each post and at intervals maximum 600 mm (24 inches) on centers. Secure fabric to posts using stretcher bars and ties or clips.
- B. // Install barbed wire, when required, on supporting arms above fence posts. Extend gate frame end member above top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands

on fence. Pull each strand taut and securely fasten to each supporting arm and extended member //.

3.4 GATES

- A. Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as indicated on Drawings and according to manufacturer's instructions. Adjust hardware for smooth operation and lubricate when necessary.

3.5 REPAIR OF GALVANIZED SURFACES

- A. Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces according to manufacturer's directions.

3.6 CLEANING

- A. Remove debris, rubbish and excess material from site.

- - - E N D - - -

SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

SPEC WRITER NOTE: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative fence system at location indicated on Drawings.
2. Decorative fence gates at location indicated on Drawings.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain
references only when specified elsewhere
in this section.

- A. Materials product data and samples: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Finish and Color: Section 09 06 00 SCHEDULE FOR FINISHES.
- C. Concrete Footing: Section 03 30 00: CAST-IN-PLACE-CONCRETE.
- D. Footing Excavation: Section 31 20 00: EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Institute of Steel Construction (AISC):
 1. ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
 1. B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- D. American Welding Society (AWS):
 1. D1.2/D1.2M-14 - Structural Welding Code - Aluminum.
- E. Master Painters Institute (MPI):
 1. No. 18 - Primer, Zinc Rich, Organic.

1.4 SUBMITTAL

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
- B. Submittal Drawings:
 1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
 - a. Point by point comparison of proposed "Equal" products.
2. Grommets indicating manufacturer recommendation for each application.
3. Installation instructions.
4. Warranty.

D. Samples:

1. Fence Material: 12 inches // long // square //, each type and color //.
 - a. Submit quantity required to show full color // and texture // range.
2. // Product //: Full sized, complete assembly.
3. Approved samples may be incorporated into work.

E. Certificates: Certify // each product complies // products comply // with specifications.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer // with project experience list //.
2. Fabricator // with project experience list //.
3. Installer // with project experience list //.
4. Welders and welding procedures.

G. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.

1. Show location and magnitude of loads applied to building structural frame.
2. Identify deviations from details shown on drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer, Fabricator, Installer Qualifications:

1. Regularly manufactures, fabricates, and installs specified products.
2. Manufactured, Fabricated, and Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //
 - b. // Provide photographs, drawings and other documents showing character and quality of completed installation //.

B. Installer Qualifications: // Product manufacturer. // Manufacturer authorized representative //.

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //
 - b. // Provide photographs, drawings and other documents showing character and quality of completed installation //.
- C. Welders and Welding Procedures Qualifications: // AWS D1.1/D1.1M. // AWS D1.2/D1.2M // AWS D1.3/D1.3M. //
- D. Delegated Design: Comply with system performance.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, // color, // production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Protect products from damage during handling and construction operations.

1.8 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

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

SPEC WRITER NOTE: Specify extended manufacturer's warranties for materials only.

- B. Manufacturer's Warranty: Warrant decorative fences and gates against material and manufacturing defects.

SPEC WRITER NOTE: Specify customarily available warranty period for specified products.

1. Warranty Period: // number // years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Industrial Decorative aluminum fence and gate system with concealed picket attachment.

2.2 SYSTEM PERFORMANCE

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.
 - 1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by Contracting Officer's Representative (COR) when deviations do not affect design concept and specified performance.
- B. Design framework complying with specified performance:
 - 1. Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings // when tested according to ASTM E330/E330M //.

SPEC WRITER NOTE: Specify actual loads
when known for project.

- a. Wind Load: // _____ // positive, // _____ // negative, minimum.
- C. Completed panels capable of supporting 135 kg (300 lb.) load (applied at midspan) without permanent deformation, 25 percent inclination change in grade.

2.3 PRODUCTS - GENERAL

- A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Provide decorative fence and gates from one manufacturer // and from one production run //.
- C. DECORATIVE FENCE SYSTEM.
 - 1. Framework: ASTM B221 extruded aluminum, alloy 6005-T5 for posts and rails (outer channels); alloy 6063-T5 for pickets and rail inner slide channels.
 - 2. Picket Fence: Extruded aluminum, 25mm (1 inch) square by 1.5 mm (0.062") thick.
 - 3. Rails: Extruded aluminum, 44mm (1.75 inch) square, 2.5mm (0.100 inch) thick top, 3mm (0.120 inch) thick sidewalls, 2mm (0.080 inch) thick inner side channel, and holes at 118mm (4.715 inch) o.c. to receive picket; seal with PVC grommets.

4. Retaining Rod: Galvanized steel, 3mm (0.125 inch).
5. Posts: Extruded aluminum, minimum 62.5mm (2-1/2 inch) square tube, 2mm (0.0800) thick, 2mm (0.080 inch) thick interior reinforcing web.
6. Gates: Extruded aluminum, 45mm (1.75 inch) sq., 45mm (1.75 inch sq.) x 6mm (.250 inch) gate ends, and 25mm (1 inch) sq. x 3mm (.125 inch) pickets.
 - a. Hardware: Manufacturer's standard.
7. Fasteners: Stainless steel.
 - a. Rail Attachment Bracket: One-way tamperproof security bolts with inverted "T-nuts".
 - b. Post Connections Bracket: Self-drilling hex-head screws.
8. Rings, Post Caps, Finials, and Miscellaneous adornments: Cast aluminum.

2.4 FABRICATION

- A. Pre-cut pickets, rails, and posts in lengths indicated on Drawings. Pre-punch manufacturer's concealed design system rails to accept pickets.
- B. Fully insert rail inner slide into outer channel for internal retaining rod raceway.
- C. Insert pickets through grommets into pre-punched holes in rails; align pre-drilled picket holes with internal raceway.
- D. Insert retaining rods in rail passing through pre-drilled holes in each picket.
- E. Fabricate gates of reinforced concealed design system, picket and rails welded at joint intersections.

2.5 FINISHES

- A. Aluminum Paint finish:
 1. Baked-Enamel or Powder-Coat Finish: Polyester powder coating, 0.0508 mm (2 mils) minimum thickness. Comply with manufacturer's coating process.
 - a. Color: // Black // Bronze // Refer to Section 09 06 00, SCHEDULE FOR FINISHES //.

2.6 ACCESSORIES

- A. Grommets: PVC, High quality.
- B. Primer: Manufacturer's spray cans or paint pens.
- C. Welding Materials: AWS D1.2/D1.2M, type to suit application.
- D. Fasteners: As recommended by manufacturer.

- E. Galvanizing Repair Paint: MPI No. 18.
- F. Touch-Up Paint: Match shop finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Correct substrate deficiencies.
 - 1. Fill.
 - 2. Grind.
 - 3. Level.

3.2 FENCE INSTALLATION

- A. Layout fence // symmetrically, // with minimum number of joints.
- B. Installation:
 - 1. Install fence and gates according to manufacturer's instructions.

SPEC WRITER NOTE: In some cases, local
restrictions of freezing weather
conditions may require a greater depth.

- 2. Set posts in concrete footers minimum 900mm (36 inches) depth, or as indicated on Drawings, whichever is greater.
 - 3. Earthwork: As specified in Section 31 20 00 Earth Moving.
 - 4. Concrete: As specified in Section 03 30 00 Cast-in-Place Concrete.
 - 5. Posts setting by other methods as plated posts or grouted core-drilled footers are permissible only when shown in engineering analysis of sufficient in strength for intended application.
- C. Installation Tolerances:
 - 1. Variation from Indicated Grade: Maximum // _____ // mm
 (// _____ // inches).
 - 2. Variation from Indicated Line: Maximum // _____ // mm
 (// _____ // inches).
- D. Touch up damaged factory finishes.
 - 1. Repair galvanized surfaces with galvanized repair paint.
 - 2. Repair painted surfaces with touch up primer.

3.3 FENCE INSTALLATION MAINTENANCE

- A. Seal expose surfaces when cutting or drilling rails or posts as follows:
 - 1. Remove metal shavings from cut area.

SPEC WRITER NOTE: Paint pen is
recommended to prevent overspray.

2. Apply custom finish paint to match fence color. Prime and finish exposed surfaces with manufacturer's spray cans or paint pens.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's instructions.
- B. Set posts plumb, in concrete footings as indicated on Drawings.

3.5 CLEANING

- A. Clean exposed surfaces. Remove contaminants and stains.
- B. Clean site of excess materials, post-hole excavations, and debris removed or scattered uniformly.

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**SECTION 32 84 00
PLANTING IRRIGATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor is responsible for providing a programmable fully automatic system with full and complete coverage within the areas indicated on the drawings. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the fully functional irrigation system, and warranty as shown on the drawings, the installation details, and as specified. Other items of work specifically included are:
1. Procurement of all applicable licenses, permits, and payment of required fees.
 2. Coordination of Utility Locates ("Call Before You Dig").
 3. Maintenance period services.
 4. Sleeving for irrigation pipes and wires as indicated, and/or beneath all hardscape surfaces.

1.2 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement of the irrigation system pipes, or wires will require disturbance of other than landscape materials.

1.3 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals: SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- D. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- E. Division 26, Electrical
- F. Section 32 90 00, PLANTING

1.4 QUALITY ASSURANCE

A. Irrigation Contractor:

1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the construction of at least five (5) irrigation systems having large diameter gasket pipe (4-inch and larger), irrigation controllers, electrically operated remote control valves, and large radius rotary sprinklers (min. 1-inch inlet with swing joint).
2. Irrigation Contractor must be licensed in the State of Florida.

B. Equipment Manufacturer:

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 24 hours 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.

C. 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 shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

D. System Requirements:

1. Full (head to head plus 10%) and complete coverage of the irrigated areas is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to head locations as required to achieve full coverage of irrigated areas.

PLANTING IRRIGATION

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. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of the drawings. Lines are to be common trenched wherever possible. Irrigation heads along roadways shall be placed between 6" and 8", unless otherwise specified.
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. Remote control valves shall be located individually or in groups of two, to minimize tripping hazards. Where the exact location for the valves has not been set, or there are any conflicts, the location shall be coordinated with the Owner's Representative before installation.
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. Irrigation lines, control wires and power wires shall be run in trenches as indicated on the drawings or as typical for industry standards, if not indicated.
6. Connect new system to existing mains. Disconnect and abandon existing irrigation system, only where noted on plans. Connect to new mains.
7. Unless noted otherwise, all irrigation lines, power wires and control wires shall be run in sleeves or conduit where installed beneath any site hardscape materials.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- F. Completely program central controller and satellite controllers according to approved master irrigation schedule.
- G. Upgrade existing controllers as noted on plans.
- H. Follow manufacturer's instructions for installation.
- I. Manufacturer of irrigation controllers to be certified complete, including all related components, and totally operational. Submit certificate to Owner's Representative.

1.5 SUBMITTALS

- A. Make submittals and provide number of copies per Specifications Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, "DO NOT DRINK" sign and all

other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Owner's Representative. Incomplete submittals will be returned without review. Sequentially number each page of the submittal for ease in referencing during submittal review. Pages within a letter or number identified Tab section may be numbered sequentially as long as the process is consistent and provide unique page identification for each page of the submittal.

- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water filtration components, electrical components and control system components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts and specifications for equipment to be included in the project work. For rotary sprinklers include Center for Irrigation Technology Space Pro Single Leg Profile showing the Distribution Uniformity and Scheduling Coefficient for the nozzles being used at the specified spacing.
- D. Shop Drawings: 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 existing services. Do not start work before final shop drawing approval.
- E. Testing: Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. Record Drawings: Submit information listed in Parts 1 and 3 of these specifications.
- H. Name and address of a permanent service organization maintained or trained by the manufacturers that will as a result of determined warranty work, or after warranty period following execution of a service contract for this facility, render satisfactory service within 24 hours of receipt of notification that service is requested.

PLANTING IRRIGATION

- I. Reproducible "as-built" drawings drawn in Autocad (2010) format. Submit information indicating the "as-built" conditions for the irrigation system to the Owner's Representative as electronic DWG files of the original bid drawings posted with all addendum, clarifications, and approved modifications. Owner's Representative
After electronic "as-built" drawing(s) have been approved, the Contractor shall utilize them to prepare an overall irrigation system drawing to replace the existing one with this expansion area included of a size suitable for display at the location determined appropriate by the Cemetery operations staff proximate to the irrigation central control computer at the location determined in the field. The As-built Drawings shall include cross-measured locations of all irrigation valves and control/pumping related equipment.
- J. 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 submitted and approved before charts are prepared.
 2. Provide one controller chart showing the area covered by controller for each automatic controller supplied at the maximum size controller door will allow. 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. Chart shall be a print with a different color used to show area of coverage for each station. Charts must be completed and approved prior to final inspection of the irrigation system.

1.6 SUBSTITUTIONS

- A. Unless otherwise noted, use specified equipment to match existing equipment. Owner's Representative must approve equipment prior to construction. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility. "As-Built" information shall show the sizes installed.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

1.7 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and appurtenances unless otherwise indicated.
 1. Irrigation Mainline Piping: 1380 kPa (200 psig).

2. Lateral Piping: 1035 kPa (200 psig).

1.8 CODES AND REGULATIONS

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

1.9 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the new irrigation system for this project or completion of portions thereof, the contractor through the permanent connection of the new irrigation system to the existing fully functional irrigation system and new fully operational irrigation water source of supply constructed as part of this project, shall be provided water at available flow and pressure, for use by the Contractor, with Contractor provided additional facilities and/or equipment as required to perform the required flushing and testing of the new irrigation system. Contractor shall coordinate the construction of the new irrigation water source of supply with the irrigation system construction to insure that water is available for irrigation purposes, or shall provide for irrigation water by other means at no cost to the Government. Once the irrigation system and irrigation water source of supply are deemed operable and approved, and prior to the final inspection, the contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. The use of water for new landscape establishment shall be coordinated, with the existing Cemetery irrigation operations so as to not adversely effect their operations or the existing irrigated landscape materials. No other expressed or implied uses of government furnished water exist.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Owner's Representative, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities for providing temporary irrigation

PLANTING IRRIGATION

water. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.10 TESTING

- A. Notify the Owner's Representative three days in advance of testing.
- B. All newly installed irrigation pipelines shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Owner's Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test – Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.
 - 3. Provide all necessary pumps, bypass piping, storage tanks, meters, 75 mm (3-inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous 700 kPa (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
 - 4. Allowable deviation in test pressure is 35 kPa (5 psi) during test period. Average pressure during the test shall be 700 kPa (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the pressure is 5 psi below the test pressure. Restore test pressure to 700 kPa (100 psi) at end of test. Water added to mainline pipe must be measured volumetrically to nearest 10 ml (0.025 gallons).
 - 5. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. The amount of additional water pumped in during the test will not exceed the value in the table, or the calculated value using the formula below, based upon differing number of joints, duration or pressure of the test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE mm (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
63mm (2 ½")	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.40
75mm (3")	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
100 mm (4")	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64
150 mm (6")	0.63	0.68	0.73	0.77	0.81	0.85	0.89	0.92	0.96
200 mm (8")	0.84	0.90	0.97	1.03	1.08	1.13	1.18	1.23	1.28
250 mm (10")	1.05	1.13	1.21	1.28	1.35	1.42	1.48	1.54	1.60
300 mm (12")	1.26	1.36	1.45	1.54	1.62	1.70	1.78	1.85	1.92

Note: Allowable Leakage calculated using $L = (NDVP)/7400$

Where: L = Allowable Leakage (gph)

N = Number of Joints

D = Nominal Diameter of Pipe (inches)

P = Average Test Pressure (psi)

The following are the values for a 2 hour duration test at 100 psi for pipe length containing 100 joints.

- 3.10 l (0.82 gallons) per 100 joints of 75 mm (3-inch) diameter pipe
- 4.09 l (1.08 gallons) per 100 joints of 100 mm (4-inch) diameter pipe
- 6.13 l (1.62 gallons) per 100 joints of 150 mm (6-inch) diameter pipe
- 8.18 l (2.16 gallons) per 100 joints of 200 mm (8-inch) diameter pipe
- 10.22 l (2.70 gallons) per 100 joints of 250 mm (10-inch) diameter pipe
- 12.26 l (3.24 gallons) per 100 joints of 300 mm (12-inch) diameter pipe

Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

- Cement or caulking to seal leaks is prohibited.
- Contractor may sub-contract testing to pipeline testing company approved by Owner's Representative.

PLANTING IRRIGATION

F. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:

1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kpa (80 psi) for 30 minutes.
2. Cap all sprinkler risers.
3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
5. Cement or caulking to seal leaks is prohibited.
6. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

G. Operational Test – Remote Control Valves, Lateral Piping and Sprinklers:

1. Activate each remote control valve in sequence from each new satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units through the central controller and/or through their stand alone communication system. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The Owner's Representative will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

H. Distribution Uniformity (DU):

1. Perform a DU Test on one zone of burial section rotors and one zone of tree lawn rotors per satellite controller. Verify that DU meets submittal 1.5C.
2. In conjunction with the Owner's Representative, select the zones of sprinklers that are representative of the area being irrigated by the satellite controller.
3. Perform a catch can test using procedures recommended by the Irrigation Association.

4. Where DU test fails adjust zone pressures and/or nozzle sizes to meet required Distribution Uniformity.
 5. Calculate and provide a written documentation of the DU for each zone tested.
 6. An Irrigation Association Certified Landscape Irrigation Auditor must perform the test.
Provide written evidence of certification prior to conducting test.
- I. Controller Grounding:
1. Test all new satellite controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, if acceptable by equipment manufacturer without equipment warranty invalidation. Test results must meet or exceed control system manufacturer's requirements for acceptance, while maintaining equipment warranty.
 2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's requirements are met. Add grounding rods as needed, bond all rods together.
 3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each satellite controller pedestal door and via a written report submitted to the Owner's Representative. Documentation should include satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
 4. A written report of the test data listing satellite name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to the local ground for each satellite must be submitted to the Owner's Representative.
- J. Irrigation System Acceptance Test (Burn in) Prior to Final Inspection:
1. Upon completion of construction and prior to Final Inspection, an Acceptance Test(Burn in) must be passed.
 2. Coordinate start of Test with Owner's Representative.
 3. During the Test, the irrigation system must be fully operational from the central control system and/or stand alone programs at the individual satellites// for the system. The irrigation system, must operate with no faults for 14 consecutive days. If at any time during

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- the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from Owner's Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. When the system has operated for 14 days without fault, contact the Owner's Representative to schedule Final Inspection.
 5. If the system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; if it does not shut down the test starts over.

1.11 WARRANTY AND REPLACEMENT

- A. The purpose of the warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
 1. Warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Acceptance by Owner's Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from Owner's Representative.
 2. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
 3. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Owner's Representative or Cemetery Staff. Coordinate temporary shut-down of existing system with Cemetery Staff prior to construction. Disturbance to cemetery operations must be minimized. See irrigation plans and installation details and Specifications Sections for required coordination efforts related to the installation of specific irrigation components.
- B. Connections to the existing mainline must be approved by the Owner's Representative while minimizing the impact on the operation of the existing irrigation system.

- C. Install irrigation mainline and control and power wiring in sleeves under new roads prior to installation of road base, and under all other concrete or asphalt, either existing or new for this project.
- D. Install irrigation components in landscaped areas unless specifically indicated otherwise. Irrigation components in other than landscaped areas shall be in sleeves as noted on plans, with no joints beneath the non-landscaped areas, unless otherwise noted on plans.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the Owner's Representative.

1.13 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
 - B40.1-05 Gauges-Pressure Indicating Dial Type-Elastic Element
- C. American Society of Sanitary Engineers (ASSE):
 - 1013-2005 Reduced Pressure Principle Backflow Preventers
- D. American Society for Testing and Materials (ASTM):
 - A242/A242M-04 (2009) High Strength Low-Alloy Structural Steel
 - A536-84 (2009) Ductile Iron Castings
 - B61-08 Steam or Valve Bronze Castings
 - B62-09 Composition Bronze or Ounce Metal Castings
 - D1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D1238-04c Standard Test Method for Melt Flow Rates of Thermoplastics
by Extrusion Plastometer
 - D1784-08 Rigid Poly(Vinyl Chloride)(PVC) Compounds and Chlorinated
Poly(Vinyl Chloride) (CPVC) Compounds
 - D1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120
 - D1894-08 Standard Test Method for Static and Kinetic Coefficients of
Friction of Plastic Film and Sheet
 - D2241-05 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 - D2464-06 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings,
Schedule 80

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- D2466-06..... Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2564-04e1..... Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- D2657-07..... Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- D3139-98 (2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- D3350-10 Standard Specification for PE Pipe & Fittings Materials
- F477-08 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- E. American Water Works Association (AWWA):
 - C110/A21.10-08 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water
 - C111/A21.11-06 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - C115/A21.15-05 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 - C151/A21.51-09 Ductile-Iron Pipe, Centrifugally Cast, for Water C153/A21.53-00 Ductile-Iron Compact Fittings for Water Service
 - C504-06 Rubber Seated Butterfly Valves
 - C509-09 Resilient-Seated Gate Valves for Water Supply Service
 - C901-08 AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, 13 mm (½ In.) through 76 mm (3 In.), for Water Service
- F. Manufacturers Standardization Society (MSS):
 - SP70-2006 Cast Iron gate Valves, Flanged and Thread Ends
- G. National Electrical Manufacturers Association (NEMA):
 - 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum);

PART 2 - PRODUCTS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Equipment used will match the equipment installed in the previous phase as noted. Owner's Representative must approve equipment prior to construction. The Contactor through written request prior to purchase or installation may

request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's. No substitutions will be accepted without written approval by Owner's Representative.

- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeves beneath all hardscape for irrigation pipe and all wiring. Provide separate sleeves beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- D. Use Class 200, SDR-21, rated at 1375 kPa (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241 or AWWA C905, DR-25 rated at 1135 kPa (165 psi) conforming to AWWA Standard C905, or use C-900 PVC pipe, rated at 1375 kPa (200 psi).
- E. Sleeve sizes are to be as shown on the drawings or twice the nominal diameter of pipe if not shown. The wiring bundle area may not exceed more than 40% of the sleeve cross sectional area, per NEC recommendations.
- F. Restrained Casing Spacers:
Use restrained casing spacers on gasketed mainline pipe contained in a sleeve. Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.
2. Sleeve Size: As shown in the Casing Spacer Installation Detail.
3. Use casing spacers manufactured from high strength ductile iron, per ASTM A536, Grade 65-45-12. Use restraining rods manufactured from high strength low alloy material meeting the requirements of ASTM A242 and ANSI/AWWA C111/A21.11. Use runners manufactured from ultra high molecular weight polymer with a tensile impact of 175-350 Joules/cm (600-1200 ft-lbs./in.) and a coefficient of friction of 0.14-0.17 per ASTM D-1894.

2.4 PIPE AND FITTINGS

- A. Irrigation Mains:
1. Provide one of the following materials (must be pipe type noted on plans):

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- a. Ductile Iron, AWWA C151, minimum working pressure 1025 kPa (150 psi), cement lined, exterior bituminous coated.
 - b. Polyvinyl Chloride (PVC) Pressure Pipe, Class 200 PVC , solvent weld for all mainline 3" and smaller, Class, 200, SDR 21, Gasketed for all mainline 4" and larger), conforming to dimensions and tolerances established by ASTM Standard D2241. All mainline shall utilize Harco Ductile Iron Restraints and be thrust blocked.
 - c. High Density Polyethylene (HDPE) pipes shall comply with AWWA Specifications C901. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.
2. Except for HDPE pipe, for all mainline 4" size and larger, use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings according to 2.4.E. For all mainline 3" and smaller utilize Solvent weld pipe and fittings. Thrust Blocks and Restraints shall be utilized on all mainline fittings (see below).
 3. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.
- B. Lateral Pipe and Fittings:
1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
 2. Use Class 200 PVC, SDR 21, solvent weld pipe for lateral piping..
 3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
- C. Threaded Pipe:
1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.
- D. Pipe Above Grade and in Concrete Structures:

1. AWWA C115, flanged joints and fittings working pressure 1025 kPa (150 psi).

E. Fittings:

1. Irrigation Mains:

- a. Ductile Iron and PVC Pipe:

Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 850 kPa(125#). All fittings shall be installed with retainer glands designed for the pipe material, and shall be manufactured with twist off screws that sheer off at the proper force to anchor the retainer gland to the pipe at the pressure rating for the pipe, or at the test pressure for the pipe, whichever is higher, without causing damage to the pipe.

2. Irrigation Laterals:

PVC, Class 200, solvent welded socket type, ASTM D2466.

3. Threaded Pipe:

PVC, schedule 80, ASTM D2464.

4. Swing Joints:

Shall be a standard complete assembly by a manufacture, with elastomeric seals that allow 360 degree rotation, and are designed for minimum 1375 kPa (200 psig) working pressure.

F. Jointing Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.

2. Irrigation Laterals: Use Class 200, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

3. Threaded pipes: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use non-hardening, non-toxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 RESTRAINTS

A. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to 75 mm (3-inch) diameter or any diameter rubber gasketed pipe. Use of mechanical restraints does not eliminate the need for installation of thrust blocks as specified.

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2. Use 20 MPa(3,000-psi) concrete.
 3. Use 50 micrometers (2-mil) plastic.
 4. Use 12.7 mm (No. 4) Rebar wrapped or painted with asphalt tar based mastic coating.
- B. Joint Restraint Harness:
1. Use a joint restraint harness as presented in the installation details and wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or retainer glands and thrust blocks.
 2. Use a joint restraint harness with all ductile iron fittings 150 mm (6-inch) and larger, transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
 3. Use a joint restraint harness or retainer glands with preset torque shearing set screws, on all mainline gate valve assemblies 100 mm (4-inch) and larger.
 4. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Use retainer conforming to ASTM A536. Use high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.

2.6 MAINLINE COMPONENTS

- A. Valves (Except remote control valves):
1. General valve installation shall be as presented in the installation details. Unless specifically noted otherwise, valves for existing facilities shall match the existing, of the same type. All valves shall meet or exceed any specified parameters identified herein, or the parameters for the existing valves being matched, whichever provided the higher quality product.
 - a. Underground Shut-Off Valves: Provide One or more of the following based upon project specific conditions. Use type in paragraph 1) unless there are special circumstances that require the other types:
 - 1) Gate valves 50 mm (2 inches) and larger: Ductile iron with 2" operating nut, non-rising stem turning clockwise to close, //1025 kPa (150 psi)//1375 kPa (200 psi)// minimum working pressure. AWWA C509.
 - b. Brass Ball Valve:
Use a brass ball rated to 1620 kPa (235 psi).
 - c. Quick Coupling Valve Assembly:
 - 1) As presented in the installation details.

- 2) Brass construction, 1-inch nominal size, operating pressure 35-860 kPa(5-125 psi) with locking rubber or vinyl cover. Acceptable manufacturer and model is //(fill in based upon the existing acceptable products)// to match existing equipment or approved equal. //For new installations use high quality brass, bronze or stainless steel manufacturer's equipment for similar golf course or lite commercial applications.
- 3) Swing Joint: Use pre-manufactured triple swing joint. Quality of manufactured product shall meet or exceed that of products manufactured by Spears, Lasco, or approved equal.
- 4) Quick Coupler Anchor: Use pre-manufactured bolt on anchor.
- 5) Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Product quality shall meet or exceed that of Brooks Products or approved equal.
- 6) Filter Fabric: Use a spunbond polyester 3.5 oz per square yard landscape fabric.

B. Flower Water Station Spigot Connection Assembly:

1. As presented in the installation details.
2. Flower Watering Station Spigot: As specified in Section 323000, Site Furnishings
3. Curb Stop Valve: Brass body, 2070 kPa (300 psi) minimum working pressure. ASTM B-62, female threaded connections, with stop and waste feature.
4. Inline pressure regulator, 275 kPa (40 psi) maximum, 1-inch maximum inlet and outlet.
5. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.
6. Valve Box: Use a concrete curb valve box with cast iron lid sized 200 mm ID x 300mm (8" ID x 12"). Valve box must be capable of being face anchored in concrete.
7. The final approved configuration, including the mounting method shall be as approved during the submittal process.

C. Valve Box:

1. Gate Valve:
 - a. Valve boxes in pavement shall be precast concrete with compressive strength of the concrete in excess of 30 Mpa (4000 psi). In turf and planter areas valve boxes shall be

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HDPE structural foam Type A, Class III, green in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.

- b. 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 2 – 2” operating nut socket wrenches with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.
 - c. Operations:
 - 1) Underground: furnish valves with 50 mm (2 inch) nut for T-Handle socket wrench operation.
 - 2) Ends of valves shall accommodate the type of pipe installed. Valves on buried irrigation mains shall have Mechanical Joint ends with retainer glands.
2. Remote Control Valves:
- a. When in pavement, valve boxes shall be precast concrete 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 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.
 - 1) After installation hot brand into lid of valve boxes boxes 75 mm (3-inch) high, 1 mm (3/16”) deep labels designating the size stencils designated controller and circuit numbers. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.
 - b. Furnish two 30 inch long valve adjustment keys.

2.7 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. Remote control valve:
 - a. As presented in the installation details. Installation shall result in the control valve being installed underground and operated by a 24-volt AC electric solenoid. 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. Higher working pressure valves shall be provided for systems that operate with working

pressures above 140 psi. Install assembly over gravel sump as presented in the installation details.

- b. Valves shall be of all brass or plastic 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 contain pressure regulators.
 - d. Valves shall be completely serviceable from the top without removing valve body from the system. Furnish 2 750 mm (30 inch) long adjustment keys. Valves to operate at no more than 7 psi pressure loss at manufacturers maximum recommended flow rate.
- 2. Brass Ball Valve: Use a brass ball rated to 235 PSI. Acceptable manufacturer is Nibco, Apollo or approved equal.
 - 3. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears, Lasco or approved equal.
 - 4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
 - 5. Wire connectors: Use 3M DBR-Y-6.
 - 6. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.
- B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:
- 1. Full Circle Sprinklers: To be a dual or tri-nozzle combination type with positive drive by means of a 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 3.0 m (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. 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,

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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.

E. Low Voltage Control Valve Wire:

1. Wire for Non-Decoder based controls: 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. All common wiring shall be No. 12 gauge size (white in color). Control Wiring shall be red in color.
2. Splicing Materials: Epoxy waterproof sealing packet, 3M DBR/Y-6 or approved equal.
3. 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.

F. Warning Tape:

1. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, 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".

G. Tracer Wires:

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

2.8 CONTROL SYSTEM COMPONENTS

- A. The Existing Control System will remain in place. Existing Controller to be upgraded as noted on plans to expand number of zones and add rain/freeze sensor. Refer to notes on plans.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. The Contractor shall verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.

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

1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Owner's Representative one week in advance of review. The Owner's Representative will identify and approve modifications during this review.

3.2 LAYOUT OF WORK

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

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Do not lay pipe on unstable material, in wet trench or when, in the opinion of the Owner's Representative, trench or weather conditions are unsuitable for the work.
- C. 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.
- D. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- E. Hold pipe securely in place while joint is being made.
- F. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.

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- G. 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.
- H. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas mains, all of which have right of way.
- I. 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.
- J. Minimum cover:
 - 1. 900 mm (36-inches) over irrigation mainline pipe in landscaped areas and to bottom of road base. (distance from top of pipe to finish grade)
 - 2. 450 mm (18-inches) over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
 - 3. 450 mm (18-inches) over control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 - 4. 450 mm (18-inches) vertical separation between lateral and mainline pipe installed in a common trench.
 - 5. 75 mm (3-inches) minimum horizontal separation between pipes and wiring in a common trench.
 - 6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
 - 7. Tops of remote control valves shall never be less than 75 mm (3 inches) below lid of valve box.
- K. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Owner's Representative.
- L. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- M. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the Owner's Representative.
- N. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

- O. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 - 1. Backfill trench using excavated material in 150 mm to 200 mm (6-inch to 8-inch) layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- P. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 - 1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 150 mm (6-inch) layers and compacting to the density of surrounding soil.
- Q. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Owner's Representative.
- R. Where utilities conflict with irrigation trenching and pipe work, contact the Owner's Representative for trench depth adjustments.
- S. 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.
- T. 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.
- U. Warning tape shall be continuously placed above sprinkler system water mains at a depth of 200-250 mm (8-10 inches).
- V. Survey monuments:
 - a. Protect markers during construction.
 - b. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it in the proper location.

3.4 SLEEVING AND BORING

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.

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- C. Extend sleeve ends a minimum of 300 mm (12-inches) beyond the edge of the paved surface.
Cover pipe ends and mark edge of pavement with a chisel or saw.
- D. Verify that sleeve sizing is adequate prior to installation. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 300 mm (12-inches) beyond edges of paving or construction. Cover pipe ends and mark edge of pavement with a chisel or saw. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.
- E. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 6 meters (20-foot) length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 6 m (20') LENGTH
38 mm (1 ½")	7.5 m (25')	2.3 m (7'-8")
50 mm (2")	7.5 m (25')	2.3 m (7'-8")
63 mm (2 ½")	30 m (100')	575 mm (1'-11")
75 mm (3")	30 m (100')	575 mm (1'-11")
100 mm (4")	30 m (100')	575 mm (1'-11")
150 mm (6")	45 m (150')	400 mm (1'-4")
200 mm (8")	60 m (200')	300 mm (1'-0")

250 mm (10")	75 m (250')	225 mm (9")
300 mm (12")	90 m (300')	200 mm (8")

B. Mainline Pipe and Fittings:

1. Plastic pipe:

- a. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.
- b. Joints
 - 1) 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.

2. Ductile iron pipe:

- a. Installation: AWWA C600.
- b. Joints:

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- 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 150 mm (6 inches) from walls or floor.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.
- d. In irrigation isles, coordinate with the location of the monuments to avoid conflicts.

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

E. Specialized Pipe and Fittings:

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

2. PVC Threaded Connections:

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

F. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil.
2. Size, orientation and placement will be as shown on the installation details.
3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
4. Install rebar with mastic coating as shown on the installation details.

G. Joint Restraint Harness:

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

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Setting of valves:

1. No valves shall be set under roads, pavement or walks.
2. Clean interior of valves of foreign matter before installation.
3. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.
4. Set valve box cover flush with finished grade.
5. Install as indicated in the installation details, per manufacturer's instructions.
6. Install where indicated on the irrigation plans.
7. Brand or cast "GV" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

B. Air/Vacuum Relief Valve Assembly:

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

C. Quick Coupling Valve Assembly:

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

D. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Sequence of construction:
 - a. Coordinate exact location with Owner's Representative.
 - b. Components are to be installed before concrete pad. Coordinate installation with concrete contractor.

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3. Location:
 - a. Stations will be installed at locations indicated on drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. No mainline or lateral pipe is to be installed under Flower Watering Stations.
4. Paint "FW" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect 50 mm (2-inch) pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 0.9 m/s (3 FPS).
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. The Owner's Representative will review the flushing operation and clarity of water before stopping the flushing operation.
 - h. Disconnect pipe from service tee(s) and install remote control valve(s).
2. Install per manufacturer's recommendations where indicated on the drawings.
3. Adjust valve to regulate the downstream operating pressure to 480 kPa (70 psi) for rotor sprinklers, 310 kPa (45 psi) for rotating stream nozzles and 240 kPa (35 psi) for spray sprinklers.
4. Wire connectors and waterproof sealant will be used to connect control wires to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
5. Install only one remote control valve to a valve box. Locate valve box 1.5m (5-feet) from and align square with nearby edges of paved areas.

6. Attach ID tag with controller station number to control wiring at solenoid.
 7. Brand controller and station number in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
- B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:
1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
 2. Install per the installation details at locations shown on the drawings.
 3. Locate rotary sprinklers 100 mm (4-inches) from adjacent edges of paved areas, walls or fences.
 4. Install sprinklers perpendicular to the finish grade.
 5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
 6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
 7. Adjust the radius of throw of each sprinkler for best performance.
 8. Install 600 mm (2-foot) square piece of sod around all rotary sprinklers in areas to be seeded.
- C. Pop-Up Spray Sprinkler Assembly:
1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
 2. Install per the installation details at locations shown on the drawings.
 3. Locate rotary sprinklers 100 mm (4-inches) from adjacent edges of paved areas, walls or fences.
 4. Install sprinklers perpendicular to the finish grade.
 5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
 6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
 7. Adjust the radius of throw of each sprinkler for best performance.
- D. Sprinkler Heads and Quick Couplers:
1. Shall be placed on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign

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matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.

2. Place part-circle rotary sprinkler heads no more than 150 mm (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.
3. Install all shrub sprays, sprinklers and quick couplers on swing joints as detailed on plans.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Stakes to be parallel to riser.
5. Install sprinklers and quick coupling valves on a swing joint assembly.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at location(s) shown in the drawings.
2. Install electrical connections per control system manufacturer's recommendations and is shown in the drawings.
3. Lightning protection: Drive grounding rod(s) into soil its full length. Furnish and install grounding plate(s) as indicated or as required to create the grounding connection with the field tested resistance value equal to or lower than the specified values identified in this specification. Connect 4mm diameter (#6 AWG) copper grounding wire to rod and plate using CADWELD style connections. Brand "GR" in 50 mm(2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
4. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
5. Connect control wire to the corresponding control unit terminal.
6. Install permanent receiver for hand held radio if not factory installed.
7. Install rain sensor and complete electrical connections to per control unit manufacturer's recommendations.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 300 mm (12-inch)

standard valve box. Coil 600 mm (2 feet) of wire in valve box. Brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites. White shall be the common (neutral) wire. All wiring is to be NEC Code compliant.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 50 mm (2-inches) below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 200 – 250mm (8-10 inches) below the ground surface, directly over the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer.
8. Connect wire to power source.

C. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 3 m (10-foot) intervals.
2. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.
3. Provide a 600 mm (24-inch) excess length of wire in an 200mm (8-inch) diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous runs of wiring. Do not tie wiring loop. Coil 600mm (24-inch) length of wire within each remote control valve box.
4. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
5. Install spare control and common wires as directed on plans.
6. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure

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- for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
7. Unless noted on plans, install wire parallel with and below mainline pipe.
 8. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 150 mm (6-inches) above the wiring.
 9. Cap all exposed wire ends with wire nuts.
 10. 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.
 11. 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.
 12. 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.
 13. Provide 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.
 14. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.
- D. Instrumentation:
1. Install per manufacturer's recommendations at location indicated on drawings.
 2. Provide electrical connections between central control system hardware and weather station under direction and observation of central control system manufacturer's personnel.

3.9 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.

3.10 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 - 1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 TEST AND FLUSHING

- A. Test irrigation system per procedures listed in section 1.10.
- B. Flushing: After testing, flush system per procedures listed in section 3.7. 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.

3.12 MAINTENANCE AND OPERATION INSTRUCTIONS

- A. Maintenance and Operating Instructions: Prior to final acceptance, provide verbal instructions, for a period of not less than 16 hours, to the operating personnel. Provide two additional years of software support for one hour each month. Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manual(s) as follows:
 - 1. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - 2. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - 3. Manufacturer's Operation and Maintenance manuals.
 - 4. Manufacturer's Technical Service Bulletins.
 - 5. Manufacturer's Warranty Documentation.

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6. Software License Information.
7. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
8. Predictive schedule for component replacement.
9. Listing of technical support contacts.
10. Operation and maintenance submittal package must be complete prior to being reviewed by the Owner's Representative. Incomplete submittals will be returned without review.
11. Provide video taping of the training for the equipment provided for the project. Training shall be produced on DVD or CD, whichever is compatible with the computer system provided for the central computer, where applicable. Training shall be suitable for refresher by the previously trained employees, or for use by new employees to learn the system equipment. Coordinate the final training presentation with the A/E and R.E. in outline form prior to creation, to insure that the format and organization of the content is applicable for the facility staff utilization.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize the new irrigation system in accordance with local practices in the first fall after completion of construction of the irrigation system and start up in the spring after completion of construction. Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the cemetery landscape maintenance personnel.

3.14 TESTING, OPERATIONAL PERFORMANCE AND ACCEPTANCE

- A. Provide the testing as indicated in previous sections of the specifications.
- B. Demonstrate the operations of the systems as indicated in the project specifications.
- C. Acceptance shall be predicated upon a successful demonstration of the operation of the systems, as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

3.15 MAINTENANCE

- A. Operate and maintain the irrigation system for a duration of 30 calendar days after Final Inspection. Make periodic examinations and adjustments to irrigation system components.

3.16 SPARE PARTS

- A. Upon completion of the work furnish the Owner the following for his maintenance stock.

1. 10 - 570C - 6p sprinklers
2. 5 – 570C – 12p sprinklers
3. 5 – FB – 100 – pc Flood Bubbler Nozzles
4. 2 – 300 – 03 Shrub Sprinkler Bodies
5. 2 – wp300 – Shrub Sprinkler Bodies
6. 1 – 252 – 06 – 06 38mm (1 ½”) valve
7. 3 – Hunter I-90 Rotors Full Circle
8. 3 – Hunter I-90 Rotors Adjustable
9. 3 – Hunter I-20 Rotors Adjustable

3.16 CLEANUP

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

--- E N D ---

SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

- A. This work consists of furnishing and installing all planting materials required for landscaping at all NCA construction projects hereinafter specified in locations as shown. The landscape contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the Contracting Officer's Technical Representative (COTR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.
- B. Agronomic consultation on the appropriateness of all plant materials proposed for installation during this project must be obtained from the District Agronomist via coordination through the COTR prior to project initiation and actual plant installation. In general, all plant material must be regionally adapted to the climate of the site, be of appropriate mature dimensions to fit the planting location and be low maintenance species. This requirement will generally exclude or severely limit the use of rose plants, wild flowers and ground covers.
- C. Any exceptions to these species exclusions must be approved by the DISTRICT Agronomist via coordination through the COTR prior to project initiation.

1.2 EQUIPMENT

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

1.3 RELATED WORK

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

1.4 SUBMITTALS

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

Inert Mulch	2.3 kg (5 pounds) of each type to be used.
Organic Mulch	2.3 kg (5 pounds) of each type to be used.
All pesticides required such as pre-emergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.

B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the Resident Engineer for approval:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
2. Fertilizers.
3. Lime
4. Peat
5. Seed
6. Sod
7. Membranes
8. Asphalt Adhesive

C. Manufacturer's Literature and Data:

1. Metal edging
2. Anti-desiccant
3. Erosion control materials
4. Hydro mulch
5. Pre-emergent herbicide

D. Licenses: Licenses of Arborist shall be submitted (one copy), to the COTR.

E. Soil laboratory testing results and any soil amendment recommendations from the Contractor. Submit soil test results for each variable soil type and condition that exists on the construction site.

1. Organic Soil Amendment and Imported Topsoil: The Contractor shall provide a 5 pound representative sample from each proposed source for testing, analysis, and approval. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Resident Engineer. Testing reports shall include the following tests and recommendations.
 - a. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists. A hydrometer shall be used to determine percent of clay and silt.
 - b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
 - c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and acidity (pH).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH shall be performed by a testing laboratory retained by the Department of Veterans Affairs as described in Section 01 45 29, TESTING LABORATORY SERVICES.
 - e. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful turfgrass growth.
 - f. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
2. Amended soil (in place): Following the incorporation of amendments and additives, the Contractor shall provide a minimum of six (6) samples per forty thousand (40,000) square feet, six inch (6") depth by three inch (3") diameter core samples of amended soil taken from the site for testing, analysis, and approval. The location of each sample shall be as directed by the Resident Engineer from areas designated to receive turfgrass or be established to turfgrass on the Contract Drawings. No seeding or hydroseeding operations shall occur until acceptance of the amended soil samples has been obtained. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Resident Engineer. Tests shall be as directed in paragraph 1.4 E.1.d. of this Section.

3. Seed: Submit a manufacturer's Certificate of Compliance to the Specifications with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.
4. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.
5. Hydro Mulching: Prior to the start of hydro mulching, submit a certified statement for approval as to the number of pounds of materials to be used per gallon of water.

1.5 DELIVERY AND STORAGE

A. Delivery:

1. Notify the Resident Engineer 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. Heel in bare root plants.
 - c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.

- d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

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

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the PM or COTR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the turfgrass and landscape plant materials to achieve an establishment condition and appearance satisfactory to the DISTRICT Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free and Landscape Plant Materials shall be fully rooted, actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant and Turfgrass Establishment Period the Contractor shall:
 1. Water all plants and turfgrass to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these conditions is best determined on site by the DISTRICT Agronomist in consultation with the Project Engineer.
 2. Prune plants and replace mulch as required.

3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the Resident Engineer in coordination with the DISTRICT Agronomist.
6. Provide the following during turfgrass establishment:
 - a. Eradicate all weeds. Water, fertilize, overseed, and perform any other operation necessary to promote the growth of turfgrass.
 - b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses mow at heights as appropriate for species and cultivar as directed by the COTR in consultation with the DISTRICT Agronomist. Final mowing height is 65 mm (3.0 inch) for cool season turfgrasses and as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.
7. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
8. Replant any areas void of turfgrass during an active growing season only.
 - a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 - b. Seeding shall be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of

grass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

Unsatisfactory areas shall be reseeded within seven (7) days during an active growing season.

9. Complete remedial measures directed by the COTR in consultation with the DISTRICT Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

- A. Landscape plant and turfgrass acceptance will occur after completion of the LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the PLANT AND TURFGRASS ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government until work has been satisfactorily completed, inspected and accepted.
- B. Criteria for acceptance of landscape plants.
 1. Planter beds and earth mound water basins are properly mulched and free of weeds.
 2. Tree support stakes, guys, and turnbuckles are in good condition.
 3. Total plants on site as required by specifications and required number of replacements have been installed.
 4. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.
- C. Criteria for acceptance of turfgrass shall be as follows:
 1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture and well rooted into the soil below so that gentle pulling of the turfgrass leaves by hand does not dislodge the sod. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 2. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT AND TURFGRASS WARRANTY

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

1.10 APPLICABLE PUBLICATIONS

- A. NCA Handbook 3420 – Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor's official reference guide to all establishment and preliminary maintenance practices employed during this construction project.
- B. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- C. American National Standards Institute (ANSI) Publications:
- ANSI Z60.1-04Nursery Stock
- ANSI Z133.1-06Tree Care Operations-Pruning, Trimming, Repairing,
Maintaining, and Removing Trees and Cutting Brush- Safety
Requirements

- D. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- E. American Society for Testing and Materials (ASTM) Publications:
 - C136-06Sieve Analysis of Fine and Coarse Aggregates
 - C516-08Vermiculite Loose Fill Thermal Insulation
 - C549-06Perlite Loose Fill Insulation
 - D977-05Emulsified Asphalt (AASHTO M140)
 - D1557-09Test Methods for Laboratory Compaction of Soil
 - D2028-97 (Rev. 2004).....Cutback Asphalt (Rapid-curing Type)
 - D2103-08Polyethylene Film and Sheeting
 - D5851 (Rev 2006)..... Planning and Implementing a Water Monitoring Program
- F. Turfgrass Producers International:Turfgrass Sodding.
- G. U. S. Department of Agriculture Federal Seed Act.
Amended July 2011.....Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turfgrass material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 ORGANIC SOIL AMENDMENT

- A. All areas to receive turfgrass seeding, sodding or sprigging may require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.
- B. Organic soil amendment will be spread and incorporated into the finished subgrade at the depths indicated on the Contract Drawings in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.
 - 1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1") screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.

2. Acceptable types of Organic Soil Amendments include peat moss, humus or peat, well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-150 meq/100 g
	Heavy Metals Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Organic content to be determined by the loss of ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the COTR/DISTRICT Agronomist.

2.3 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- C. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Resident Engineer, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
- D. Provide nursery grown, Grade 1, plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.
- E. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
- F. Bare-root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.
- G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the Resident Engineer in consultation with the DISTRICT Agronomist authorizes a change order

providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

- I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 LABELS

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

2.5 TOPSOIL

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

2.6 LIME

Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such fineness that not less than 90% must pass No. 8 mesh and not less than 25% must pass No. 100 mesh. Moisture is not to exceed 10%.

2.7 SOIL CONDITIONERS

- A. Peat shall be a natural product of // sphagnum moss peat // peat moss // hypnum moss // peat reed-sedge peat/peat humus // derived from a fresh-water site conforming to Fed. Spec.

Q-P-166, except as otherwise specified. Peat shall be shredded and granulated to pass through a ½ inch) mesh screen and conditioned in storage piles for at least six months after excavation.

- B. Coarse Sand: Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, and free of limestone, shale and slate particles and of toxic materials.
- C. Perlite shall conform to ASTM C549.
- D. Vermiculite shall be horticultural grade and free of any toxic materials and conform to ASTM C516.
- E. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm. (.004in. and .59in.).
 - 1. Pine bark shall be aged sufficiently to break down all woody material. Pine bark shall be screened
 - 2. pH shall range between 4.0 and 7.0.
 - 3. Submit manufacturer's literature for approval.
- F. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

The planting soil mixture shall be composed of 3 parts topsoil, and 1 part peat moss.

2.9 PLANT FERTILIZERS

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

2.10 TURFGRASS FERTILIZER

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

starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.11 MEMBRANES

- A. Polyethylene shall conform to ASTM D2103 and shall be 0.1 mm (four mils) thick and clear in color.
- B. Fiberglass mat shall be of lime borosilicate glass fibers with an average fiber diameter of 0.3 mm (8 to 12 microns) and 50 to 100 mm (2 to 4 inch) strands of fiber bonded with phenol formaldehyde resin. The mat shall be 100 percent textile glass fiber. Mat shall be roll type, water permeable, and a minimum of 6 mm (1/4 inch) and maximum of 13 mm (1/2 inch) thick with a density of not less than 12 kg/m³ (3/4 pound per cubic foot).
- C. Landscape Fabric shall be a // spun bonded polyester fabric weighing 18 grams per square meter (3/4 oz per sq. yd) and with a 9,000 liter per minute flow rate per sq. meter (225 gal. per minute flow rate per sq. ft.) // woven needle-punched polypropylene weighing 113 grams per square meter (4.8 oz. per sq. yd.) And a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.)//

2.12 MULCH

- A. Mulch shall be free from deleterious materials and shall be stored as to prevent inclusion of foreign material.
- B. Inert mulch materials shall be riverbank stone, granite chips, marble chips, volcanic rock or similar and shall range in size from 25 mm (one inch) to 65 mm (2-1/2 inches) in accordance with ASTM C 136.
- C. Organic mulch materials shall be wood based products such as chips, nuggets or shredded hardwood:
 - 1. Straw for turfgrass seed bed mulch shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
 - 2. Wood cellulose fiber mulch for use with hydraulic application (Hydro mulch) with fertilizer shall consist of specially prepared wood cellulose fiber, processed to contain no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of the application of materials. Do not apply any turfgrass seed in this type mixture. On an air-dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus three percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber shall be manufactured so that:

- a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogenous slurry.
- b. When hydraulically sprayed on the ground, the material will form a blotter like cover.
- c. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.

2.13 ASPHALT ADHESIVE

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

2.14 EROSION CONTROL

- A. Erosion control net material shall be // heavy, twisted jute mesh weighing _____kg/m² (pounds per square yard). Openings between strands approximately _____mm square (inches square) // plastic net with a mesh of 13 mm square (1/2 inch square) // knitted synthetic netting, interwoven with paper strips in rolls approximately 1500 mm (56 to 60 inches) wide. Openings between strands shall be approximately 13 mm square (1/2 inch square) //. Material will be secured with 150 mm (6 inch) wire staples made by the same manufacturer as the netting. // Burlap of standard weave with a weight of 100 to 142 g/m (3.5 to 5.0 ounces per yard). // Chicken wire with a mesh of _____ // All erosion control material is to be installed according to the respective manufacturer's recommendations.
- B. Erosion control blanket material shall be cellulose fiber blanket bonded to 6 mm (1/4 inch) square plastic net weighing 10 kg/100 m² (20 pounds per 1000 square feet) in 1250 mm (50 inch) wide rolls.

2.15 STAKES AND GUYING STRAPS

- A. Provide stakes for tree support of rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be a minimum of 50 mm by 50 mm (2 inches by 2 inches), or 65 mm (2-1/2 inches) in diameter, by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1 ¼ in.) x 3000 mm (10') with cap, primed with 2 coats flat black exterior enamel.
- B. Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose of all the same color on the project.
- C. Flags to be fastened to guys shall be surveyor's plastic tape, white in color and 150 mm (6 inches) in length.
- D. Guying straps shall be a fabric material designed specifically to guy newly planted trees. No wire should ever be used for this purpose.

- E. Turnbuckles shall be galvanized or cadmium-plated and have a 75 mm (3 inch) minimum lengthwise opening fitted with screw eyes.
- F. Eye bolts shall be galvanized or cadmium plated having a 50 mm (one inch) diameter eye with a minimum screw length of 40 mm (1-1/2 inches).
- G. Deadmen shall be 100 mm by 200 mm (4 inch by 8 inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.
- H. Arrow shaped or auger iron anchors shall be noncorrosive, and sized according to the manufacturer's recommendation.

2.16 WATER

Water shall not contain elements toxic to plant life. It shall be obtained // from _____ // as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services at no cost to the Contractor.

2.19 ANTI-DESICCANT

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

2.20 SEED

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

Cool Season Turfgrass Seed Mixtures: Seed is % by weight

Primary mixture* – 50% perennial ryegrass, 30% Ky bluegrass, 20% fine fescue

SEEDING RATE = 6 lb/1000 sq.ft.

Secondary mixture* – 50% tall fescue and 50% perennial ryegrass

SEEDING RATE = 10 lb/1000 sq.ft.

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

Warm Season Turfgrass Seed Mixtures: Seed is % by weight**

Preferred mixture, sunny locations – Hybrid bermudagrass cultivars available as seed. Use a blend that contains a minimum of 2 cultivars in roughly equal proportion from this list – Sunsport, Princess, Riviera, Southern Star, Blackjack, Savannah, Primo Blend.

SEEDING RATE = 2 lb/1000 sq.ft.

Preferred species, shady locations: St. Augustinegrass – sod only

Secondary species, low visibility areas – centipedegrass or bahiagrass

SEEDING RATE = 8 lb/1000 sq.ft Bahiagrass or 2 lb/1000 sq.ft. Centipedegrass

** Zoysiagrass is not generally an acceptable turfgrass species for NCA cemetery use due to its extremely slow rate of growth and high maintenance costs. If unique environmental and growing conditions exist at a NCA construction site suggest that Zoysiagrass should be considered as the recommended turfgrass species, a special waiver endorsed by the NCA Chief Agronomist and appropriate DISTRICT Agronomist must be obtained in writing before approval of the planting plan.

Any deviation from these turfgrass species requirements must be approved in writing by the NCA Chief Agronomist and/or appropriate DISTRICT Agronomist in coordination with the RE and/or COTR.

2.21 SOD

Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding. Sod must also conform to the turfgrass species limitations as outlined in seeding mixtures in 2.20C above in this spec.

2.22 HERBICIDES AND OTHER PESTICIDES

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

PART 3 – EXECUTION

3.1 LAYOUT

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

3.2 FINE GRADING AND ORGANIC SOIL AMENDMENT INCORPORATION

- A. Contractor shall obtain Resident Engineer's written approval of previously completed rough grading work prior to commencing organic soil amendment incorporation work.
- B. Immediately prior to dumping and spreading the approved organic soil amendment, the subgrade shall be cleaned of all stones greater than two inches (2") and all debris or rubbish. Such material shall be removed from the site. Prior to spreading of the organic soil amendment, subgrades which are too compact to drain water and too compact based upon compaction tests shall be ripped with a claw one foot (1') deep, pulled by a bulldozer two feet (2') on center, both directions. Contractor shall then regrade surface.
- C. Organic soil amendment material shall be placed and uniformly spread over approved finish sub-grades to a depth sufficiently greater than the specified depth so that after natural settlement and light rolling, the specified minimum compacted depth will have been provided and the completed work will conform to the lines, grades and elevations indicated. Incorporate organic soil amendment by disc harrowing, rototilling or other means in a uniform manner. The depth of incorporation shall be based upon the organic content of the tested and approved organic soil amendment, so as to produce a finished soil with an organic matter content of between four (4) and six percent (6%). Supply additional organic soil amendment material, after in-place testing and approval (see paragraph 1.4. E.1d), as may be needed to give the required organic matter content and finished grades under the Contract without additional cost to the Government.
- D. Disturbed areas outside the limit of work shall be spread with four inch (4") minimum depth of organic soil amendment material to the finished grade.
- E. No subsoil or organic soil amendment material shall be handled in any way if it is in a wet or frozen condition.
- F. Sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Connect contours and spot elevations with an even slope.
- G. After organic soil amendment material has been incorporated into the subsoil, it shall be carefully prepared by scarifying or harrowing and hand raking. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over one and

one half inch (1-1/2") diameter from the amended soil bed. The amended soil shall also be free of smaller stones in excessive quantities as determined by the Resident Engineer.

3.3 EXCAVATION FOR PLANTING

- A. The whole surface shall then be compacted with a roller or other suitable means to achieve a maximum dry density of 88 to 90 percent in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional organic soil amendment and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades. The acceptable condition of the finished soil grade for all areas that are to be established to turfgrass is best described as **"fine textured and firm"**. **The test for satisfactory firmness requires that the surface soil not be fluffy or powdery and will support the weight of an average adult person without creating a visible depression.**
- B. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- C. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the Resident Engineer may select other locations for plant material.
- D. 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.
- E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.
- F. Where existing soil is to be used in place, till new ground cover and plant beds to a depth of 100 mm (4 inches). Spread peat soil amendment uniformly over the bed to depth of 50 mm (2 inches) and thoroughly incorporate it into the existing soil to a depth of 100 mm (4 inches) using a roto-tiller or similar type of equipment to obtain a uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till the soil down to a depth necessary to support the growth of new planting. During tillage operations, remove all

sticks, stones, roots, and other objectionable materials. Bring plant beds to a smooth and even surface conforming to established grades.

- G. In areas of new grading where existing soil is being replaced for the construction of new ground cover and plant beds, remove 100 mm (4 inches) of existing soil and replace with topsoil. Plant beds shall be brought to a smooth and even surface conforming to established grades. Till 50 mm (2 inches) of peat soil amendment into the topsoil as specified.
- H. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2" high for shrubs and 4" high for trees.
- I. Treat plant saucers, shrub, and ground cover bed areas, after mulching, with preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.4 SETTING PLANTS

- A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants so that the root crown is 1" higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil.
- B. Backfill balled and burlapped and container-grown plants with the native soil removed from the planting hole to approximately half the depth of the ball and then tamp and water. It is desirable to use 100% percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material. For balled and burlapped plants, carefully fold back the top half of the burlap and remove tying materials. Any wire caging or similar material, must be completely removed. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill native soil; then form earth saucers or water basins around isolated plants with topsoil.
- C. Plant bare-root stock arranging the roots in a natural position. Form a hill or mound in the center of the planting hole to allow the plant to sit at the proper depth. The roots are then spread out, over, and down the "hill" in a natural position. The "hill" should be firm to avoid settlement of the entire plant. Remove damaged roots with a clean cut. Carefully work native soil in among the roots. Tamp and water the remainder of native soil; then form earth saucers or water basins around isolated plants with topsoil.

3.5 STAKING AND GUYING

- A. Stake and guy plants as shown on the drawings and as specified.

- B. Drive stakes vertically into the ground to a depth of 800 to 900 mm (2-1/2 to 3 feet) in such a manner as not to injure the ball or roots, unless otherwise shown on the drawings.
- C. Place deadmen not less than 450 mm (18 inches) below the surface of the ground, unless otherwise shown on the drawings.
- D. Install iron anchors according to manufacturer's recommendations.
- E. Fasten flags securely on each guy strap approximately 2/3 of the distance up from ground level.
- F. Remove stakes and guy straps after one year.

3.6 MULCHING PLANTS

- A. Mulch within 48 hours after planting and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Do not mulch in ground cover areas that shall have organic material placed before planting.
- B. Placing Inert Material: Place polyethylene sheet fiberglass mat Landscape fabric with edges lapped 150 mm to 300 mm (6 inches to 12 inches) to receive inert mulch material. Punch a grid of 6 mm (1/4 inch) holes for drainage in the polyethylene sheet fiberglass mat 300 mm (one foot) on centers over the entire area. Spread inert mulch to a uniform thickness over the membrane as shown.
- C. Placing Organic Material: Spread a mulch of wood based origin to a uniform minimum thickness of 50-75 mm (2-3 inches).
- D. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.7 PRUNING

- A. Prune new plant material and indicated existing plant material in the following manner:
Remove dead, broken and crossing branches. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove the leader. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.
- B. Existing trees to be pruned are shown on the drawings. Perform tree pruning and cavity work by a licensed arborist an arborist in accordance with ANSI Z 133.1. Remove dead wood 13 mm (1/2 inch) or more in diameter, branches interfering with or hindering the healthy growth of the trees, and diseased branches with a clean cut made flush with the branch collar. Cut back or remove branches as necessary to give the trees proper shape and balance. In removing large limbs, make the initial cut on the underside at a safe distance from the trunk or lateral, to

prevent ripping of bark. Ensure branches and trimmings do not endanger traffic or cause damage to property during removal. Section large branches or limbs that cannot be removed in one piece without endangering traffic or property. Lower sections by ropes. Repair any damage resulting from the Contractor's negligence during pruning. Workmen are not permitted to climb trees with climbing spurs. To promote proper healing, cut off flush with the branch collar stubs or limbs that have resulted from improper cuts or broken as a result of former pruning. Remove girdling roots.

3.8 FERTILIZATION OF EXISTING TREES

Apply fertilizer to existing trees shown on the drawings at the rate of 36 g/mm (2 pounds per inch) caliper. Apply in 300 mm to 450 mm (4 inch to 8 inch) deep holes 40 to 50 mm (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at not more than 600 mm (2 feet) on center throughout the outer half of the branch spread zone of each tree. Fertilize to within 100 mm (4 inches) of the surrounding grade. Use topsoil to bring the surface up to the surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply in accordance with manufacturer's recommendations.

3.9 TILLAGE FOR TURFGRASS AREAS

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

3.10 FINISH GRADING

After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of ____150____ mm (6 inches). Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.11 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft. In addition, adjust soil acidity as recommended by soil test results and add any soil conditioners as specified herein for suitable topsoil under PART 2, Paragraph 2.2AandB, and 2.5 TOPSOIL.
- B. Spread lime as recommended by the soil test results.

- C. Incorporate lime into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation. Starter fertilizer should be lightly mixed with the top ½ inch of soil. Immediately restore the soil to an even condition before any seeding or sod placement.

3.12 MECHANICAL SEEDING

- A. Broadcast seed by approved application equipment at the rate as outlined in section 2.20C in this spec above. All turfgrass seed shall be planted prior to the application of any mulch material. The seed shall be uniformly distributed in a minimum of 2 directions at right angles to each other. Drag the seeded area to inter-mingle the seed and surface soil by means of spike-tooth harrow, cultipacker, or other approved device.
- B. Immediately after dragging, firm the entire area with a roller not exceeding 225 kg/m (150 pounds per foot) of roller width.
- C. Immediately after preparing the seeded area, evenly spread an organic mulch of straw by hand or by approved mechanical blowers at the rate of 0.5 kg/m² (2 tons per acre). Application shall allow some sunlight to penetrate and air to circulate but also reduce soil and seed erosion and conserve soil moisture. Anchor mulch by a mulch tiller, asphalt emulsion, twine, or netting. When asphalt emulsion is used, apply either simultaneously or in a separate application. Take precautionary measures to prevent asphalt materials from marking or defacing structures, pavements, utilities, or plantings.

3.13 HYDRO-MULCHING

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

3.14 SODDING

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

3.15 WATERING

- A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 50 mm (2 inches). Supervise watering operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment.

Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.

- B. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the Resident Engineer. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.16 PROTECTION OF TURFGRASS AREAS

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

3.19 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations lay the material evenly and smoothly and in contact with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.
- B. For waterways, unroll the material in the direction of water flow. When two or more strips are required to cover a ditch area, they shall overlap at least 100 mm (4 inches). In case a strip is to be spliced lengthwise, the ends of the strips shall overlap at least 150 mm (6 inches) with the upgrade section on top.
- C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.
- D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 1200 mm (4 feet) longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 300 mm (one foot) intervals at the end. Firmly embed staples in the underlying soil.
- E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Warranty Period.

3.17 RESTORATION AND CLEAN-UP

Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one

paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.18 ENVIRONMENTAL PROTECTION

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

--END--

SECTION 33 10 00
WATER UTILITIES

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.
4. Sites for national cemeteries may have full, limited, or no access to existing potable water supply sources from existing government operated campus type water systems, or from connection to municipal water systems. Adjust this specification section according to the conditions applicable for the potable water supply for the specific project site.
5. Fire protection for NCA cemetery facilities may be provided from the same potable water supply sources as that for the buildings, from onsite ponds, or from the irrigation system which may only be available for the portion of the year when the irrigation system is operational. Modify this specification section accordingly, based upon the conditions applicable for the specific project site.
6. The "Safe Drinking Water Act" (SDWA) was originally passed into law in 1974. It was amended several times. The "Reduction of Lead in Drinking Water Act" was passed in January 2011 and amends the SDWA to the new lead free standard to include NSF 61 and NSF 372.

PART 1 - GENERAL

SPEC WRITER NOTE: Retain following Description paragraph 1.1 and modify as appropriate for the project.

1.1 DESCRIPTION

- A. Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing potable water supply.

B. Definitions:

SPEC WRITER NOTE: Modify the definitions to reflect the site specific conditions regarding which type of services are to be provided from the potable water supply source.

1. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout the site, as applicable, and in the building areas that provides water from the potable water supply source for the project, including //hydrants, // valves, and other appurtenances used to supply water for domestic, //and fire-fighting/fire protection// purposes only when required due to Life Safety issues.
2. Water Service Line: Pipe line connecting building piping to water distribution lines.

SPEC WRITER NOTE: Add or delete paragraphs that are applicable to the potable water utilities for the project.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS. Erosion and Sediment Control.
- F. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- G. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- H. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- I. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- J. Section 09 91 00, PAINTING.

SPEC WRITER NOTE: If Section 21 12 00 is included in this project the section shall be obtained from VA Masters.

- K. Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- L. //Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Building Plumbing starting 1500 mm (5 feet) outside of the building.//

- M. Section 31 20 00, EARTH MOVING: Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing.

SPEC WRITER NOTE: Coordinate the work for the Water Utilities to ensure connection is made between the water utility and the building where applicable, at 1500 mm (5 feet) outside of the building.

- N. //Section 32 30 00, SITE FURNISHINGS: Flower Watering Spigot Assemblies.//

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- A112.6.3-2016.....Floor and Trench Drains
 - B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250
 - B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings
 - B16.26-2013.....Cast Copper Alloy Fittings for Flared Copper Tubes
 - B18.2.2-2015.....Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
 - B18.5.2.1M-2006 (R2011).Metric Round Head Short Square Neck Bolts
 - ASME Boiler and Pressure Vessel Code -
 - BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications
- C. American Society of Safety Engineers (ASSE):
- 1003-2009 Water Pressure Reducing Valves

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

A36/A36M-2014.....Standard Specification for Carbon Structural
Steel

A47/A47M-1999 (R2014)...Standard Specification for Ferritic Malleable
Iron Castings

A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings

A148/A148M-2015a.....Standard Specification for Steel Castings, High
Strength, for Structural Purposes

A307-2014.....Standard Specification for Carbon Steel Bolts,
Studs, and Threaded Rod 60,000 PSI Tensile
Strength

A536-1984(R2014).....Standard Specification for Ductile Iron
Castings

A563-2015.....Standard Specification for Carbon and Alloy
Steel Nuts

B61-2015.....Standard Specification for Steam or Valve
Bronze Castings

B62-2015.....Standard Specification for Composition Bronze
or Ounce Metal Castings

B88-2014.....Standard Specification for Seamless Copper
Water Tube

B117-2011.....Standard Practice for Operating Salt Spray
(Fog) Apparatus

B633-2013.....Standard Specification for Electrodeposited
Coatings of Zinc on Iron and Steel

C443-2012.....Standard Specification for Joints for Concrete
Pipe and Manholes, Using Rubber Gaskets

C857-2014.....Standard Practice for Minimum Structural Design
Loading for Underground Precast Concrete
Utility Structures

C858-2010e1.....Standard Specification for Underground Precast
Concrete Utility Structures

D1785-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Plastic Pipe, Schedules 40, 80, and 120

D2000-2012.....Standard Classification System for Rubber
Products in Automotive Applications

- D2464-2015.....Standard Specification for Threaded Poly(Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- D2467-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2672-2014.....Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- F437-2015.....Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F439-2013.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F441/F441M-2015.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F593-2013a.....Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- E. American Water Works Association (AWWA):
- B300-2010.....Hypochlorites
- B301-2010.....Liquid Chlorine
- C104-2013.....Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C111-2012.....Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C115-2011.....Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- C150-2014.....Thickness Design of Ductile-Iron Pipe
- C151-2009.....Ductile-Iron Pipe, Centrifugally Cast
- C153-2011.....Ductile-Iron Compact Fittings
- C502-2014.....Dry-Barrel Fire Hydrants

- C504-10.....Rubber-Seated Butterfly Valves
- C508-2009.....Swing-Check Valves for Waterworks Service, 50
mm thru 600 mm (2 inches through 24 inches) NPS
- C509-2009.....Resilient-Seated Gate Valves for Water Supply
Service
- C510-2007.....Double Check Valve Backflow Prevention Assembly
- C511-2007.....Reduced-Pressure Principle Backflow Prevention
Assembly
- C512-07.....Air Release, Air/Vacuum and Combination Air
Valves
- C550-2013.....Protective Interior Coatings for Valves and
Hydrants
- C600-2010.....Installation of Ductile Iron Water Mains and
Their Appurtenances
- C605-2013.....Underground Installation of Polyvinyl Chloride
(PVC) and Molecularly Oriented Polyvinyl
Chloride (PVC0) Pressure Pipe and Fittings
- C651-2014.....Disinfecting Water Mains
- C700-2015.....Cold-Water Meters - Displacement Type, Metal
Alloy Main Case
- C701-2015.....Cold-Water Meters - Turbine Type, for Customer
Service
- C702-2015.....Cold-Water Meters - Compound Type
- C706-2010(Withdrawn)....Direct-Reading, Remote-Registration Systems for
Cold-Water Meters
- C707-2010.....Encoder-Type Remote-Registration Systems for
Cold-Water Meters
- C800-2014.....Underground Service Line Valves and Fittings
- C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 100 mm Through 300 mm (4
inches Through 12 inches), for Water
Transmission and Distribution
- C906-15.....Polyethylene (PE) Pressure Pipe and Fittings, 4
In. (100 mm) Through 64 In. (1,600 mm), for
Water Distribution and Transmission
- F. American Welding Society (AWS):
 - A5.8/A5.8M-2011.....Specification for Filler Metals for Brazing and
Braze Welding

- G. Copper Development Association, Inc. (CDA):
A4015.....Copper Tube Handbook
- H. National Fire Protection Association (NFPA):
24-2016.....Standard for the Installation of Private Fire
Service Mains and Their Appurtenances
- I. NSF International:
61-2014a.....Drinking Water System Components-Health Effects
- J. University of Southern California Foundation for Cross Connection
Control and Hydraulic Research (USC FCCCHR):
9th Edition.....Manual of Cross-Connection Control

SPEC WRITER NOTE: Review and edit the following submittal listing, as applicable, for the specific conditions of the project site. Fire Hydrant Assemblies are included in this section for submittal, even though they may be installed and connected to the irrigation system at the project site. If the project site is an existing facility with potable water and fire protection uses from the same system, then the fire hydrants are typically included in the NCA water utilities.

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 10 00, WATER UTILITIES", with applicable paragraph identification.
- C. Make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval by VA will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly

integrated their equipment and controls to provide a complete and efficient installation.

- F. Provide lists of previous installations by the installing contractor. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.

SPEC WRITER NOTE: Modify the list in the following paragraph to include those items relevant for this specific project. Add any items that may be missing and delete those not being utilized and renumber.

- G. Manufacturers' Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit all items as one package. Ductile iron pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and AWWA C605 respectively.

1. Piping.
2. Fittings
3. Gaskets.
4. Valves.
5. Fire hydrants.
6. Meter.
7. Vaults, frames and covers.
8. Steps.
9. Backflow Preventer
10. Post indicator.
11. Valve boxes.
12. Corporation and curb stops.
13. Curb stop boxes.
14. Joint restraint.
15. Disinfection products.
16. Warning Tape
17. Link/sleeve seals.

- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a compatible and efficient installation. Final review and approvals will be made only by groups.

I. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

SPEC WRITER NOTE: Modify the following paragraph to indicate all of the testing certifications that will be required for this work. Clarify whether the Contractor is required to submit the procedures to be followed, timing for the work in the project, and who will be performing the certifications and what will be certified. Clarify how much of the above is required during the submittal process for this section and whether it is required as part of the all-inclusive submittal.

J. Testing Certifications:

1. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

K. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

L. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

1.5 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply, and servicing of the specified products for at least 5 years. However, digital electronics devices, software, and systems such as controls, instruments, and computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.

2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within ____ km (____miles) // 160 km (100 miles)// of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail, or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail, e-mail addresses, and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation, and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability, and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the (COR).
5. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be the product of one manufacturer.
6. Assembled Units: Ensure that manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
8. Use of asbestos containing products, equipment, or materials is prohibited.

SPEC WRITER NOTE: Edit, delete and or modify Paragraphs B and C, as required, to reflect the conditions for providing a potable water supply source for the

project site. Delete as required and
renumber accordingly.

- B. //Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.//
- C. //Comply with all rules and regulations of Federal, State, and Local //Health Department// //Department of Environmental Quality// having jurisdiction over the design, construction, and operation of potable water systems.//
- D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed //electronic// copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- E. Welding: Before any welding is performed, submit a certificate certifying that welders comply with the following requirements:
 - 1. Qualify welding processes and operators for piping according to ASME BPVC Section IX.
 - 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 - 3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 - 4. All welds shall be stamped according to the provisions of the American Welding Society.
- F. Execution (Installation, Construction) Quality:
 - 1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
 - 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely

- accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.
3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
 5. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.
- G. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading, and welding of piping shall be removed.
 2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
 3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, and fixture faucets shall be flushed of debris prior to final acceptance.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.
- H. All material surfaces in contact with potable water shall comply with NSF 61.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until final acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall

not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter with double thickness cement mortar lining interior, interior asphaltic seal coat, and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.

SPEC WRITER NOTE: Modify the following paragraph and clarify which conditions are applicable for the project. If restrained joint pipe is required, modify to provide information describing the approved restrained joints.

2. Below Grade: Supply pipe in lengths not in excess of a nominal 6.1 m (20 feet) with rubber ring type push-on joints, mechanical joint, or approved restrained joint. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.

SPEC WRITER NOTE: Modify or delete the following based upon the determination of soil characteristics as indicated in SPEC WRITER NOTE for paragraph DUCTILE IRON PIPE in PART 3.

3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation, and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter.
//Provide flange joint pipe where shown on the drawings.// Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 861 kPa (125 psi) or 1724 kPa (250 psi) standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and as herein specified in paragraph LINK/SLEEVE SEALS.
3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
4. Rubber Ring Gaskets: Full face type, AWWA C111, 1.6 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.

SPEC WRITER NOTE: Modify as required to identify what the paint color shall be, based upon the location for the pipe.

5. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop-primed on the outside with one coat of the pipe manufacturer standard color of rust inhibitive primer or equal. Finished paint color shall be as selected for the location.

SPEC WRITER NOTE: Modify the following and identify where the two identified types of bolt assemblies are to be used. Connections that will periodically be opened for maintenance should use the stainless steel.

6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.

- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2413 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148/A148M. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 861 kPa (125 psi) or

1724 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.

- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Class-Rated Polyvinyl Chloride (PVC) Pipe: Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working pressure, and production code.

- 1. PVC pipe and accessories 100 mm to 355 mm (4 inches to 14 inches) in diameter, AWWA C900, Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
- 2. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441/F441M.

B. Joints:

- 1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F477.
- 2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D2464) or solvent welded (ASTM D2672). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

- 1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153. Mechanical joint fittings shall include retainer glands, unless otherwise noted.
- 2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. Solvent welded fittings shall conform to ASTM D2467. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.3 MECHANICAL JOINT RETAINER GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances conforming to either AWWA C111 or AWWA C153, shall conform to the following:
1. Restraint devices for nominal pipe sizes 75 mm (3 inch) through 900 mm (36 inch) shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of AWWA C110.
 2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
 3. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 Brinell Hardness Number (BHN).
 4. An identification number consisting of year, day, plant, and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. All components shall be manufactured in the United States.
 5. Mechanical Joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 6. Mechanical joint restraints shall be listed by Underwriters Laboratories, and approved by Factory Mutual in the 75 mm (3 inch) through 300 mm (12 inch) sizes.
 7. All casting bodies shall be surface pretreated with a phosphate wash, rinse, and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester-based powder to provide corrosion, impact, and UV resistance.

2.4 COPPER PIPE AND TUBING

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

SPEC WRITER NOTE: Modify and/or delete
the following paragraphs based upon the
valve types applicable for the project.

2.5 VALVES

A. Gate:

1. Unless otherwise specified, valves shall conform to AWWA C509 with mechanical-joint ends. Valves 75 mm (3 inches) and greater shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type, turning counter-clockwise to open, with a minimum 1380 kPa (200 psi) WOG. The resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Asbestos packing is prohibited.

2. Operator:

- a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation.
 - b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

- ### B. Check Valve: Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, and trademark shall be cast on the body of each valve. Valves 50 mm (2 inches) and greater shall be //outside lever and spring// //outside lever and weight// // // type.

1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or ASTM B62, 1380 kPa (200 psi) WOG.
2. 100 mm (4 inches) and Greater: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1380 kPa (200 psi) WOG. Check valves shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.

- C. Corporation Stops and Saddles: Ground key type; bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.
- D. Curb or Service Stops: Ground key, round way, inverted key type; made of bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow. Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1380 kPa (200 psi) WOG per AWWA C800.
- E. Vacuum and Air Relief Valves: Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Valves shall be rated for the same operating pressure as the pipeline.
- F. Pressure Reducing Valves: Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for // // kPa (// // psi) operating pressure on the inlet side, with outlet pressure set for // // kPa (// // psi). The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be //threaded// //flanged//. Valve bodies shall be bronze, cast iron, or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

SPEC WRITER NOTE: The following two paragraphs shall be modified or deleted, as applicable based upon the project conditions. The final water utility pipe installation shall be locatable by the NCA staff with appropriate locating equipment, and the warning detection tape

shall be present when excavating down on top of the water utility pipeline or appurtenances.

2.6 TRACER WIRE FOR NONMETALLIC PIPING

- A. Provide bare copper or aluminum wire not less than 2.5 mm (0.10 inch) in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.7 WARNING TAPE

- A. Standard, 0.10 mm (4-mil) polyethylene 75 mm (3 inch) wide tape, //detectable// //non-detectable// type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

SPEC WRITER NOTE: Modify or delete the following paragraph according to the project conditions. For existing NCA facilities, the Spec Writer shall determine if the NCA has suitable equipment for the purposes of utility location, and if not, or if the equipment doesn't perform the required location capabilities, revise this paragraph and those in Part 3 to require that the Contractor provide appropriate location equipment.

2.8 //LOCATOR EQUIPMENT

- A. Provide location equipment (device and appurtenances) suitable for locating tracer wire and/or detectable warning tape placed above water utility lines at the actual depths for this project. The locator device shall be capable of locating the detectable warning tape from above the tape without making physical contact with the detectable warning tape. Before acceptance, the equipment shall be demonstrated at various locations and conditions for the project to confirm the functionality for its intended purpose.//

2.9 CURB STOP BOX

- A. Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 600 mm (2 feet) above top of deepest stop box.

2.10 VALVE BOX

SPEC WRITER NOTE: Indicate how many "T" handles are to be provided by the Contractor; it is recommended that a minimum of 2 be provided.

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide // // "T" handle socket wrenches of 18 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box. The least diameter of the shaft of the box shall be 135 mm (5-1/4 inches). Cast iron box shall have a heavy coat of bituminous paint. Valve box and cover shall be installed where indicated on the drawings to be utilized as access points for the tracer wire or detectable warning tape.

2.11 POST INDICATOR VALVE

- A. Valve: Valve shall conform to the specifications listed in paragraph VALVES for gate valves. The Post Indicator shall conform to NFPA 24 and shall be fully compatible with the valve and all the supervisory switches.

2.12 FIRE HYDRANTS

- A. Size of main valve opening of each hydrant shall be 135 mm (5-1/4 inches), minimum. Hose thread, size of fire apparatus connection, and shape, size, and direction of rotation of operating head of hydrant shall be identical with //present local fire department and/or water department standards// //those in use at the facility//.
- B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:
1. Interior removable without digging up hydrant; can be packed under pressure; one 115 mm (4-1/2 inch) pumper connection and two 65 mm (2-1/2 inch) hose connections with caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 50 mm (2 inches) above finished grade. All fire hydrants shall have 150 mm (6 inch) bottom connection. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502.

2. Provide fire hydrants with a finish paint identical to the existing fire hydrants. If there are no existing hydrants, contact the nearest fire department responder (fire department) to the site for appropriate color.

SPEC WRITER NOTE: Indicate how many operating wrenches are to be provided by Contractor. It is recommended that a minimum of 2 be provided.

- C. Provide // // wrenches with handles not less than 355 mm (14 inches) long.

2.13 TAPPING SLEEVES

- A. Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, stainless steel or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings, and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of //1035// // // kPa //(150// //(// psi). Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 67.8 Newton-meters (50 foot-pounds).

SPEC WRITER NOTE: Modify the following to make pipe sleeves under roadways to be in compliance with the local State Department of Transportation standards, or for a selected local town, or specify on the drawings the size, material, thickness, length, etc.

2.14 PIPE SLEEVES

- A. Cast gray ductile iron or zinc coated steel.

2.15 SLEEVE-TYPE MECHANICAL COUPLINGS

- A. Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward

each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. //For //ductile iron// //and// //PVC plastic// pipe, the middle ring shall be of cast iron //or steel; and the follower rings shall be of malleable or ductile iron//.// //For steel piping, the middle ring shall be of steel and the follower rings shall be of steel or malleable iron.// //Cast iron, ASTM A48/A48M not less than Class 25.// Malleable and ductile iron shall conform to ASTM A47/A47M and ASTM A536, respectively. //Steel shall have a strength not less than that of the pipe.// Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1 or with hex nuts, ASME B18.2.2. Bolts shall be 18 mm (5/8 inch) in diameter; minimum number of bolts for each coupling shall be // // for // // mm (// // inch) pipe, // // for // // mm (// // inch) pipe, and // // for // // mm (// // inch) pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.16 BACKFLOW PREVENTER

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 103 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 24.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.

- D. Backflow preventers shall be approved by the Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR) of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous, or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance, and repair. Access and clearance shall require a minimum of 300 mm (1 foot) between the lowest portion of the assembly and grade, floor, or platform. Installations elevated more than 1500 mm (5 feet) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

SPEC WRITER NOTE: Retain only one applicable Water Meter paragraph and modify to include the name of the Water Service Utility, and the flow rate parameters for sizing the flow meter, as applicable.

2.17 //WATER METER

SPEC WRITER NOTE: Modify the following and provide flow rate information for sizing the meter. Select the appropriate paragraph 1 and modify as required.

- A. Furnished and set by Contractor for use by Owner. Meter shall be a:
 - 1. //Turbine Type Meters: Shall conform to AWWA C701 //Class I//
//Class II//. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed, and shall read in //liters// //cubic meters//
//(U.S. gallons)// //(cubic feet)//. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements of AWWA C701.//
 - 2. //Displacement Type Meters: Shall conform to AWWA C700. Registers shall be straight-reading and shall read in //liters// //cubic meters// //(U.S. gallons)// //(cubic feet)//. //Meters in sizes 15 mm through 25 mm (1/2 inch through 1 inch) shall be frost-protection

design.// Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be //a direct reading remote register designed in accordance with AWWA C706// //or// //an encoder type remote register designed in accordance with AWWA C707//. Meters shall comply with the accuracy and capacity requirements of AWWA C700.//

3. //Compound Type Meters: Shall conform to AWWA C702// and shall be furnished with strainers//. The main casing shall be //bronze// //cast iron protected by corrosion resistant coating// with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be //permanently sealed// //open// and shall read in //liters// //cubic meters// //(U.S. gallons)// //(cubic feet)//. //The meter shall be equipped with a coordinating register.// Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be //a direct reading remote register designed in accordance with AWWA C706// //or// //an encoder type remote register designed in accordance with AWWA C707//. Meters shall comply with the accuracy and capacity requirements of AWWA C702.//

2.18 //WATER METER

- A. Furnished and set by Water Service Utility.//

2.19 //WATER METER

- A. Furnished by Water Service Utility and installed by Contractor.//

2.20 //WATER METER

- A. Furnish and install meter approved by Water Service Utility. Forward approval.//

2.21 WATER METER BOXES

SPEC WRITER NOTE: Select one of the paragraphs in this section.

- A. Cast iron body and cover for water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

SPEC WRITER NOTE: Delete subparagraph below if not permitted.

1. Base section may be cast iron, PVC, PE, or other pipe.
B. Cast iron body and double cover for water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between

covers; and slotted, open-bottom base section of length to fit over service piping.

SPEC WRITER NOTE: Use meter box in paragraph below in walks or unpaved areas away from traffic; do not use in roadways.

- C. Polymer-concrete body and cover for water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping, vertical and lateral design loadings of 6800 kg minimum over 254 mm by 254 mm (15,000 lb minimum over 10 by 10 inches) square.

SPEC WRITER NOTE: Modify the following paragraph to include compliance with the local water purveyor's standards, if applicable. Whenever possible, install meters and backflow devices inside of buildings. Next choice for backflow devices is in above ground locations, especially where weather conditions allow.

2.22 CONCRETE VAULTS

- A. Precast, reinforced-concrete vault: ASTM C858, designed for AASHTO HS20-44 load designation.
1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 2. Drain: ASME A112.6.3, cast iron floor drain with outlet. Include body anchor flange, light-duty cast iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

SPEC WRITER NOTE: Retain one of the two following paragraphs. Alternate load designations are defined in ASTM C857.

3. //Manhole Frame and Cover: ASTM A48/A48M, Class No. 35A minimum tensile strength, gray cast iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//
4. //Manhole Frame and Cover: ASTM A536, Grade 60-40-18, ductile iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//

SPEC WRITER NOTE: Modify the cover assemblies for large meter and/or backflow preventer assemblies in underground vaults, when applicable, to require suitable hatches for access to the vault rather than manholes, whenever possible.

2.23 CAST IRON FRAME AND COVER, STEPS, ETC.

- A. Frames and Covers: Shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181 Kg (400 lbs.). The word "WATER" shall be stamped or cast into covers so that it is plainly visible.
- B. Manhole Steps: Plastic or rubber coated, pressure-molded to the steel. Plastic coating shall conform to ASTM D4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs are prohibited. Steps are not required in manholes less than 1.2 m (4 feet) deep.

2.24 POTABLE WATER

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

2.25 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5 gram tablets, and shall contain 65 percent chlorine by weight.

2.26 LINK/SLEEVE SEALS

- A. The seal assemblies shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and have the following properties as designated by ASTM: 1) coloration shall be throughout elastomer for positive field inspection; 2) each link shall have a permanent identification of the size and manufacturer's name molded into it.
 - 1. For Standard Service Applications: EPDM = ASTM D2000 M3BA510, Color = Black
 - 2. For Hydrocarbon Service Applications: Nitrile = ASTM D2000 M1BF510, Color = Green
 - 3. For High Temperature of Fire Seal Applications: Silicone = ASTM D2000 M1GE505, Color = Gray

- B. The modular seal hardware for fastening the links shall be sized according to the manufacturer's recommendations for the service intended. Bolts, flange hex nuts shall be:

SPEC WRITER NOTE: Spec Writer shall generally select the first paragraph 1. for conditions where the presence of groundwater on the outside of the penetration is not anticipated. Select the second paragraph 1. for conditions where groundwater, or other standing water, is anticipated on the outside of the penetration. The second paragraph 1. should be selected for any other conditions where the designer has concerns of long term corrosion of the fasteners.

1. //Mild Steel with a 415 MPa (60,000 psi) minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B633 and Organic Coating, tested in accordance with ASTM B117 to pass a 1,470 hour salt spray test.//
2. //316 Stainless Steel per ASTM F593, with a 585 MPa (85,000 psi) average tensile strength.//

- C. Quality Assurance: Manufacturer's modular seal components and systems shall be domestically manufactured at a plant with a current ISO-9002 registration. Copy of the ISO-9002 registrations shall be provided with the submittal for these items.

SPEC WRITER NOTE: Determine the appropriate wall opening (i.e. steel sleeve, Thermoplastic (HDPE) sleeve, cored hole or formed hole.) The wall opening size and/or type shall be selected according to recommendations found in the most recent modular seal catalog of the manufacturer. For openings that require water stops use the following:

- D. Water Stop Wall Sleeve: Unless otherwise shown or specified, install molded non-metallic high density polyethylene sleeves having an integrally formed hollow water stop. Water stop shall be sized a minimum of 100 mm (4 inches) larger than the outside diameter of the sleeve itself and allowing 1/2 movement between wall forms to resist pour forces. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve itself installed at each end of the sleeve so as to prevent deformation during the initial concrete pour

and to facilitate attaching the sleeve to the wall forms. End caps shall remain in place to protect the opening from residual debris and rodent entry prior to pipe insertion. The wall sleeve shall be manufactured by the same company as the modular seal assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 BUILDING SERVICE LINES

- A. Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed, provide temporary caps.

3.3 REGRADING

- A. Raise or lower existing valve and curb stop boxes, or any other applicable water system facilities, to finish grade in areas being graded.

3.4 PIPE LAYING, GENERAL

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as recommended by the manufacturer in order to maintain the product performance as if it were undamaged.
- B. All pipe and fittings shall be inspected just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost or time to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.
- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown. If elevations are not indicated, pipe shall have a minimum depth of cover of // // m (// // feet).
- D. Exercise extreme care when installing piping to shore up and protect from damage all existing utilities and structures.

- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth compacted in place to a depth of at least 300 mm (12 inches) over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends, and hydrants installed on underground pipe shall be anchored. See paragraph PIPE SUPPORTS.
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water, and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.

SPEC WRITER NOTE: Coordinate and modify this paragraph with the other paragraphs where warning tape, identification wire and Locator Equipment are described.

- M. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade above buried water pipes, or at bottom of subbase where roadways exist, whichever is deeper with overall depth not exceeding 600 mm (24 inches). Detectable warning tape shall be locatable by the NCA staff from the finish grade above the pipe, utilizing existing locating equipment, or the approved locator equipment provided by the Contractor to the Owner (NCA Staff) as specified in paragraph LOCATOR EQUIPMENT.
- N. Trench excavation and compaction of backfill shall comply with the requirements of Section 31 20 00, EARTH MOVING.

3.5 DUCTILE IRON PIPE

SPEC WRITER NOTE: Modify the following paragraph based upon testing of the soils. If soils are determined to be corrosive when tested in accordance with Appendix A of AWWA C105, then it is recommended that polyethylene encasement in accordance with the AWWA C105 standard be installed for corrosion protection.

Adjust the following paragraph accordingly.

- A. Installing Pipe: Lay pipe in accordance with AWWA C600// with polyethylene encasement, if required, in accordance with AWWA C105//. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.

SPEC WRITER NOTE: Modify the following paragraph to select the allowable procedure(s) for cutting the pipe in the field.

- C. When cutting pipe is required, the cutting shall be done by //machine,// //an appropriate industry standard method,// leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell in order to conform to the manufactured spigot end. Cement lining shall be undamaged// or perform cutting following manufacturer's recommendations for field cutting of pipe//.
- D. Jointing Ductile-Iron Pipe:
 - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home following industry standard procedures or manufacturer's approved means.
 - 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque. For new construction, all mechanical joints at valves and fittings shall be secured with an approved mechanical joint retainer glands suitable for the pipe.
 - 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of

structures, the socket end shall be at the structure and ball end assembled to the socket.

4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.6 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.

SPEC WRITER NOTE: Modify or delete the following paragraph for the project conditions and coordinate with the other paragraphs for tracer wire, warning tape, and locator equipment in this section.

- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (984 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

SPEC WRITER NOTE: Modify the following according to the project conditions and coordinate with the other paragraphs regarding identification wire, warning tape and locator equipment in this section.

3.7 TRACER SYSTEM INSTALLATION

- A. Install with all buried water main piping.
- B. Begin and terminate system at all connections to existing mains.
- C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 50 mm (2 inch) wide, 0.25 mm (10 mil) thickness polyethylene pressure sensitive tape.

- D. Install splices only as authorized by the COR. Allow the COR to inspect all below-grade splices of tracer wire prior to backfill.
- E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the COR.
- F. Bring two wires to the surface at each hydrant designated location within a valve box and cover and terminate with an accessible tracer wire termination.
- G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair any discontinuities.

3.8 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

3.9 PIPE SUPPORTS

- A. All piping shall be properly and adequately supported. Hangers, supports, base elbows, tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on center and at each fitting.
- B. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
- C. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
- D. Where hangers cannot be used, provide pipe saddle supports with pipe column and floor flange.

3.10 RESTRAINED JOINTS

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1380 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be as specified herein in paragraph MECHANICAL JOINT RETAINER GLANDS or approved equal.
- D. Thrust blocks shall be required, unless otherwise noted.
- E. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- F. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with the specified Mechanical Joint Restrainer Gland, or approved equal.

3.11 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
 - 1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary, or sewer service connection.
 - 2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
 - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
 - b. The water main invert is at least 457 mm (18 inches) above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
 - 3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile

iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 457 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 3 m (10 feet) horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in (1) above; or
 - b. The water main passes under a sewer or drain.
3. A vertical separation of 457 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.12 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 457 by 457 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Set curb stop box and cover for access to identification wire and/or detectable warning tape with a 300 by 300 by 75 mm (12 by 12 by 3 inches) at approximately the depth of the warning tape and bring the tape and/or identification wire into the box and coil extra length sufficient to allow the tape or wire to be uncoiled and extended 1500 mm (5 feet) above finish grade at the location.

- E. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.13 SETTING OF FIRE HYDRANTS

- A. Set center of each hydrant not less than 600 mm (2 feet) nor more than 1829 mm (6 feet) back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 457 mm (18 inches) above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.
- B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 381 mm (15 inches) square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of all foreign matter before installation.

3.14 PIPE SLEEVES

- A. Install where water lines pass through retaining walls, building foundations, and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.15 HYDROSTATIC TESTING

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, provide and install all required temporary thrust restraints required to safely conduct the test.
- E. Install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.

SPEC WRITER NOTE: Modify the pressure and leakage test pressure readings, as applicable to meet or exceed the requirements of the local water purveyor, or use 1.5 times the operating pressure for the water main, whichever is greater, and if no other information is available, use the value in the paragraph.

F. Perform pressure and leakage tests for the new system for 2 hours to 1380 kPa (200 psi). Leakage shall not exceed the following requirements.

1. Copper Tubing: No leaks.
2. Ductile Iron Pipe: AWWA C600. Provide to COR office.
3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COR office.

SPEC WRITER NOTE: Edit the following section to conform to governing Health Department/Department of Environment Quality Regulations.

3.16 FLUSHING AND DISINFECTING

- A. Flush and disinfect new water lines in accordance with AWWA C651.
- B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/s (2.5 f/s) at 276 kPa (40 psi) residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 76 cm/sec (2.5 ft/sec)(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. mm (in.)			
				25(1)	38(1 1/2)	51(2)	64(2 1/2)
mm	(In)	L/sec	(gpm)	Number of taps on pipe			
100	(4)	6.3	(100)	1	--	--	1
150	(6)	12.6	(200)	--	1	--	1
200	(8)	25.2	(400)	--	2	1	1
250	(10)	37.9	(600)	--	3	2	1
300	(12)	56.8	(900)	--	--	3	2
400	(16)	100.9	(1600)	--	--	4	2

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

- C. Provide the water source for filling, flushing, and disinfecting the lines; only potable water shall be used. Provide all required temporary

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

- D. Dispose of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.
- E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the //Health Department// //Department of Environmental Quality// of the State. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.17 BACKFLOW PREVENTOR TESTING

- A. All backflow preventers shall be installed, tested, and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COR.

3.18 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.19 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.20 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for
//four// // // hour//s// to instruct each VA personnel responsible in
the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance
with the requirements of Section 01 91 00, GENERAL COMMISSIONING
REQUIREMENTS.//

- - - E N D - - -

SECTION 33 40 00 STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, 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 Owner for review prior to commencement of the work of this Section:
 - 1. Manufacturers' documentation (including product data sheets) for all specified products.
 - 2. Shop drawings showing fabrication and construction details for drainage structures.

- C. At project completion, submit record (as-built) drawings showing installed system as specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

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

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. Florida Department of Transportation (FDOT):
2013 Standard Specifications for Road & Bridge Construction

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 OWNER requirements:

1. Precast Reinforced Concrete Rings: Rings or Sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the Sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top Section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top Sections shall be eccentric unless otherwise indicated on the Drawings. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Flat top manhole tops shall be reinforced concrete as detailed on the Drawings.
4. Precast Catch Basins: Concrete for precast Sections shall have a minimum compressive strength of 5,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO 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 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.

3.4 DRAINAGE STRUCTURES

- A. General:
 - 1. Circular Structures:
 - a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top

Section will be at the required elevation. Cutting the conical top Section is not acceptable.

- b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

B. Rectangular Structures:

- 1. Concrete work for cast-in-place reinforced concrete structures shall be constructed in accordance with Section 03 30 53, 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.

3.5 INSPECTION OF SEWERS

- A. Inspect and obtain the Owner'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.

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SECTION 33 46 13 FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies foundation drainage system, including installation, backfill, and cleanout extensions, to place of connection to municipal storm sewer or onsite facilities.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: For each type of filter fabric, pipe, and fitting indicated
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 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):
 - M006-08-UL Standard Specification for Fine Aggregate for Hydraulic Cement Concrete, Single User Digital Publication
 - M252-08-UL Corrugated Polyethylene Drainage Pipe
 - M288-06-UL Geotextile Specification for Highway Applications
- C. American Society for Testing and Materials (ASTM):
 - D448-08 Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D2321-08	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2751-(2005)	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
D2729-03	Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D2737-03	Standard Specification for Polyethylene (PE) Plastic Tubing
D3034-08	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D4216-06	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds
F477-08.....	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F758-95(2000)e1	Standard Specification for Smooth-Wall Poly (Vinyl Chloride)(PVC)Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.
F949-(2006a).....	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe for foundation drainage system shall be of the type and size indicated. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected.
- B. Underslab Header:
 - 1. ASTM A74 or ASTM A746 cast-iron soil pipe and fittings in DN 100 to DN 375 (NPS 4 to NPS 15). Joints shall be hub-and-spigot, gasket type.
 - 2. PE drainage tubing and fittings per ASTM D2737, in DN 100 to DN 250 (NPS 4 to NPS 10). Joints shall be coupling type.
 - 3. PE pipe and fittings per ASTM D2737, in DN 300 to DN 900 (NPS 12 to NPS 36). Joints shall be coupling type.

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

C. Perforated Drainage Pipe:

1. Perforated, PE pipe and fittings per ASTM D2737, in DN 100 to DN 150 (NPS 4 to NPS 6). Joints shall be coupling type.
2. Perforated, PE pipe and fittings per ASTM D2737, in DN 200 to DN 600 (NPS 8 to NPS 24). Joints shall be coupling type.
3. Perforated, PVC sewer pipe and fittings per ASTM D2729, in DN 100 (NPS 4) only. Joints shall be bell-and-spigot, loose type.

- D. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron. Gravity Sewer pipes shall have a neoprene gasket joints and long sweep elbow fittings. Cleanouts for pre-placed crypt field underdrains shall be as indicated on the drawings and shall be set so as to not interfere with mowing operations. Plastic tops for the crypt field cleanouts shall be provided with concrete anchorage with all features set so as to not cause damage to the mowers.

E. Drainage Conduit:

1. Pipe, fittings, and couplings shall be perforated and smooth PVC complying with ASTM D4216 and ASTM D2729.
2. Pipe size shall be 200 mm (8 inches) and have a high minimum flow rate equal to a DN 100 (NPS 4) pipe.
3. Fittings shall be PVC with DN 100 (NPS 4) outlet connection.
4. Couplings shall be PVC.

F. Filter Fabric

Filter fabric shall be a pervious sheet of polyester, nylon, or polypropylene filaments woven or otherwise formed into a uniform pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (AOS) no finer than the US Standard Sieve No. [_____] and no coarser than the US Standard Sieve No. [_____]. AOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. [The percent open area provided shall not be less than [_____] percent and not more than [_____] percent. Percent open area is defined as the summation of open areas divided by the total area of the filter fabric and expressed as a percent.] [The filaments shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, or vinylidene-chloride, and shall

contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.] The fabric shall have a minimum physical strength of [_____] pounds per inch in any direction when tested in accordance with ASTM D 5034 using the grab test method with 1 square inch jaws and a constant rate of travel of 12 inches per minute. Elongation at failure shall be between [30] [_____] and [70] [_____] percent. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other. [The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric.] [The fabric shall be woven into a width that may be installed as shown without longitudinal seams.]

G. Drainage Material:

1. Bedding: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.
2. Fill to 300 mm (1 foot) above pipe: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.

H. Concrete Sand: AASHTO M006.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Trenching and Excavation

Perform required trenching and excavation in accordance with Section 31 00 00 EARTHWORK. Keep trenches dry during installation of drainage system. Changes in direction of drain lines shall be made with 1/8 bends. Use wye fittings at intersections.

B. Bedding

Place graded bedding, minimum 6 inches in depth, in the bottom of trench for its full width and length compacted as specified prior to laying of foundation drain pipe. Each section shall rest firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall fully support the lower quadrant of the pipe.

C. Pipe Laying

1. Lay drain lines to true grades and alignment with a continuous fall in the direction of flow. Bells of pipe sections shall face upgrade. Clean interior of pipe thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed and the location marked with wooden

- stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and relaid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.
2. Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the Resident Engineer. Invert elevation of drain pipe shall not be higher than top of lowest floor elevation nor lower than a 45 degree line projected from bottom of any adjacent footing. Lay drain lines and firmly bed in granular material a minimum of 75 mm (3 inches) below invert to top of pipe to true grades and alignment with bells facing upgrade, and to slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed to 300 mm (1 foot) above top of pipe, unless otherwise noted.
 3. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standard:
 - a. PE and PVC pipe installation shall be per ASTM D2321 and ASTM F758.
 - b. PE joint construction shall be per ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, "Joint Properties."
 - c. PVC joint construction shall be per ASTM D3034 with elastomeric seals gaskets per ASTM D2321.
 - d. Perforated PVC joint construction shall be per ASTM D2729, with loose bell and spigot joints.
 4. Lay perforated pipe with perforations down. Lay plain end pipe with closed joints held in place with two No. 9 spring steel wire clips at each joint or by standard clay collars.
 5. For foundation subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 900 mm (3 feet), unless otherwise indicated.
 6. For underslab subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
 7. Install cleanout extensions where shown on the Contract Documents.
 8. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.

D. Jointing

Perforated and porous types of drain pipes shall be laid with closed joints.

- E. Backfilling: Place a minimum of 300 mm (12 inches) of granular material, hand tamped, extending in width a minimum of 600 mm (2 feet) from building wall. Then place a minimum of 150 mm (6 inches) of concrete sand, well tamped. Continue backfill with // concrete sand // pit run sand and gravel with a maximum plasticity index of 6 // drainage material from site excavation // to within 900 mm (3 feet) of finished grade in planting areas. Remainder of backfill shall be comparable to existing adjacent soils. In bituminous and concrete paving areas, backfill to the bottom of the base course with pervious material. Where foundation drain is within 600 mm (2 feet) of finished grade, one-half of fill shall be made with crushed stone.
1. Filter fabric may be substituted for sand layer.
 2. Vertical drainage mat in conjunction with geotextile may be substituted for sand and drainage material.
 3. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed and their location marked with wooden stakes.

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