

SECTION 03 30 53
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01410, TESTING LABORATORY SERVICES.

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:

- A. Testing agency retained and reimbursed by the Contractor and approved by the COR.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

1.4 TOLERANCES:

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch).

1.5 REGULATORY REQUIREMENTS:

- A. ACI 315 – Details and Detailing of Concrete Reinforcement.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 – Standard Specifications for Structural Concrete.

1.6 SUBMITTALS:

- A. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology and copy of report of latest CCRL, Inspection of Laboratory.
- B. Test Report for Concrete Mix Designs: Trial mixes including water-cement ratio curves, concrete mix ingredients, and admixtures.

1.7 PRE-CONCRETE CONFERENCE:

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
 - 1. Submittals.
 - 2. Coordination of work.
 - 3. Availability of material.
 - 4. Concrete mix design including admixtures.
 - 5. Methods of placing, finishing, and curing.
 - 6. Material inspection and testing.
- C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; Contracting Officer; COR.

1.8 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. Federal Specifications (Fed. Spec.):
 - MM-L-751HLumber Softwood
- C. American Concrete Institute (ACI):
 - 117-90Standard Specifications for Tolerances for Concrete Construction and Materials
 - 117R-90.....Commentary on Standard Specifications for Tolerances for Concrete Construction and Materials
 - 211.1-91Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 211.2-98Standard Practice for Selecting Proportions for Structural Lightweight Concrete

214-77	Recommended Practice for Evaluation of Strength Test Results of Concrete
301-99	Standard Specifications for Structural Concrete
304R-2000.....	Guide for Measuring, Mixing, Transporting, and Placing Concrete
305R-99.....	Hot Weather Concreting
306R-(R2002)	Cold Weather Concreting
308-(R1997)	Standard Practice for Curing Concrete
309R-96.....	Guide for Consolidation of Concrete
315-99	Details and Detailing of Concrete Reinforcement
318/318R-02	Building Code Requirements for Reinforced Concrete and Commentary
347R-(R1999)	Guide to Formwork for Concrete

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

A135.4-95	Basic Hardboard
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E. American Society for Testing and Materials (ASTM):

A82-02	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
A185-02	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
A615/A615M-03.....	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A653/A653M-03.....	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A706/A706M-03.....	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A767/A767M-00 REV.B	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
A775/A775M-01	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
A820-01	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
A996/A996M-03 REV.A	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
C31/C31M-03	Standard Practice for Making and Curing Concrete Test Specimens in the field
C33-03	Standard Specification for Concrete Aggregates
C39/C39M-01	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-03	Standard Specification for Ready-Mixed Concrete
C143/C143M-00	Standard Test Method for Slump of Hydraulic Cement Concrete
C150-02 REV. A	Standard Specification for Portland Cement
C171-03	Standard Specification for Sheet Materials for Curing Concrete
C172-99	Standard Specification for Sampling Freshly Mixed Concrete
C173-01	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-02	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
C231-97(E1999)	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C260-01	Standard Specification for Air-Entraining Admixtures for Concrete

C309-REV. A 98.....	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C330-03.....	Standard Specification for Lightweight Aggregates for Structural Concrete
C494/C494M-REV. A 99(E2001)	Standard Specification for Chemical Admixtures for Concrete
C496-96.....	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
C567-00.....	Standard Test Method for Density of Structural Lightweight Concrete
C618-03.....	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
C666-03.....	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
C881-02.....	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
C1107-02.....	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
D6-95(R2000)	Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
D297-93(R2002)(E2003)	Standard Test Methods for Rubber Products-Chemical Analysis
D1751-99	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D4397-02	Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
E1155-96(R2001)	Standard Test Method for Determining FF

F. American Welding Society (AWS):

D1.4-98	Structural Welding Code - Reinforcing Steel
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G. Concrete Reinforcing Steel Institute (CRSI):

DA4-90Manual of Standard Practice

H. National Cooperative Highway Research Program (NCHRP):

Report No. 244-81Concrete Sealers for the Protection of Bridge Structures

I. U. S. Department of Commerce Product Standard (PS):

PS 1-83.....Construction and Industrial Plywood

J. U. S. Army Corps of Engineers Handbook for Concrete and Cement:

CRD C513-74Rubber Waterstops

CRD C572-74Polyvinyl chloride Waterstops

PART 2 – PRODUCTS:

2.1 MATERIALS:

A. Portland Cement: ASTM C150 Type I or II.

B. Coarse Aggregate: ASTM C33.

1. Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
2. Maximum size of coarse aggregates not more than one fifth of narrowest dimension between sides of forms, one third of depth of slabs, nor three fourth of minimum clear spacing between reinforcing bars.

C. Fine Aggregate: ASTM C33.

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

E. Admixtures:

1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
3. High-Range Water-Reducing Admixture (Super plasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent

- testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260.
 6. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.
- F. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.
- G. Reinforcing Bars to be Welded: ASTM A706.
- H. Galvanized Reinforcing Bars: ASTM A767.
- I. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- J. Sheet Materials for Curing Concrete: ASTM C171.
- K. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.
- L. Epoxy shall be in conformance to ODOT SS-2070.

2.2 CONCRETE MIXES:

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
 2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, admixtures, weight of fine and coarse aggregate per m³ (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement ratio, and consistency of each cylinder in terms of slump.
 3. Prepare a curve showing relationship between water-cement ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
 4. If the field experience method is used, submit complete standard deviation analysis.
- B. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of the COR or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. The COR may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and approval of design mix.

- C. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str.	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
4,000 psi	300 (500)	*	310 (520)	*

* Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

- D. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, MM (INCHES)*

Type of Construction	Normal Weight Concrete
Reinforced Footings and Substructure Walls	5 inches

- * Slump may be increased by the use of the approved high-range water-reducing admixture (super plasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 75 mm to 100 mm (3 inches to 4 inches), and 100 mm to 125 mm (4 inches to 5 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.
- E. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

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

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 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	

F. Enforcing Strength Requirements: Test as specified in Section, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, Contracting Officer may require any one or any combination of the following corrective actions, at no additional cost to the Government:

1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, COR may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, the COR may order load tests, made by the Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the Contracting Officer.

2.3 BATCHING AND MIXING:

A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by the COR. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38°C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)

-17 degrees C to -1.1 degrees C degrees to 30 degrees F.)	(0	21 degrees C (70 degrees F.)
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1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the COR for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise COR.

PART 3 – EXECUTION

3.1 PLACING REINFORCEMENT:

- A. General: Details of concrete reinforcement in accordance with ACI 318 and ACI 315, unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
 1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with soil shall be made of or coated with a non-corroding material. Type, number, and spacing of supports conform to ACI 315.
- C. Spacing:
 1. Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.
 2. If the beam is formed against the trench sides, ensure trench sides are as close to vertical as possible. Reinforcement may need to be set slightly higher and narrower to account for the rougher surfaces in order to maintain required cover.
- D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
 1. Lap splices: Lap splices are permitted.
 2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength (fy) for the bars. Welding conform to the requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
 - a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
 - b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.

- c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by the COR.
- 3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength (fy) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
 - a. Initial qualification: In the presence of the COR, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.
 - b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.
- E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by Contracting Officer Representative.
- F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.
- G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

3.2 PLACING CONCRETE:

- A. Preparation:
 - 1. Remove hardened concrete, wood chips, shavings and other debris from forms.
 - 2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
 - 3. Ensure trench cuts are clean and vertical before depositing concrete. Once placed, the vertical sides of the beam should not bear on the soil at all (as they would if the beam was wider at the top than at the bottom). Material that has sloughed either because the soil isn't cohesive enough or because of it was kicked in shall be removed from the trench before depositing concrete. Non-cohesive spots shall be formed vertical.
 - 4. Ensure pre-cast boxes are level and stabilized from movement during concrete placement. Remove any temporary anchors from precast boxes immediately after placing concrete.
 - 5. Have forms, trench, pre-cast box placement, and reinforcement inspected and approved by the COR before depositing concrete.
 - 6. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.

1. Preparing surface for applied topping:

- a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
- b. Broom clean and keep base slab wet for at least four hours before topping is applied.
- c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete subject to approval of the COR.

D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.

1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (super plasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (super plasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.
7. Concrete on metal deck:

- a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
 - 1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.
- E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
 1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
 2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.3 HOT WEATHER:

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by the COR.

3.4 COLD WEATHER:

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Contracting Officer Representative.

3.5 PROTECTION AND CURING:

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Allow at least 7 days after concrete placement before backfilling the beam. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are

removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Contracting Officer Representative.

1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m²/L (400 square feet per gallon) on steel troweled surfaces and 7.5m²/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.6 CONCRETE SURFACE PREPARATION:

- A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.
- B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.
- C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

3.7 CONCRETE FINISHES:

- A. Concrete surfaces will not require additional finishing.

3.8 SITE WORK CONCRETE TESTING:

A. Batch Plant Inspection and Materials Testing:

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least 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 the COR make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. The COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at

- random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations.
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
 12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
 13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 17. Observe concrete mixing:

- a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
- a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:
- a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

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

--- E N D ---

SECTION 04 01 00
HEADSTONE CLEANING

1.1. DESCRIPTION OF WORK

1.1.1. This section outlines headstone cleaning services. The Contractor shall provide all supervision, professional advice/guidance, labor, parts, materials, equipment, and personnel, to provide the services defined herein.

1.1.2. The COR will determine the beginning point and ending points in each gravesite section.

1.1.3. DEFINITIONS:

1.1.3.a. “Clean” under this contract means the headstones and flat markers shall contain NO discoloration, environmental deposits, mold, mildew, moss, algae, lichen, dirt/mud, grass clippings, grass marks, bird droppings, etc.

1.2. All equipment and supplies maintained and operated by the Contractor shall be consistent and fully compliant with all applicable Federal, State, and County laws, ordinances and regulations and meet State inspection, safety, licensing, registration, and insurance requirements.

1.2.1. All in-ground vases, temporary markers, floral, commemorative, or other types of decorations (arrangements) causing interference with the headstone cleaning operation shall be carefully, and in an orderly manner, moved from and after completion of the work, moved back to all gravesites by the Contractor. Prior to removal, the contractor shall verify the numbering sequence and location of the headstone and associated decorations or vases.

1.2.2. Use care not to scratch or damage headstones or flat markers in any manner. Contractor shall be responsible for replacing damaged headstones or flat markers and restoring all damages caused to turf during performance of this work. Any headstones or flat markers that are chipped, marred, broken, or damaged by the Contractor shall be reported to the COR or the Cemetery Director by close of business each working day in order that the grave can be properly marked. The Contractor shall be responsible for the cost of the headstone replacement. The cost of the replacement headstones will be deducted from Contractor’s invoice(s). All headstone replacements must be coordinated with the COR. Any existing permanent gravesite control markers, temporary contractor installed control markers, grid or sectional monuments that are disturbed, displaced, or broken shall be replaced and properly reset by a licensed surveyor at the Contractor’s expense. Curbs, roads, walks, turf, trees, utilities, etc. existing above and below the ground that are damaged or disturbed by the Contractor during performance of contract work shall be repaired at the Contractor’s expense. The requirements of this paragraph shall be completed by the Contractor within fourteen (14) workdays, unless otherwise agreed to by the COR.

1.3. HEADSTONE CLEANING PROCESS

- 1.3.1. All in-ground vases, temporary markers, floral, commemorative, or other types of decorations (arrangements) causing interference with the cleaning of the headstones or flat markers operation shall be carefully, and in an orderly manner, moved from and after completion of the work, moved back to all gravesites by the Contractor. Prior to removal, the contractor shall verify the numbering sequence and location of the headstone and associated decorations or vases.
- 1.3.2. Cleaning techniques shall demonstrate a clear understanding of, and the sensitivity to, such environmental issues as ground water contamination, wetlands, etc., and shall be consistent and fully compliant with all applicable Federal, State, and County laws, ordinances and regulations.
- 1.3.3. Clean water shall be used to clean headstones and flat markers. Cleaning techniques with water shall include high pressure spraying, hand scrubbing, and rinsing. When water under pressure is used, such pressure shall not be greater than 600 PSI. Excessive staining and/or discoloration may be removed with pressurized water and a stiff nylon brush (no wire brushes, bleach, or abrasive cleaners shall be permitted) followed by rinsing with clear water.
- 1.3.4. If water used in cleaning should soften the soil around the base of the headstone or flat marker so that the headstone or flat marker is loosened, care shall be taken not to tip the headstone or flat marker out of plumb or alignment. Headstones and flat markers shall be set and anchored firmly in place with no movement from forces subjected by the COR or inspector after cleaning has been completed.
- 1.3.5. Care shall be taken to protect the turf area from damage. Any turf damaged by the Contractor shall be restored at Contractor's expense.
- 1.3.6. UPRIGHT AND FLAT MARBLE HEADSTONES ONLY: After cleaning upright marble headstones, apply a final undiluted spray application of "D/2 Biological Solution" cleaner (or approved equal) per manufacturer's recommendations to all sides of the headstone: Apply to WET stone surface using a sprayer; gently agitate with a soft bristle brush, and RINSE thoroughly with water. Contractor shall submit the required Safety Data Sheets (SDS) to the COR prior to use of any chemicals including but not limited to D/2 Biological Solution. **Do not use D/2 Biological Solution on upright granite, flat granite, or bronze markers.**
- 1.3.7. Headstones and flat markers that have been cleaned but become marked, discolored, dirt covered, or muddied due to subsequent contract work including but not limited to turf reestablishment issues shall be re-cleaned at no additional cost to the government. Headstones and flat markers that become discolored, dirt covered, or muddied, etc. after initial cleaning has been completed, but prior to overall project completion, shall

be re-cleaned at no additional cost to the government. All headstones and flat markers are to be clean at the time of the project Final Inspection.

- 1.3.8. The end result of this service is that the Contractor shall provide the Government “CLEAN” headstones. The definition of “CLEAN” is listed above in Paragraph 3.13.

--- E N D ---

SECTION 10 80 00
HEADSTONE RAISE, LOWER, REALIGN, LEVEL, BACKFILL

1.1. DESCRIPTION OF WORK

- 1.1.1. This section outlines upright headstone raise, lower, realignment, reset, and backfill services, defined as work consisting of extracting, resetting, aligning, backfilling, and compacting headstones that are already in place which have shifted out of vertical and/or horizontal alignment and plumb, as well as inventorying and assuring accurate placement on each gravesite at the Cemetery. (The term “headstone” shall hereafter refer to both upright and flat if not specified.) The Contractor shall provide all supervision, professional advice/guidance, labor, parts, materials, equipment, and personnel, to provide the services defined herein.
- 1.1.2. The COR will determine the beginning point and ending points in each gravesite section.
- 1.1.3. Upright headstone descriptions:
- 1.1.3.a. Standard upright headstones are approximately 42 inches long, 13 inches wide, 4 inches thick, and weigh approximately 230 pounds.
- 1.1.3.b. Other headstone types may exist and are not included in the contract scope of work unless otherwise specified.
- 1.1.4. All in-ground vases, temporary markers, floral, commemorative, or other types of decorations (arrangements) causing interference with the raise and realignment of upright headstone operation shall be carefully, and in an orderly manner, moved from and after completion of the work, moved back to all gravesites by the Contractor. Prior to removal, the contractor shall verify the numbering sequence and location of the headstone and associated decorations or vases.
- 1.1.5. Headstones shall be removed from their sockets using wooden and/or metal clamps. If metal clamps are used, the area that contacts the headstone must be protected with a rigid fabric that will prevent damage to and marking of the headstone. Clamps may be attached to a skid steer loader (i.e. Bobcat®) or similar machine to extract the

headstone from the socket. Use care not to scratch or damage headstones in any manner.

- 1.1.6. **WHEN HEADSTONES ARE REMOVED FROM THEIR SOCKETS, THEY SHALL BE CAREFULLY STORED ON EACH ASSOCIATED GRAVESITE.** DO NOT place on dirt piles or mud; they should be carefully placed on each associated gravesite and protected in such a way as to prevent any soiling and be out of the way of any other work. The headstones shall be laid with front inscription side up while the headstone is lying horizontally on the ground. The headstone shall be protected from direct ground contact while lying horizontally. The protection method shall be as approved by the COR and shall be free of deterioration in weather. An approved method is to support each headstone with two wood 4X4's. Alternate methods can be approved. Cardboard shall not be used. Wood or other suitable appropriate and attractive material shall be used to keep the headstones from contact with the soil while lying horizontally during the construction period. This also shows respect towards the families visiting the gravesites and the remains that are buried.
- 1.1.7. Contractor shall be responsible for replacing damaged headstones and restoring all damages caused to turf during performance of this work.
- 1.1.8. Crushed Rock Base Material Specifications:
- 1.1.8.a. Crushed Rock shall be composed of limestone, granite, dolomite, or any other hard, sound rock that is produced by blasting and then crushing.
 - 1.1.8.b. Crushed Rock shall be clean, hard, tough, and durable fragments (excluding) schist, shale or slate) of uniform quality throughout and free of any detrimental quantities of soft, friable, thin, elongated or laminated pieces, disintegrated material, dirt, organic matter, oil, alkali, or other deleterious substance.
 - 1.1.8.c. Crushed Rock shall consist of hard durable fragments of particles of rock, free of stripping dirt, vegetation, and other foreign substances. Hardness: Resistant to breaking, crushing or crumbling.
 - 1.1.8.d. Shape: Sharp and angular (Do not use rounded pea gravel.)
 - 1.1.8.e. Gravel or Crushed Gravel mixed with filler, sand, crushed rock, or crushed stone is **NOT** an acceptable substitutes.
 - 1.1.8.f. Crushed Rock shall consist of the product obtained by crushing rock or stone so that is meets the following gradation requirements:

Sieve Size % Passing	
Particle Size	% of Passing

1/2 inch	100
3/8 inch	70 – 90
No. 4	50 – 72
No. 8	35 – 55
No. 40	14 – 32
No. 200	4.0- 10.0

- 1.1.8.g. The gradation of crushed rock shall comply with ASTM D-448. Sampling and sieve analysis shall be performed in accordance with ASTM D-75 and ASTM C-136.

1.1.9. Compaction of Crushed Rock Base Material:

- 1.1.9.a. The Crushed Rock Base Material shall be compacted in lifts not exceeding 1-1/2” in thickness. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. If the fines are dry at the time of compaction, use a very fine mist type hose and spray the Base Material sparingly. The moisture content of the material during placing operations shall be within $\pm 2\%$ of the optimum moisture content as determined by ASTM D 1557. Compact each layer to 90% to 95% relative density. Do not perform compaction operations on excessively wetted soils.

- 1.1.9.b. Tamping Tools: Shall be approved by COR prior to use. Tamping tools shall have sufficient impact area and weight to achieve 90% to 95% compaction of the Crushed Rock Base Material. ***Tamping tools having wood handles and that do not have sufficient weight are not acceptable.***

1.2. UPRIGHT HEADSTONE INSTALLATION, BACKFILL, AND COMPACTION

- 1.2.1. Headstones shall be removed from their sockets per paragraph **1.1.5**.

- 1.2.2. Sockets shall be dug with a three (3) inch clearance at the front, back, sides and underneath the headstone. Headstone sockets shall be dug to the required depth to meet the height and alignment requirements as specified in paragraph **1.4.7**.

- 1.2.3. All headstone sockets shall be clean and free of loose dirt and debris prior to adding Crushed Rock Base Material.

- 1.2.4. Moistened Crushed Rock Base Material shall be added and heavily tamped to 90% to 95% compaction in the bottom of the sockets to provide a minimum three (3) inch footing under the base of the headstone prior to the re-installation of the headstones. Moistened Crushed Rock Base Material shall be placed around all four sides of the headstones and compacted, providing for a minimum fourteen (14) inches depth of Crushed Rock Base Material along the sides of the headstone as measured from the bottom of the headstone. Typically there should be three (3) inches of space remaining from the top of the compacted Crushed Rock Base Material to the ground surface to

allow tamped topsoil and grass seed to be applied, to match surrounding landscaping. The actual measurement shall vary depending on the how much the headstone was raised or lowered and will be approved by the COR.

1.2.5. The completed raised and realigned headstones shall be anchored firmly in place such that the headstones are rigid with no give or play in any direction regardless of the soil and terrain conditions. All headstones shall be firmly set and anchored in place with no movement from forces subjected by the COR.

1.2.6. In cases where headstone sockets need to be realigned/shifted, and/or re-dug, apply the following procedures:

1.2.6.a. After removal of the headstone(s), backfill and compact the existing socket prior to digging the new socket. Backfill the existing socket with Moistened Crushed Rock Base Material. Thoroughly tamp to 90% to 95% compaction at each 1-1/2" inch vertical intervals (1-1/2" inch lifts), leaving the last 3 inches at the top to have tamped topsoil and grass seed/sod applied.

1.2.6.b. Contractor shall dig/excavate the new socket in accordance with the requirements in paragraph 1.2.2.

1.2.6.c. All headstone sockets shall be clean and free of loose dirt and debris prior to adding Crushed Rock Base Material.

1.3. HEADSTONE RAISE AND REALIGNMENT PROCESS:

1.3.1. Prior to starting work in each burial section, the location of the existing permanent gravesite control markers and the required gravesite row/gravesite spacing layout dimensions shall be verified and certified by a licensed surveyor and coordinated with the COR.

1.3.1.a. The Contractor shall use a licensed surveyor to validate and/or relocate any existing permanent control markers that do not conform to the section layout.

1.3.1.b. The Contractor shall use a licensed surveyor to install temporary control markers where any existing permanent control markers cannot be located or are missing.

1.3.1.c. The Contractor shall use a licensed surveyor to accurately and precisely install temporary control markers at the ends of each gravesite row.

1.3.2. Headstones shall be accurately adjusted and precisely reinstalled on the correct gravesites by utilizing temporary grave plotting maps, existing permanent gravesite control markers, temporary contractor installed gravesite control markers, and temporary contractor installed control markers at the ends of each gravesite row. All measurements, setting of string lines, and the layout of rows/columns shall be taken

from existing or temporary gravesite control markers, and NOT from previously set headstones, unless otherwise directed by the COR.

- 1.3.3. The mean (or average) topsoil level shall be determined for the entire section to be aligned in all directions with assistance from a licensed surveyor and the COR, with approval by the COR. The Contractor shall use the mean (or average) topsoil level to allow all of the headstones in the section to be aligned vertically without having drastic changes in headstone heights (several inches) between the rows and columns of headstones in ALL directions. In irregular terrain where sloping and uneven ground conditions exist, all headstones and markers will be set at the proper height and overall level necessary to provide a smooth, flowing transition between ALL headstones in ALL directions through uneven terrain. The Contractor shall take the adjoining sections and/or terrain into consideration when determining the mean topsoil levels. IMPORTANT: To meet the requirement of a smooth, flowing transition, the Contractor may be required to set the headstones at a height other than at the specified height above grade with approval by the COR.

1.3.4. Keystone Placement and Installation

- 1.3.4.a. The headstone realignment process starts by the selection of specific headstones throughout the gravesite section to be designated as “Key” stones (or “Keystones”) for use throughout the remainder of the realignment process. Keystones shall be chosen and utilized throughout the section at a maximum spacing of every 10th headstone or at a more frequent spacing as necessary in areas of sloped or rolling terrain in order to achieve a smooth, flowing transition between the rows and columns.
- 1.3.4.b. Each of the Keystones shall be permanently set in accordance with the requirements of paragraphs **1.2** and **1.3** at the proper location and at the proper height using a licensed surveyor with the approval of the COR. The Keystones shall be laid out to the correct dimensions to match the required measurements for the section such that the rows and columns are evenly spaced. The vertical height of the Keystones shall be adjusted to accommodate the mean (average) topsoil levels throughout the entire section in order to achieve a smooth, flowing transition between all the rows and columns.
- 1.3.4.c. All Keystones shall be vertically plumbed and aligned by leveling the front, back, and sides while raising or lowering the headstone as necessary to achieve a height of 25 inches for upright headstones. IMPORTANT: To meet the requirement of a smooth, flowing transition, the Contractor may be required to set the Keystones at a height other than at the specified height above grade with approval by the COR.

- 1.3.4.d. The COR shall approve of the quantity, location, height, and installation of the Keystones prior to the Contractor continuing with the realignment process.
- 1.3.5. The next step in the headstone realignment process is the Contractor selects a row and a column of headstones at the center or close to the center of the section to be realigned with approval from the COR.
- 1.3.6. Install heavy string lines along the front, sides, tops, and transversely of all applicable Keystones. The string lines shall be laid out to the correct dimensions as determined by Keystones and the requirements of paragraph **1.4.2** such that the rows and columns are evenly spaced. All headstones shall be vertically plumbed and aligned by leveling the front, back, and sides while raising or lowering the headstone as required to achieve a height of 25 inches for upright headstones. **IMPORTANT:** To meet the requirement of a smooth, flowing transition, the Contractor may be required to set the headstone at a height other than at the specified height above grade with approval by the COR. These measurements shall be adhered to as closely as possible and may be adjusted to suit unique site conditions with approval by the COR.
- 1.3.7. At the start of work in each burial section, the first row/column of reset/realigned headstones in each burial section shall be inspected by COR for appearance, spacing, depth, alignment, plumb, height, accuracy, and smoothness in grade transition. No further setting of headstones shall be done until this first row has been inspected and accepted by the COR. It is the Contractors responsibility to notify the COR 24 hours in advance of when each of these inspections will be needed.
- 1.3.8. All remaining headstones in all rows, columns, and transverse directions are then aligned in accordance with paragraph **1.4.6**. The installation, adjusting, and setting of the remaining headstones shall meet the requirements of paragraphs **1.2** and **1.3**.
- 1.3.9. A plus/minus (+/-) 1/8 inch maximum tolerance shall be maintained in the lateral and transverse directions in accordance with the dimensional requirements of paragraph **1.4.2**. The alignment of the headstones should be checked frequently during this process because the tamping of the headstones may move the headstone out of level or off the mark on the line.
- 1.3.10. Headstones shall be installed to within one degree of fully vertical when measured on front and sides using a digital level.
- 1.3.11. The measurements between rows or columns of headstones and between the headstones within each row or column may differ from one gravesite section to the next. This condition is to be discussed with COR where this is found to occur. Some variances may be allowed by the COR in order to keep a uniform appearance of headstones being aligned.

- 1.3.12. Any headstones broken or damaged by the Contractor shall be reported to the COR or the Cemetery Director by close of business each working day in order that the grave can be properly marked. The Contractor shall be responsible for the cost of the headstone replacement. The cost of the replacement headstones will be deducted from Contractor's invoice(s). All headstone replacements must be coordinated with the COR. Any existing permanent gravesite control markers, temporary contractor installed control markers, grid or sectional monuments that are disturbed, displaced, or broken shall be replaced and properly reset by a licensed surveyor at the Contractor's expense. Curbs, roads, walks, turf, trees, utilities, etc. existing above and below the ground that are damaged or disturbed by the Contractor during performance of contract work shall be repaired at the Contractor's expense. The requirements of this paragraph shall be completed by the Contractor within fourteen (14) workdays, unless otherwise agreed to by the COR.
- 1.3.13. Government furnished headstones that are permanently removed from a grave for any purpose shall be transported by the Contractor to an approved location on cemetery grounds and destroyed, ensuring that the replaced headstone cannot be used for private, personal, or commercial activities.

--- E N D ---

SECTION 31 20 00 **EARTHWORK**

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes the requirements for earthwork including, but not limited to, the following:
1. Site preparation.
 2. Excavation.
 4. Filling and backfilling.
 5. Grading.
 6. Soil Disposal.

1.2 SUBMITTALS

- A. Unless otherwise noted, submittals shall be made 14 days before commencing the Work specified in this Section. The following shall be submitted.
1. Import Material: The Contractor shall submit the following for each imported material a minimum of 14 days prior to delivery:
 - a. Material source(s);
 - b. Particle size analysis in accordance with ASTM C136

2. Equipment List: The Contractor shall submit a list of equipment to be utilized for the work 7 days prior to mobilization. The list shall include equipment make, model, year, tire or track dimensions, weight and other information.
3. Construction Procedures Plan: The Contractor shall submit a plan that includes, but not be limited to, material excavation, marker surveying and identification tagging, marker removal, marker collar removal, marker transportation and storage, marker re-installation, backfill processing and placement, equipment use, borrow source utilization, and protection to be provided in the event of rain, wind, heat or other potential cause of damage 14 days prior to material construction.
4. Record Drawing Information: Record Drawings including, but not limited to, drawings showing the original and final marker locations. The preconstruction survey of the markers will be submitted to the COR in draft form for use during construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. SCREENED PLANTING TOPSOIL

1. The planting topsoil shall be a loam, sandy loam, and/or sandy clay loam conforming to ASTM D 5268-07, Standard Specification for Topsoil Used for Landscaping Purposes, with pH range of 6.5 to 7.8, a minimum of 4 percent organic material content and a maximum of 10% organic material content; free of weed seeds, noxious weeds, invasive plants, stones 1 inch or larger in any dimension, foreign matter and other extraneous materials harmful to plant growth, including, but not limited to roots, plants, sod, stones, and clay lumps.
2. Topsoil shall not be infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens.
3. Topsoil shall be friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.

PART 3 – EXECUTION

3.1 SITE PREPARATION

- A. Trees and Shrubs: Protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs that are to remain, than the farthest extension of their limbs. If the Contractor is obstructed by tree roots within the drip-line of a standing tree that are 2 inches in diameter or greater, the Contractor shall

request an inspection by the COR. The COR will inspect and determine if any roots will be pruned.

- B. Lines and Grades: With the services of a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Site Survey section, the Contractor shall survey and document existing lines and grades and submit for approval new lines and grades in order to achieve grades that provide a smooth surface free from irregular surface changes. The intent here is not to change the overall contour of the gravesites but rather to eliminate any irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated by the approved survey. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.

3.2 EXCAVATION

- A. The Contractor shall perform excavation of every type of material encountered within the limits of grading to the lines, grades, and elevations indicated and as specified. Grading shall be in conformance with the Site Survey Drawings and the tolerances specified in Paragraph Grade Tolerance. Excavation areas will be cleared of vegetation prior to excavation. Satisfactory excavated materials shall be transported to and placed in fill as indicated. Unsatisfactory materials encountered within the excavation shall be excavated below grade and replaced with satisfactory materials as directed. Surplus excavated material not required for fill shall be disposed offsite.

3.3 SUBGRADE PREPARATION

- A. Ground surface on which fill is to be placed shall be cleared of vegetation.
- B. The subgrade shall be shaped to lines, grades, and sections shown on the Construction Drawings, and compacted as specified. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Existing low areas and those resulting from removal of unsatisfactory material shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped and compacted as specified.
- C. All subgrade areas shall be moisture conditioned and compacted to not less than 90 percent compaction in accordance with ASTM D2922.
- D. If the Contractor excavates below the lines and grades indicated on the Construction Drawings, the Contractor shall place fill to elevate these areas back to grade at no cost to the Government.
- E. The prepared subgrade surface shall be reasonably smooth, free of holes, depressions greater than 3 inch deep, or protrusion extending above the surface more than 3 inch. No overlying materials shall be placed until the subgrade has been checked and approved. The subgrade surface shall be protected and restored if damaged.

3.5 FILL AND BACKFILL

- A. Fill shall be not be dropped from a height greater than 3 feet nor excessively loaded on markers. The soil shall be placed and compacted in 4 inch deep loose lifts. The moisture content of fill placed shall be adjusted prior to placement. Each lift shall be rough graded prior to compaction. Equipment shall be operated with careful attention to protection of markers. Fill shall not be constructed on surfaces that are muddy, frozen, or contain frost.

3.6 GRADE TOLERANCE

- A. Excavation and finish grades shall be constructed to within plus or minus 0.1 foot of the indicated grades. The finished surface of the excavations and fills shall be free of depressions and shall be reasonably smooth in accordance with the grade tolerances.

3.7 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Remove from site and legally dispose trash and debris.
- B. Remove from site and legally dispose excess soil after all fill and backfill operations are completed.

3.8 CLEAN UP

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

--- E N D ---

SECTION 32 84 00 PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work consists of installing a complete underground irrigation system as shown on the Drawings and as specified hereafter. The Contractor is responsible to achieve 100% irrigation surface coverage and to blend seamlessly with the existing irrigation system. The Contractor shall 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 including the furnishing, installing and testing of all pipe, fittings, valves, heads, controllers, wires, air release valves, valve boxes, and all other components pertinent to the plans and specifications of this system. The Contractor shall perform all trenching, excavation, boring, backfilling, compaction, concrete placement, electrical work, welding, and any other work necessary for the successful completion of the landscape irrigation system as shown and described in the Contract Documents.

- B. The term 100% irrigation surface coverage is defined as head to head coverage not to exceed the radius of each individual specified irrigation head radius as shown on the "Irrigation Legend" on the Drawings. As an example, the Toro TR70 PSS-27 sprinkler head's specified radius is 51.2 feet. The head to head coverage shall not exceed 51.2 feet spacing between the irrigation heads in the rows and between the rows thereby achieving 100% irrigation coverage of the area that is irrigated.
- C. 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. Sleeving for irrigation pipes as indicated, and/or beneath all hardscape surfaces.
- D. These Written specifications and the Drawings together are the Contract Documents. Contract Documents are binding as one instrument for the installation of a complete working landscape irrigation system as shown and described in the Contract Documents.

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. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- C. Excavation, Backfill: Section 31 20 11, EARTH MOVING (SHORT FORM).

1.4 SITE INVESTIGATION:

- A. The Contractor shall examine related work and surfaces before starting the work of this section. The Contractor shall report to the COR or his/her authorized representative, in writing, conditions which will prevent the proper execution of irrigation installation. Deviations from plans and specifications shall be executed only with the express permission of the Contracting Officer and at no cost to the Owner. If obvious

inadequacies or inappropriate design are found on the drawings, they shall be promptly brought to the attention of the COR in writing before proceeding with installation of the system.

1.5 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 of similar construction.
2. The Irrigation Contractor shall be a licensed irrigator in the State of Arkansas and provide proof to the COR before beginning the landscape irrigation installation. The Contractor's on-site supervisor shall be a State of Arkansas licensed irrigator and provide proof to the COR before beginning the landscape irrigation installation.

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 receipt of notification that service is requested.
3. Installer, or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform the specified work.

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 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.
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.
3. Locations of remote control valves are schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads. Manifolding of remote control valves off of a single submain connection is not allowed – each remote control valve shall be connected independently to the submain line(s). 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 COR 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.
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 or roadways. Sleeves shall be installed using boring methods only, no trenching/cutting through roadways or hardscape materials is allowed.

E. Follow manufacturer's instructions for installation.

1.6 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review.
- B. Manufacturers' Literature and Data: Submit manufacturers' catalog cuts and specifications for equipment to be included in the project work:
 1. Piping
 2. Jointing Materials
 3. Valves
 4. Irrigation Controller
 5. 24 Volt Wire
 6. Irrigation Heads
 7. PVC Fittings
 8. Wire Splicing Materials
 9. Quick Coupler Assembly

10. Valve Boxes
11. Valve ID Tags
12. Flow Sensing Cable
13. Line Location Tape
14. Flow Sensing Assemblies
15. Air Release Valves
16. PVC Solvent Cement and Primer
17. Joint Compound

- C. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, and heads. Quantities of materials need not be included.
- D. Provide two (2) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for sprinklers, pipe and fittings, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the COR. 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.
- E. 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; valves; 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.
- F. 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.
- G. Maintenance and Operation Instructions: Submit information listed in Part 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.
- I. Reproducible "as-built" drawings.

1.7 SUBSTITUTIONS

- A. Unless otherwise noted, use specified equipment to match existing equipment. COR 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.

1.8 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 (150 psig).

1.9 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.

1.10 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, 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.

1.11 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with COR. Coordinate temporary shut-down of existing system with the COR, Cemetery Director, and 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 COR while minimizing the impact on the operation of the existing irrigation system.
- C. Install irrigation mainline and control 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. All sleeves shall be installed by boring methods only, no trenching or cutting of roadways are allowed.
- D. Install irrigation components in landscaped areas unless specifically indicated otherwise. Irrigation components in other than landscaped areas shall be in sleeves, with no joints beneath the non-landscaped areas.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the COR.

1.12 TESTING

- A. Notify the COR three days in advance of testing.
- B. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:
 - 1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure for 30 minutes.
 - 2. Cap all 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.
- D. Operational Test – Remote Control Valves, Lateral Piping and Sprinklers:
 - 1. Coordinate with COR to activate the remote control valve. The COR will visually observe operation, water application patterns, and leakage.
 - 2. Adjust or move water emission devices to correct operational or coverage deficiencies.
 - 3. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
 - 4. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

1.13 WARRANTY AND REPLACEMENT

- A. The purpose of the warranty is to ensure 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 COR. 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 COR.
 - 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.

1.14 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with COR. Coordinate temporary shut-down of existing system with the COR, Cemetery Director, and 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 COR while minimizing the impact on the operation of the existing irrigation system.
- C. Install irrigation mainline and control 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. All sleeves shall be installed by boring methods only, no trenching or cutting of roadways are allowed.
- D. Install irrigation components in landscaped areas unless specifically indicated otherwise. Irrigation components in other than landscaped areas shall be in sleeves, with no joints beneath the non-landscaped areas.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the COR.

1.15 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):

1013-2005Reduced 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

D1785-06Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80,
and 120

D1238-04c.....Standard Test Method for Melt Flow Rates of
Thermoplastics by Extrusion Plastometer

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

D1785-06Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80,
120

D1894-08Standard Test Method for Static and Kinetic Coefficients of
Friction of Plastic Film and Sheet

D2241-05Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR
Series)

D2464-06Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe
Fittings, Schedule 80

D2466-06Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule
40

D2564-04e1.....Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic
Piping Systems

D2657-07Standard Practice for Heat Fusion Joining of Polyolefin
Pipe and Fittings

D3139-98 (2005).....Joints for Plastic Pressure Pipes Using Flexible Elastomeric
Seals

D3350-10Standard Specification for PE Pipe & Fittings Materials

F477-08Elastomeric 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):
250-2008Enclosures for Electrical Equipment (1000 Volts Maximum);

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new and without flaws or defects of any type and shall be the best of their class and kind. All materials shall have a minimum guarantee of one year against material defects or defective workmanship.
- B. All material shall be the brands and types noted on the Drawings or as specified herein, or approved equal.
- C. The irrigation system was designed around equipment manufactured by specific companies as a standard. Approved equal equipment by other manufacturers may be used only with the approval of the COR. Submission of irrigation sprinkler heads for approval, as equal shall only be considered if submitted heads match the precipitation rate, gallons per minute and spacing of specified sprinkler heads.
- D. All irrigation equipment including pipe, pipe fittings, ductile iron fittings, mechanical restraints, wire, valves, etc., shall be inspected and approved by the COR before installed.
- E. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.2 SLEEVING

- A. Provide sleeves beneath all hardscape for irrigation pipe.
- 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 200 psi, conforming to dimensions and tolerances established by ASTM Standard D2241.
- 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.

2.3 PVC PIPE AND FITTINGS

- A. Plastic Pipe: Sub-main and lateral line piping shall be as specified on the drawings. All sub-main piping shall be Class 200 "0" ring gasket pipe, SDR 21; lateral line piping downstream of the zone valves which is 2-1/2" in diameter and greater shall be Class 200 SDR 21 and shall conform to ASTM D 2241. Lateral line piping downstream of the zone valves which is two inches (2") in diameter or less shall be Schedule 40 PVC and shall conform to ASTM D 1785. All PVC pipe shall be continuously marked with identification of the manufacturer, type, class, and size, and shall be free of holes, foreign material, blisters, wrinkles, dents or sunburn.
- B. PVC Pipe Fittings Pipe Size 2" and Smaller: Fittings on PVC lines 2" and smaller shall be Schedule 40 PVC, Type 1, Cell Classification 12454 and shall comply with ASTM D 2466.
- C. PVC Pipe Fittings Pipe Size 2 W' and Larger: All joints at changes in direction on PVC pipe sizes 2 W' and larger shall have Harco push on joint deep bell ductile iron fittings (or approved equal) with Harco knuckle joint restraints (or approved equal). All joints in straight runs of PVC pipe sizes 2 W' and larger immediately upstream or downstream of a change in direction shall be Harco push on deep bell ductile iron coupling restrained with Harco knuckle joint restraints (or approved equal).
- D. Threaded Nipples: All threaded PVC nipples shall be Schedule 80 molded PVC pipe. All galvanized nipples shall be Schedule 40 galvanized steel pipe.

2.3 VALVES AND VALVE BOXES

- A. All valves and valve boxes shall be protected as specified on the Drawings.

2.4 HEADS

- A. Heads shall be as specified on the Drawings or equal.

2.5 IRRIGATION CONTROLLERS

- A. Controllers shall be protected as specified on the Drawings.

2.6 CEMENTS, CLEANERS/PRIMERS AND JOINT COMPOUNDS

- A. Cement shall be IPS Weld -On, Wet 'R Dry 725 (or equal) PVC solvent cement for use on all schedules of PVC pipe and fittings 4" and smaller. For PVC pipe and fittings larger than 4" cement shall be IPS Weld-On, 711 (or equal) PVC solvent cement. Cement must be low VOC (Volatile Organic Compounds), NSF approved, and meet ASTM D 2564 requirements.
- B. Primer shall be IPS Weld-On, P-75 Wet 'R Dry (or equal) primer for PVC pipe 4" and smaller. For PVC pipe and fittings larger than 4", primer shall be IPS Weld-On, P-70 (or equal) purple primer.

- C. All threaded connections between metal to metal, PVC to metal and PVC to PVC shall be made using RECTORSEAL #5 slow dry, soft set, thread sealing compound. Thread sealing compound shall not be used on threaded connections between sprinkler and nipple or bubbler and nipple.
- D. All "O" ring gasket and pipe spigot ends shall be lubricated using the lubricant recommended or supplied by the pipe manufacturer. If the pipe manufacturer does not provide a lubricant for the pipe, use IPS Weld-On Seal lube as manufactured by Industrial Polychemical Service.

2.7 WIRE

- A. Wire for the 120 volt wiring shall be solid copper (or stranded copper in larger wire sizes), underground feeder for direct burial and PVC insulated. Size of wire shall be #12 AWG.
- B. Wire for the 24 volt wiring shall be solid copper wire, PVC insulated, UL approved underground feeder wire for direct burial in ground. Common wires shall be #12. Color white. The wire shall be supplied in either 500' or 2,500' rolls. The control wires shall be #14, color red, unless otherwise indicated on Drawings.
- C. Wire Splicing Materials: All wire splices shall be made water-tight using 3MTM DBRIY direct bury splice kit or equal.
- D. Grounding wire, ground rods, grounding plates and wire clamps for controllers shall be as detailed on the Drawings and shall meet the ASIC Guideline 100-2002 (January 2, 2002) for Earth Grounding Electronic Equipment in Irrigation Systems.

2.8 WARNING TAPE

- A. Detectable marking tape shall consist of a minimum 5.0 mil (0.0050") overall thickness, five-ply composition; ultra-high molecular weight; 100% virgin polyethylene; acid, alkaline and corrosion resistant. Elongation properties shall be in accordance with ASTM D882-80A and shall be less than 150% at break. The tape shall have a 20 gauge (0.0020") solid aluminum foil core, encapsulated within 2.55 mil (0.00255") polyethylene backing. The tape color shall be blue with a legend that reads "Caution Waterline Below." The tape tensile strength shall be in accordance with ASTM D882-80A and be not less than 7,800 psi. The tape width shall be at least 6". Tape bury depth shall be 6" above irrigation pipe.

2.9 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.
 - 2. Thrust block installation shall be as specified on the drawings.

B. Joint Restraint Harness:

1. Use a joint restraint harness 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.

2.10 OTHER MISCELLANEOUS FITTINGS AND MATERIALS

- A. All other miscellaneous fittings and materials shall be as specified on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. This section includes installation specifications for all items installed as a part of the irrigation system. Certain construction procedures or minor equipment installation procedures may have been omitted from these specifications that are necessary for the proper installation of the system. In any case, all materials and equipment shall be installed in a neat and workmanlike manner according to manufacturer's recommendations and specifications, local and state codes, as shown on the Drawings and as specified herein.

3.2 PRODUCT HANDLING

- A. Contractor shall be responsible for correct procedures in loading, unloading, staking, transporting and handling all materials to be used in the system. The Contractor shall avoid rough handling which could affect the useful life of equipment. Pipe shall be handled in accordance with the manufacturer's recommendations on loading, unloading and storage.

3.3 POINT OF CONNECTION

- A. All existing water main line locations shown on the Drawings are schematic. It shall be the Contractor's responsibility to pothole and field check to determine actual locations as incidental requisite to the construction contract.
- B. The existing satellite controller location is indicated on the plans.

- C. Where connections to existing stub outs are required, the Contractor shall make necessary adjustments should stubs not be located exactly as shown, at no additional cost to the Owner.

3.4 EXCAVATION AND TRENCHING

- A. The Contractor shall stake out the location of each run of pipe and all sprinkler heads and valves prior to trenching. Each run of the system shall be approved by the COR before actual installation is started. Notify the COR one week in advance of review. The COR will identify and approve modifications during this review.
- B. 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 COR.
- D. Excavation and trenching for pipe lines shall be a true and straight line with the trench banks as nearly vertical as practical. The width of the trenches shall not be greater than necessary to permit proper joining, tamping, backfilling, bedding or any other installation procedures that may be necessary. Trench widths shall also be wide enough so that there will be a minimum horizontal and vertical separation of 4" between pipes in the same trench, except as noted on the Drawings.
- E. In locations where construction of irrigation piping is obstructed by existing trees and no other acceptable route for piping is available, the pipe installation shall be accomplished by means of horizontal directional boring. Alternate routes for location of pipe must be approved by the COR. The COR must be present when horizontal directional boring operations are in progress.
- F. Trench depths shall be sufficient to provide the specified pipe cover as described elsewhere in these specifications or as noted on the Drawings. In rocky areas the trenching depth shall be 6" below normal trench depth to allow for pipe bedding as described in other portions of these specifications.
- G. Concrete thrust block shall be installed where the irrigation main changes direction as at elbows 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.
- 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. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COR.

3.5 SLEEVING AND BORING

- A. Sleeves shall be the split type, installed around the existing pipe, and secured in place before casting the beam.
- B. Furnish and install where pipe will pass through the beam.
- C. Install sleeving at a depth that permits the encased pipe or wiring to remain at the same burial depth.
- D. During concrete placement, protect ends of sleeves from concrete intrusion. Keep sleeve openings clear. Extended Sleeve ends 12-inches beyond the edge of the beam to meet this requirement. Use formwork in these areas instead of forming the beam against the trench sides.
- E. 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 12-inches beyond edges of paving or construction. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.

3.6 PIPE AND FITTINGS INSTALLATION:

- A. Installation of PVC pipe and fittings shall be in accordance with the manufacturer's recommendations and procedures and as mentioned in the specifications. Manufacturer's recommended procedures for making solvent weld fittings shall be strictly adhered to. Only solvent cements, cleaners, and primers or lubricants recommended or supplied by the pipe manufacturer shall be used.
- B. Caution shall be exercised by the Contractor in handling, loading, unloading, and storing of pipe and fittings. All pipe shall be stored and transported in a vehicle with a bed long enough to allow the pipe to lie flat without subjecting it to undue bending or concentrated external load at any point. Pipe shall be protected from damage by exposure to sunlight. Any section of pipe that has been scratched, dented or damaged or in any other way found to be defective, either before or after laying shall be replaced with sound pipe without additional expense to the Owner.
- C. Before installation, the inside of the pipe shall be cleaned of all dirt and foreign matter and shall be kept in a clean condition during and after laying of pipe. When work is not in progress, open ends of pipe and fittings shall be secured closed so that no trench water, earth or other foreign substances will enter the pipe or fittings. Where pipe ends are left for future expansion or connections, they shall be valved and/or capped as directed on the irrigation system drawings.
- D. All pipe and fittings shall be assembled to permit the pipe or fittings to be joined at the true parallel position of the fittings. Placement of pipe in curving trenches which cause excessive bending and stress on pipe and fittings will not be permitted. No excess piping or fittings shall be permitted in the installation of the system, which may increase pressure loss or potential blockage.

- E. Before installing the pipe, all rubbish and large rocks shall be removed from the trenches. If the soil is extremely rocky, the trenches shall be bedded with dirt or sand as outlined in other portions of these specifications. Material used for pipe bedding shall be approved by the COR. The full length of each section of the pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, joints and couplings, except as noted on the Drawings.
- F. Pipe shall not be laid in water or when trench or weather conditions are unsuitable for the work. Any water which may be encountered or may accumulate in the trenches or excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the trench or excavation free and clear of water during the progress of the work. Pipe shall not be laid when the temperature is 32 degrees F or below.
- G. Pipe will expand or contract at the approximate rate of 1" per 100' per 10 degrees F change of temperature. Therefore, the pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer.
- H. The minimum horizontal and vertical clearance between lines in the same trench shall be 4", except as noted on the Drawings.
- I. All joints at changes in direction on PVC pipe sizes 2-1/2" and larger; all joints in straight runs of PVC pipe sizes 2-1/2" and larger immediately upstream or downstream of a change in direction; PVC sub-main o-ring gasket body gate valves; and all PVC sub-main valves with flange fittings shall be constructed with joint restraints, pipe restraints or self-restrained flange adapters as specified herein.
- J. After all piping, risers, valves, thrust blocks, etc., have been installed and partially backfilled as specified in other parts of these specifications, the control valve shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested in accordance with the testing section of these specifications. At the conclusion of the pressure test, the heads shall be installed and the backfill operation completed.

3.7 PVC PIPE SOLVENT WELDING PROCEDURE:

- A. PVC plastic pipe shall be squarely cut utilizing a hacksaw with a blade of 18 or 24 teeth per inch.
- B. Burrs left from cutting shall be wiped off with a clean dry cloth.
- C. Utilizing a cleaner/primer, thoroughly clean the mating pipe end and the fitting socket with a clean, dry cloth.
- D. Apply a uniform coat of solvent cement to the outside of the pipe end with a non-synthetic brush or dauber.
- E. In like manner, apply a thin coating of solvent cement to the inside of the fitting socket.

- F. Re-apply a light coat of solvent cement to the pipe end and quickly insert it into the fitting to the full depth of the fitting socket.
- G. Rotate the pipe or fitting approximately 1/4 turn to insure even distribution of the solvent cement.
- H. Hold in position for approximately 30 seconds.
- I. Wipe off any excess solvent cement that forms as a bead around the outer shoulder.
- J. Care should be taken so as not to use an excess amount of solvent cement that could cause burrs or obstructions to form on the inside of the pipe joint.
- K. Solvent weld joints shall be allowed to cure for at least 24 hours or as specified by the solvent manufacturer before pressure is applied to the system.

3.8 BACKFILLING:

- A. Upon completion of a particular section of the irrigation system, and after sufficient time has elapsed for the curing of solvent weld joints, partial backfilling shall begin, leaving all joints, fittings, risers and connections exposed for visual inspection during the hydrostatic testing. Only upon successful completion of the hydrostatic test shall the backfill operation be completed for any one particular section.
- B. All backfill material shall be subject to approval by the COR. Backfill material shall be free from rock, large stones, brush, sod, frozen material or other unsuitable substances that may damage pipe during the backfilling operations.
- C. In the event that the material from the excavation or trenching is found to be unsuitable for use in backfill by the COR, it shall be removed from the site and properly disposed of by the Contractor at his own expense. The Contractor shall then, at no additional cost to the Owner, arrange for, purchase, and furnish suitable backfill material consisting of earth, loam, sandy clay, sand or other approved materials free of large clods of earth or sharp stones and capable of attaining the same relative density of the surrounding ground.
- D. In rocky areas, the trench depth shall be 6" below the normal trench depth to allow for an additional 6" of bedding material as padding for the pipe. In like manner, there shall be at least 6" of bedding material on all sides of the pipe as padding against the rock wall of the trench.
- E. All mainline and lateral piping shall have irrigation line location tape installed in the trench six (6") inches above the pipe.
- F. Backfill shall be placed in horizontal layers not exceeding 6" in depth and shall be thoroughly tamped, or water compacted to near original density or so that no settling will result. Backfill shall be placed to the original ground level. If settlement of trenches

occurs within one (1) year from date of completion, it shall be the Contractor's responsibility to refill trenches and install new sod, new gravel mulch, or repave the repaired areas.

- G. After pipe is placed in trench and the first 6" layer of backfill is placed and compacted, the irrigation line marking tape shall be placed continuously in all trenches prior to completion of backfill operations.

3.9 SADDLE TAPS:

- A. No saddle taps shall be permitted on PVC piping except as required to install new lateral zone electric remote control valves on existing PVC sub-main piping, or as approved by the COR.

3.10 HEAD INSTALLATION:

- A. Heads shall be of the type and make specified and shall be installed as shown on the Drawings. Heads shall be installed with a 6" space or as otherwise indicated on the Drawings between the edge of the head and curbs, walls, driveways, building walls, etc. Heads shall be installed in the vertical position and backfilled and compacted to near 85% density.
- B. Head spacing shall not exceed the spacing shown and shall be in the location and configuration as shown on the Drawings. Contractor shall verify turf area dimension while staking head location. Heads shall be spaced to achieve uniform (head to head) coverage, or greater.
- C. After all piping and risers are in place and connected and before installation of the heads, all control valves for a given section shall be fully opened and a full head of water shall be used to flush out the system. If water pressure without the heads installed is not sufficient to provide adequate water flow from end risers, the Contractor shall cap off enough risers closest to the water source to provide adequate flushing of the end riser assemblies.

3.11 EXISTING SATELLITE/FIELD CONTROLLER:

- A. Controller location is as indicated on the Drawings.
- B. Remote control valves shall be connected to the Controller in the numerical sequences as shown on the Drawings or as directed by the COR.
- C. Verify the existing Controllers is grounded as specified by the manufacturer and in accordance with ASIC Guideline 100-2002 (January 2, 2002) for Earth Grounding Electronic Equipment in Irrigation Systems.

3.12 AUTOMATIC CONTROL VALVE INSTALLATION:

- A. Automatic control valves shall be of the type and size indicated on the Drawings. Installation shall be according to these specifications, the Drawings and the manufacturer's recommendations.

- B. The valve boxes shall be of the size and type as shown in the detail drawings.
- C. Valve wire splices shall be waterproofed using 3MTM DBRN direct bury splice kits (or equal) and the Contractor shall provide a 36" wire expansion coil to facilitate raising splices to ground level without cutting wires.
- D. Thoroughly flush mainline before installation of Control Valve Assemblies.
- E. Use a volume of water such that the velocity in the largest pipe flushing to this point is 0.9 m/s (3 FPS).
- F. Multiple points may be flushed simultaneously.
- G. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
- H. The COR will review the flushing operation and clarity of water before stopping the flushing operation.
- I. 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.
- J. Attach ID tag with controller station number to control wiring at solenoid.
- K. Brand controller and station number in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

3.13 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. Set valve box cover flush with finished grade.
 - 4. Install as indicated in the installation details, per manufacturer's instructions.
 - 5. Install where indicated on the irrigation plans.
 - 6. 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 manufacturer's instructions.
 - 2. Install where indicated in the irrigation plans.
 - 3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.
- C. Quick Coupling Valve Assembly:

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

D. 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. Install sprinklers perpendicular to the finish grade.
4. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
5. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
6. Adjust the radius of throw of each sprinkler for best performance.
7. Install all sprinklers and quick couplers on swing joints as detailed on plans.

3.14 24-VOLT CONTROL VALVE WIRING:

- A. Wire installation procedures as described herein shall be checked to conform to local codes.
- B. Contractor shall install the 24 volt control valve wiring in the same trench as the irrigation submain. All wires shall be laid below the pipe. In no case shall the wire be laid on top of the pipe. The wires shall be laid loose in the trench and taped together at 10'-0" intervals. When trenches used for piping are not appropriate for routing wire, Contractor shall install wire in a separate trench, 18" deep.
- C. Wire splices, other than at valve box locations, shall be kept to a minimum and if needed shall be made only at common splice points and placed in a wire splice box. These wire splices shall be made waterproof using 3MTMDBRN direct bury splice kits or equal. 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.
- D. At control wire splices, the Contractor shall provide a 36" wire expansion coil to facilitate raising splices to ground level without cutting wires.
- E. Continual wire shall be one color and in no case shall wires of different colors be spliced together.
- F. All 24 volt wiring shall be installed in PVC conduit when inside a building. All 24 volt wiring installed on exterior building walls shall be installed in metal conduit.
- G. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 3 m (10-foot) intervals.

- H. 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.
- I. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
- J. Unless noted on plans, install wire parallel with and below mainline pipe.
- K. Cap all exposed wire ends with wire nuts.
- L. 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.

3.15 TESTING:

- A. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- B. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
- C. Furnish clean, clear water and all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous 150 psi pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
- D. Upon completion of mainline and sub-mains, the mainline and each sub-main shall be tested with the COR present, for a two (2) hour period at 150 psi, unless otherwise noted. Prior to testing, the mainline and sub-mains shall be partially backfilled, leaving all joints and connections exposed for visual inspection. All dirt shall be flushed from the system and the line filled with water to remove air. The mainline shall be brought to static pressure. A pressure gauge and temporary valve shall be installed at the end of the mainline to permit air pressure to be applied to the main. A pressure of 150 psi must be retained for a two (2) hour period. The pressure shall not drop by more than 3 psi during the two (2) hour testing period. Any leaks resulting from the two (2) hour pressure test shall be repaired and the system retested until the system passes the test.\
- E. Upon completion of the lateral piping sections, each lateral system shall be pressure tested, with the COR present for two (2) hours at 100 psi. On systems using flex nipples, or swing joints, the lateral system shall be tested prior to installation of the flex nipples or

swing joints. Prior to testing the lateral lines shall be partially backfilled leaving all joints and connections exposed for visual inspection. All air and dirt shall be flushed from the system and all open fittings shall be capped. The testing procedure shall be the same as used for the main line and sub-mains. The pressure shall not drop by more than 3 psi during the two (2) hour testing period. If after two (2) hour 100 psi pressure has been retained, the heads shall be installed, and the backfill operation completed. Any leaks resulting from the hydrostatic test shall be repaired and the system retested until the system passes the test.

- F. Contractor shall test the grounding for the existing controller as specified by the controller manufacturer and the ASIC Guideline 100-2002 (January 2, 2002) for Earth Grounding Electronic Equipment in Irrigation Systems. The COR must witness and approve the test.
- G. The Contractor shall demonstrate and document the continuous fault free operation of the Rain Master Central Control System and the Rain Master satellite controllers throughout the cemetery; all mainline and sub-mainline master valves and flow sensors for the complete irrigation system for a period of thirty (30) consecutive days minimum. A fault is a cause to restart the test. The test shall be completed as described below:
 - 1. The system must operate automatically from the program in the Rain Master Central Control computer.
 - 2. Prior to starting the test, each zone must demonstrate normal function and the controller must demonstrate automatic function. Activate each remote control valve in sequence from the satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The COR will visually observe operation, water application patterns, and leakage.
 - 3. Prior to starting the test, the primary main line flow sensor at the primary main line master valve and the two primary main line deductive flow sensors must be programmed in sequence to read a flow of zero (0) during normal system operations. When the primary main line flow sensors sense a flow in excess of zero, that will indicate a primary main line significant leak (in excess of 125 gpm) and will close the primary main line master valve. Prior to starting the test, the correct operation of the primary main line flow sensors and master valve shall be verified by manually opening a sub-main master valve and the submain lateral zones as required to simulate a leak with a flow in excess of 125 gpm. The primary main line flow sensors must sense the simulated leak and close the primary main line master valve.
 - 4. Prior to starting the test, each sub-main flow sensor must be set to sense an excessive flow. This is normally set at 10% above the largest flow on a single zone. After setting the flow sensor, the sensor must be tested by using the controller to turn on the largest zone and then manually bleeding on another valve to simulate a leak. The flow sensor must sense the leak and close the master valve.
 - 5. If the testing of the flow sensors and master valves for the primary main line and all submains pass, then and only then can the 30-day fault free test begin.

6. The system must run on automatic for thirty (30) days.
7. Each day the system must be checked by the COR to make certain that all programs ran; and to determine if there were any problems with operations.
8. If the system or part of the system failed to run for any reason, that is a fault and the fault must be corrected and the test must start over.
9. If the system runs but there is a valve stuck open, a broken head or a broken pipe, etc. and a flow sensor senses the excessive flow and closes the appropriate valve or master valve, then the system functioned properly and there is no fault. After repairing the problem area, the test continues. However, if the system failed to sense the excessive flow then there is a fault. Therefore the system must be repaired, the flow sensor/master valve corrected and the test starts over for another 30-day period.
10. If during the test, there is a problem with existing irrigation equipment such as a controller, an electric remote control valve, etc. which was not installed by the Contractor, the Owner shall be responsible for correcting said problem. There is no fault. Once the problem with the existing equipment is corrected, the test will continue.

E. Distribution Uniformity (DU):

1. Perform a DU Test on one zone of burial section rotors.
2. In conjunction with the COR, 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.

3.16 ADJUSTING OF SYSTEM:

- A. Prior to starting the thirty (30) day fault free test, the Contractor shall adjust all valves for the proper operating pressure and adjust all heads for uniform coverage and even flow. Correct operations of the system must be accepted by the COR. Contractor shall wire the existing Controller (valve/station) as directed by the COR. The valve number shall be indicated on the Controller panel for each station.

3.17 PROGRAMMING IRRIGATION CENTRAL CONTROL SYSTEM

- A. The Contractor shall retain and pay for the services of a Rain Master Certified Irrigation Water Manager. The Water Manager shall have the following minimum level of certification and shall provide written verifications of certification to the COR:
 1. "Rain Master Factory Trained Oasis/Evolution DX2 Operator"
 2. "Rain Master Factory Trained Oasis/Evolution DX2 Technician"
- B. The Water Manager shall be responsible for updating the programming the Irrigation Central Control System for the updated Satellite Controller for the new irrigation

expansion area. Programming of the Central Control System shall include but not necessarily be limited to the following.

1. Verify system communications from Central Controller to the updated Satellite Controller, Flow Sensors, and Master Valves.
2. Using the Central Control hardware and software, establish databases and adjust program the system for the entire cemetery as necessary to accommodate the new irrigation system expansion area.
3. Document the flow of each lateral zone in gallons per minute and enter the flow for each zone in the system database.
4. With input from the Dallas-Fort Worth National Cemetery Maintenance Work Leader, build and install the "baseline/default watering program" with station run times for each lateral zone in the cemetery. Establish Cycle + Soak" parameters as required to avoid runoff and puddling throughout the cemetery.
5. Calculate and program flow sensor limits on all flow sensor pulse monitors.
6. Program the system to operate as required for monitoring flow sensors at the main line and each sub-main, recording flow and automatically reacting to problem flows by shutting down the affected portion of the system.
7. Program the system to operate as required to manage the total flow demand placed on the water source.
8. Program the system to operate as required to monitor the existing system weather station as needed to track evapotranspiration and automatically adjust the Satellite Controllers' station (zone) run time or day cycle intervals to match the landscape water requirements.
9. Monitor, service, and repair the system as needed to successfully accomplish the required thirty (30) day "Fault Free Test"

3.18 CLEAN UP:

- A. Contractor shall continuously keep a neat and orderly area in which they are installing the system. Disposal of rubbish and waste material resulting from the installation shall be continual. Upon completion of the system, the Contractor shall remove from the Owner's property at his own expense, all temporary structures, excess soils, rubbish, waste material, tools and equipment resulting from or used in the installation of the system.

3.19 PROTECTION OF EXISTING UTILITIES:

- A. The Contractor shall be responsible for locating all cables, conduits, piping, and any other utilities or structures that may be encountered either above or below ground. All necessary precautions must be taken by the Contractor to prevent any damage to these existing utilities and improvements. In the event that such damage should occur from his operations, the Contractor shall repair or replace damaged utilities to their original condition at no additional expense to the Owner.

3.20 ROCK OR OTHER MATERIAL:

- A. If the Contractor encounters unfavorable trenching conditions, no additional compensation will be paid. When material from the excavation or trenching is unsuitable for use as backfill, additional backfill material suitable for this purpose shall be brought in at the expenses of the Contractor. It shall also be the Contractor's responsibility to

remove and dispose of all unsuitable materials removed from the trench that cannot be used in the backfill operation.

3.21 FINAL ACCEPTANCE:

- A. Upon successful completion of the thirty (30) day fault free test, when the Contractor is satisfied that the system is operating properly, and all work and clean-up is completed he shall request a final inspection. The COR will respond to the notice of completion by the Contractor and shall appear for an inspection of the project. At that time the Contractor shall demonstrate the operation of each system in its entirety. In judging the work, no allowance for deviation from the original Drawings and Specifications will be made unless prior approval has been obtained.

3.22 OPERATIONAL INSTRUCTION:

- A. After the system has been tested and accepted, the Contractor shall instruct cemetery personnel as selected by COR in the operation and maintenance of the system. Training provided shall be a minimum of 8 hours.
- B. Contractor shall provide the Owner with two (2) keys for the following:
 - 1. Manual Gate Valves.
 - 2. Manual Drain Valves.
 - 3. Valve Boxes.
 - 4. Controllers.
 - 5. Any locking assembly in need of key access.
 - 6. Quick Couplers
- C. Contractor shall provide the Owner with two copies of a Maintenance Manual bound in a three ring binder. The maintenance manual shall include copies of the approval submittals, controller operations manuals and manufacturers warranties on all irrigation products.

3.23 SYSTEM MAINTENANCE AND WARRANTY:

- A. Maintenance of the irrigation system shall begin immediately following the installation of the system and shall continue until the entire system is accepted. Maintenance shall include repair of defects or damages, adjustments and fine tuning of the system, and repairs of damages resulting from vandalism, erosion, weather, and the like.
- B. For a period of one (1) year from final acceptance of the system, the Contractor shall promptly furnish and install, without cost to Owner, any and all parts or materials which prove defective in material or workmanship. Damage due to irrigation system line breaks shall be repaired and brought to original condition by the Contractor at no expense to the Owner.
- C. For a period of one (1) year from final acceptance of the system, the Contractor shall repair any settlement of trenches by one of the following methods as directed by the COR:

1. For Trenches in Turf Areas:
 - a. Bring to grade by top-dressing (raking topsoil into the grass).
 - b. Bring to grade with topsoil and seed.
 - c. Remove existing sod, fill depression with topsoil, and replace with new sod to match existing sod.
 2. For Trenches in Gravel Areas:
 - a. Remove existing gravel, fill depression with topsoil, and replace gravel.
 - b. Rake to smooth uniform grade.
- D. Repair by any of the above methods shall result in a smooth, level area. Maintenance of repaired areas shall be the responsibility of the Owner.
- E. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- F. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

3.24 INSPECTION:

- A. The following inspections shall be the minimum required inspections during the course of construction. Additional inspections shall be made at any time at the discretion of the Owner or COR. It shall be the responsibility of the Contractor to notify the COR, in writing, 48 hours in advance of each required inspection. The sequence of required inspections shall not be changed from the sequence listed below. The Contractor shall not proceed with work of the next sequence without written approval of the work of previous sequence. The Contractor shall attach a copy of the written inspection approvals to all applications for payment.
1. Inspect staked locations of main lines, sub-mains, valves, laterals and heads.
 2. Inspect and pressure test main lines and sub-mains.
 3. Inspect 24 volt control wire installation.
 4. Inspect and pressure test automatic valves and lateral irrigation installation.
 5. Inspect automatic controller installation and operation.
 6. Inspect head placement, coverage and operating pressure prior to planting.
 7. Inspect at end of maintenance period.

3.25 SPARE PARTS

- A. Upon completion of the work furnish the Owner the following for his maintenance stock.
1. 5 – Rainbird 8005 sprinklers
 2. 2 – Toro P-220-27-0-8 Control Valves or equivalent
 3. 2 – 2” Brass Gate Valves (Control Valve Assembly)

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SECTION 32 92 00
TURFGRASS RENOVATION AND REESTABLISHMENT

1.1. WORK OVERVIEW

1.1.1. This section outlines operational procedures to be followed in sections designated for topsoil surface leveling, renovation, and re-establishment of the existing turfgrass stand. Turf renovation generally includes curb-to-curb renovation unless otherwise directed by the COR. The contractor shall provide all supervision, professional advice/guidance, labor, parts, materials, equipment, and personnel, to provide the services defined herein.

1.1.2. The COR will determine the beginning point and ending points in each gravesite section.

1.2. TOPSOIL AND TURFGRASS RENOVATION PROCESS:

1.2.1. The following renovation process shall begin with the approval of the COR and only when the existing turfgrass is actively growing and not in dormancy.

1.2.2. Mow and trim target area several times removing grass clippings each time. Initial mowing in this sequence should be at normal maintenance height (i.e. 2.5 to 3 inches) and subsequent mowing 2 or 3 days apart should be at lowered height (i.e. 1.5 to 2 inches).

1.2.3. After a minimum of two or more preparatory mowings and trimmings, the entire vegetated area should be treated with an application of an appropriate non-selective herbicide. Application rate should be the maximum label recommended rate for the complete elimination of perennial grass species and contaminant weeds. **IMPORTANT: Application must be made at a time when grass is actively growing for the herbicide to work.** Application to be made by a licensed pesticide applicator. Allow a minimum of 10 to 14 days to elapse for herbicide to fully translocate throughout all plant parts.

1.2.4. The COR shall confirm and approve that all vegetation (turfgrass, weeds, etc.) in the treated area is completely dead prior to removal of the dead vegetation. If any vegetation within the treated area is still vital (alive) it shall not be removed. Re-treat the vegetated area in accordance with paragraph 2.2.3 until the vegetated area is completely dead.

1.2.5. Contractor shall inventory, remove, and store all irrigation heads and cap head risers within the limits of work. Provide a copy of the inventoried equipment and materials

- to the COR. Provide protection of any exposed components, risers, etc. that might be damaged by renovation equipment.
- 1.2.6. Contractor shall locate and inventory all irrigation components: (valve boxes, gate valves, quick couplers, etc.) within the limits of work and protect the location and component access throughout contract work. Provide a copy of the inventoried equipment and materials to the COR.
 - 1.2.7. The Contractor shall be responsible for the replacement of irrigation heads and components at finish grade, ensuring all irrigation lines and heads are free of foreign matter and operating properly.
 - 1.2.8. Removal of Existing Turf Stand:
 - 1.2.8.a. Power rake or verticut entire treated area to loosen and prepare the site for the removal of all residual plant debris including thatch.
 - 1.2.8.b. Remove all residual plant debris including thatch.
 - 1.2.9. Topsoil Preparation: Rototill area to a minimum depth of 6 inches to uniformly mix topsoil and to uniformly loosen top surface for re-grading and leveling.
 - 1.2.10. Topsoil Leveling and Grading
 - 1.2.10.a. Grade and compact surface of site to achieve desired finished appearance, which is to be smooth and uniformly level down each row and between each row, free of all surface ripples, depressions, high spots, low areas, ridges. The finish grade for each gravesite section shall be smooth and uniformly level with adjacent gravesite sections and surrounding terrain. New surfaces shall be blended to existing areas.
 - 1.2.10.b. The prepared surface (finish grade) shall be a maximum 1 inch below the adjoining grade of any surfaced area. The prepared surface (finish grade) shall be a nominal 25 inches below the top of all upright headstones and 1 inch below the top of all flat markers, or by direction and approval of the COR.
 - 1.2.10.c. In locations where existing burial area surface has formed “ridges” between rows, these areas shall be knocked down by grading between high and low surfaces of the rows so that finished surface is uniformly flowing from row to row, and down each row. If this process does not achieve desired smooth and uniformly flowing finished grade due to numerous depressions and low or sunken areas in the existing surface grade, import, spread and compact additional high quality topsoil of similar characteristics and texture to the soil already present on site.

- 1.2.10.d. Topsoil shall be free of foreign matter, any objects bigger than 25 mm (1 inch) and weed seeds.
- 1.2.10.e. Apply and compact sufficient topsoil to eliminate all ripples, depressions, and sunken grave areas as needed to achieve the desired smooth and uniformly level finish grade and appearance.
- 1.2.10.f. Firm the topsoil by rolling with a standard turfgrass roller that is half-full of water. If more weight is required to adequately firm the surface, fill the roller with water and repeat rolling as necessary. Properly firmed soil will show a foot print when walked upon, but will not allow the walker's foot to sink into the soil
- 1.2.10.g. Protect finished areas from damage by vehicular or pedestrian traffic.
- 1.2.10.h. Install and maintain erosion control material to meet local environmental regulations. Copies of these requirements may be reviewed by contacting the COR.
- 1.2.11. After finish grade has been established, raise all irrigation components and install sprinkler heads to finish grade. Adjust sprinkler heads to provide full coverage and best distribution uniformity.
- 1.2.12. Turfgrass Sod Transplanting and Installation:
 - 1.2.12.a. Provide certified sod as specified in Exhibit (D).
 - 1.2.12.b. Moistening the Soil: During periods of higher than optimal temperature for the species specified, and after all unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to installation of the turfgrass sod.
 - 1.2.12.c. Starter Strip: The first row of turfgrass sod shall be laid in a straight line, with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the pieces are not stretched or overlapped and that all joints are butted tightly to prevent voids that would cause air drying of the roots.
 - 1.2.12.d. Sloping Surfaces: On 3:1 or greater slopes, traditional size (1 sq yd / 1 sq m) turfgrass sod shall be laid across the angle of the slope (perpendicular), with staggered joints and secured by tamping, pegging, stapling or other approved methods of temporarily securing each piece. Large-roll turfgrass sod shall be laid in the direction of the slope, with temporary securing being at the discretion of the installation contractor.

- 1.2.12.e. Swales and Intermittent Waterways: The installation of turfgrass sod within drainways or intermittent waterways shall be determined after considering maximum channel velocities for storms of a designated intensity. Traditional size turfgrass sod shall be laid perpendicular to the direction of flow and pegged to resist washout during the establishment period, while large-roll pieces shall be laid in the direction of the flow, with temporary securing being at the discretion of the installation contractor.
- 1.2.12.f. Watering and Rolling: The installation contractor shall water the turfgrass sod immediately after transplanting to prevent drying. As sod placement is completed in any one section, the entire area shall be lightly rolled. It shall then be thoroughly watered to a depth sufficient to ensure the underside of the new sod pad and soil immediately below the pad are thoroughly wet. The Contractor shall be responsible for having adequate water available at the site prior to and during installation.
- 1.2.12.g. All turfgrass sod shall be uniform in color, leaf texture and shoot density and shall be reasonably free of weeds, diseases and other visible imperfections at acceptance.

1.2.13. Turfgrass Sod Establishment:

- 1.2.13.a. The establishment period for turf shall begin immediately after installation, with the approval of the COR. All turf established by the Contractor shall be irrigated and fully maintained by the Contractor until final acceptance is made by the Government. The Governments reserves the right to increase or decrease frequency of watering as deemed necessary.
- 1.2.13.b. Watering: Irrigate area routinely and as required to ensure complete and satisfactory sod establishment. Apply water at a moderate rate so as not to flood the plants and turf. Soil on sod pads shall be kept moist at all times to maintain moist soil to a depth of at least 4 inches. Sod shall be watered daily for the first 10 to 14 days to avoid dry out. Then, water sod routinely as needed to prevent visual wilt (blue/gray hue). In all cases, Contractor shall coordinate irrigation schedules with the COR.
- 1.2.13.c. Eradicate all weeds. Water, fertilize, over-seed, and perform any other operation necessary to promote the growth of grass. Replant areas void of turf 0.1 m² (one square foot) and larger in area. Mow the new lawn at least three times, prior to the final inspection. Begin mowing when grass is two and one-half (2-1/2) inches high. Mow to a two (2) inch height per each of the three mowings prior to final inspection. String trim/stick trim the turf around the headstones at least three times, maintaining the same surrounding height of the mowed turf prior to the final inspection. Begin trimming when grass is three and one-half (3-1/2) inches high.

- 1.2.13.d. Mowing: Mowing shall be performed in accordance with the requirements of paragraph **1.3**. The first mowing shall not be attempted until the turfgrass sod is firmly rooted and securely in place. Begin mowing sod when plant height reaches two and one-half (2-1/2) inches or as otherwise directed by the COR.
 - 1.2.13.e. Fertilizing: Apply turf fertilizer after sod is fully rooted; established and has been mowed at least 2 times. Provide and apply a 3:1:2 ratio (preferably analysis of 21:7:14) or similar; the fertilizer shall have a 50% of nitrogen in a slow release form. Fertilizer SDS and Labels shall be submitted and accepted by the CD Agronomist and the COR prior to application.
 - 1.2.13.f. Continue mowing and irrigation until sod is 100% established. After the sod has been established the Contractor shall request a Final Inspection in writing to the Contracting Officer and COR.
 - 1.2.13.g. Germinated weeds must be eliminated by spraying with a typical three-way broadleaf herbicide combination product or with Drive™ or an approved equal post emergence herbicide for control of crabgrass or both if necessary to achieve 100% turfgrass cover. The seedling turfgrass shall be mowed at least three times before any herbicide treatment is applied.
- 1.2.14. In areas where turf work has been completed, clear the area of all debris. Any areas damaged during establishment operations must be restored to their original condition.
- 1.3. MOWING PROCEDURES AND EQUIPMENT FOR TURFGRASS SOD ESTABLISHMENT
- 1.3.1. The Contractor shall use rear-discharge mowers or mowers with mulching decks only. At no time is freshly mowed grass to be blown onto headstones. Riding mowers may be used if they are not operated within two (2) inches of headstones, flat markers, monuments, tree trunks or other vertical surfaces.
 - 1.3.2. Commercial grade power trimmers and power edgers shall be used to trim grass from around headstones, monuments, markers, etc. The Contractor shall use trimmers with a plastic blade attachment to cleanly trim edges around all flat markers. Care must be taken not to chip flat markers with blades.
 - 1.3.3. All mowing equipment shall be cleaned before mowing at the Cemetery to reduce the risk of introducing contaminant weed seeds into the cemetery turf. No equipment will be cleaned on cemetery property.
 - 1.3.4. Cutting blades on mowing and trimming equipment must be kept sharp so that grass tips are cleanly cut and not torn or damaged.

- 1.3.5. Turfgrass Heights: Turf shall be maintained at a height within one (1) inch of the range as specified in Exhibit (D) or as directed by the COR. The height of grass is what is measured to get the correct cutting height. The cutting height of all mowing equipment shall be set to maintain the specified height. At no time will more than one-third (1/3) of leaf blade be removed during any single mowing.
- 1.3.6. Trimming: The base of headstones, trees, monuments, markers, buildings walls, fences, signs and other vertical surfaces shall be trimmed to keep the grass within one (1) inch above the range as specified in Exhibit (D) or as directed by the COR. Trimming operations will be considered a part of mowing and accomplished concurrently with mowing operations. A mowing cycle will not be considered complete until all trimming operations are accomplished. Areas will be mowed first, followed by the trimming operation.
- 1.3.7. Mowing and trimming will be accomplished free of scalping, rutting, bruising, and uneven and rough cutting. Use of cutting equipment that is out of adjustment, thereby causing streaks or irregularities, uneven cutting, plowing, or gouging of the soil is not permitted. After cutting, grass will have a uniform height.
- 1.3.8. Contractor shall be familiar with and utilize different mowing patterns. Changing direction and patterns reduces turf wear, prevents wheel rutting, and provides a neater appearance. All mowing around trees will be accomplished in a manner that prevents a "ringing pattern" around the tree and associated damage to turf.
- 1.3.9. Mowing, trimming and edging operations will not damage headstones, markers, floral or commemorative items, structures, survey monuments, irrigation equipment, etc.
- 1.4. TRASH, DEBRIS & LEAF REMOVAL
 - 1.4.1. Debris and Trash: Any item, material, or foreign object not permanently attached to or planted within the cemetery grounds and boundaries. Items include, but are not limited to, fallen twigs and branches that are under ten (10) inches (25.40 cm) in diameter, paper products, cigarette butts, gum, glass and metal products, plastic and any other synthetic items, loose rock and stone over three (3) inches (7.62 cm) in diameter that are not the apparent result of an interment. Not included is the material found within trash receptacles.
 - 1.4.2. Contractor shall collect and dispose of all debris and trash before and after each mowing and trimming event within the Cemetery.
 - 1.4.3. Any clippings deposited on headstones, flat markers, monuments, roadways, walkways (inside and out), flagpole bases, or other non-turf grass areas, shall be mechanically blown onto nearby turf areas when possible, or collected and disposed of on the same day as the mowing and trimming event that produced them. Any clippings deposited on sidewalks or at public visitor areas including at the Committal Shelter areas shall be swept or removed using mechanical blowers at same time mowing work is occurring.

Clearly visible windrows of clippings, as a result of infrequent mowing, will be removed and disposed of at no extra cost to the Government.

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SECTION 32 92 00

TURFGRASS RENOVATION AND REESTABLISHMENT

1.5. WORK OVERVIEW

1.5.1. This section outlines operational procedures to be followed in sections designated for topsoil surface leveling, renovation, and re-establishment of the existing turfgrass stand. Turf renovation generally includes curb-to-curb renovation unless otherwise directed by the COR. The contractor shall provide all supervision, professional advice/guidance, labor, parts, materials, equipment, and personnel, to provide the services defined herein.

1.5.2. The COR will determine the beginning point and ending points in each gravesite section.

1.6. TOPSOIL AND TURFGRASS RENOVATION PROCESS:

1.6.1. The following renovation process shall begin with the approval of the COR and only when the existing turfgrass is actively growing and not in dormancy.

1.6.2. Mow and trim target area several times removing grass clippings each time. Initial mowing in this sequence should be at normal maintenance height (i.e. 2.5 to 3 inches) and subsequent mowing 2 or 3 days apart should be at lowered height (i.e. 1.5 to 2 inches).

1.6.3. After a minimum of two or more preparatory mowings and trimmings, the entire vegetated area should be treated with an application of an appropriate non-selective herbicide. Application rate should be the maximum label recommended rate for the complete elimination of perennial grass species and contaminant weeds. **IMPORTANT: Application must be made at a time when grass is actively growing for the herbicide to work.** Application to be made by a licensed pesticide applicator. Allow a minimum of 10 to 14 days to elapse for herbicide to fully translocate throughout all plant parts.

1.6.4. The COR shall confirm and approve that all vegetation (turfgrass, weeds, etc.) in the treated area is completely dead prior to removal of the dead vegetation. If any vegetation within the treated area is still vital (alive) it shall not be removed. Re-treat the vegetated area in accordance with paragraph **2.2.3** until the vegetated area is completely dead.

- 1.6.5. Contractor shall inventory, remove, and store all irrigation heads and cap head risers within the limits of work. Provide a copy of the inventoried equipment and materials to the COR. Provide protection of any exposed components, risers, etc. that might be damaged by renovation equipment.
- 1.6.6. Contractor shall locate and inventory all irrigation components: (valve boxes, gate valves, quick couplers, etc.) within the limits of work and protect the location and component access throughout contract work. Provide a copy of the inventoried equipment and materials to the COR.
- 1.6.7. The Contractor shall be responsible for the replacement of irrigation heads and components at finish grade, ensuring all irrigation lines and heads are free of foreign matter and operating properly.
- 1.6.8. Removal of Existing Turf Stand:
 - 1.6.8.a. Power rake or verticut entire treated area to loosen and prepare the site for the removal of all residual plant debris including thatch.
 - 1.6.8.b. Remove all residual plant debris including thatch.
- 1.6.9. Topsoil Preparation: Rototill area to a minimum depth of 6 inches to uniformly mix topsoil and to uniformly loosen top surface for re-grading and leveling.
- 1.6.10. Topsoil Leveling and Grading
 - 1.6.10.a. Grade and compact surface of site to achieve desired finished appearance, which is to be smooth and uniformly level down each row and between each row, free of all surface ripples, depressions, high spots, low areas, ridges. The finish grade for each gravesite section shall be smooth and uniformly level with adjacent gravesite sections and surrounding terrain. New surfaces shall be blended to existing areas.
 - 1.6.10.b. The prepared surface (finish grade) shall be a maximum 1 inch below the adjoining grade of any surfaced area. The prepared surface (finish grade) shall be a nominal 25 inches below the top of all upright headstones and 1 inch below the top of all flat markers, or by direction and approval of the COR.
 - 1.6.10.c. In locations where existing burial area surface has formed “ridges” between rows, these areas shall be knocked down by grading between high and low surfaces of the rows so that finished surface is uniformly flowing from row to row, and down each row. If this process does not achieve desired smooth and uniformly flowing finished grade due to numerous depressions and low or sunken areas in the existing surface grade, import, spread and compact

additional high quality topsoil of similar characteristics and texture to the soil already present on site.

- 1.6.10.d. Topsoil shall be free of foreign matter, any objects bigger than 25 mm (1 inch) and weed seeds.
- 1.6.10.e. Apply and compact sufficient topsoil to eliminate all ripples, depressions, and sunken areas as needed to achieve the desired smooth and uniformly level finish grade and appearance.
- 1.6.10.f. Firm the topsoil by rolling with a standard turfgrass roller that is half-full of water. If more weight is required to adequately firm the surface, fill the roller with water and repeat rolling as necessary. Properly firmed soil will show a foot print when walked upon, but will not allow the walker's foot to sink into the soil
- 1.6.10.g. Protect finished areas from damage by vehicular or pedestrian traffic.
- 1.6.10.h. Install and maintain erosion control material to meet local environmental regulations. Copies of these requirements may be reviewed by contacting the COR.
- 1.6.11. After finish grade has been established, raise all irrigation components and install sprinkler heads to finish grade. Adjust sprinkler heads to provide full coverage and best distribution uniformity.
- 1.6.12. Turfgrass Sod Transplanting and Installation:
 - 1.6.12.a. Provide certified sod as specified in Exhibit (D).
 - 1.6.12.b. Moistening the Soil: During periods of higher than optimal temperature for the species specified, and after all unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to installation of the turfgrass sod.
 - 1.6.12.c. Starter Strip: The first row of turfgrass sod shall be laid in a straight line, with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the pieces are not stretched or overlapped and that all joints are butted tightly to prevent voids that would cause air drying of the roots.
 - 1.6.12.d. Sloping Surfaces: On 3:1 or greater slopes, traditional size (1 sq yd / 1 sq m) turfgrass sod shall be laid across the angle of the slope (perpendicular), with staggered joints and secured by tamping, pegging, stapling or other approved methods of temporarily securing each piece. Large-roll turfgrass

sod shall be laid in the direction of the slope, with temporary securing being at the discretion of the installation contractor.

- 1.6.12.e. Swales and Intermittent Waterways: The installation of turfgrass sod within drainways or intermittent waterways shall be determined after considering maximum channel velocities for storms of a designated intensity. Traditional size turfgrass sod shall be laid perpendicular to the direction of flow and pegged to resist washout during the establishment period, while large-roll pieces shall be laid in the direction of the flow, with temporary securing being at the discretion of the installation contractor.
- 1.6.12.f. Watering and Rolling: The installation contractor shall water the turfgrass sod immediately after transplanting to prevent drying. As sod placement is completed in any one section, the entire area shall be lightly rolled. It shall then be thoroughly watered to a depth sufficient to ensure the underside of the new sod pad and soil immediately below the pad are thoroughly wet. The Contractor shall be responsible for having adequate water available at the site prior to and during installation.
- 1.6.12.g. All turfgrass sod shall be uniform in color, leaf texture and shoot density and shall be reasonably free of weeds, diseases and other visible imperfections at acceptance.

1.6.13. Turfgrass Sod Establishment:

- 1.6.13.a. The establishment period for turf shall begin immediately after installation, with the approval of the COR. All turf established by the Contractor shall be irrigated and fully maintained by the Contractor until final acceptance is made by the Government. The Governments reserves the right to increase or decrease frequency of watering as deemed necessary.
- 1.6.13.b. Watering: Irrigate area routinely and as required to ensure complete and satisfactory sod establishment. Apply water at a moderate rate so as not to flood the plants and turf. Soil on sod pads shall be kept moist at all times to maintain moist soil to a depth of at least 4 inches. Sod shall be watered daily for the first 10 to 14 days to avoid dry out. Then, water sod routinely as needed to prevent visual wilt (blue/gray hue). In all cases, Contractor shall coordinate irrigation schedules with the COR.
- 1.6.13.c. Eradicate all weeds. Water, fertilize, over-seed, and perform any other operation necessary to promote the growth of grass. Replant areas void of turf 0.1 m² (one square foot) and larger in area. Mow the new lawn at least three times, prior to the final inspection. Begin mowing when grass is two and one-half (2-1/2) inches high. Mow to a two (2) inch height per each of the three mowings prior to final inspection. String trim/stick trim the turf around the headstones at least three times, maintaining the same

surrounding height of the mowed turf prior to the final inspection. Begin trimming when grass is three and one-half (3-1/2) inches high.

- 1.6.13.d. Mowing: Mowing shall be performed in accordance with the requirements of paragraph 1.3. The first mowing shall not be attempted until the turfgrass sod is firmly rooted and securely in place. Begin mowing sod when plant height reaches two and one-half (2-1/2) inches or as otherwise directed by the COR.
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- 1.6.13.f. Continue mowing and irrigation until sod is 100% established. After the sod has been established the Contractor shall request a Final Inspection in writing to the Contracting Officer and COR.
- 1.6.13.g. Germinated weeds must be eliminated by spraying with a typical three-way broadleaf herbicide combination product or with Drive™ or an approved equal post emergence herbicide for control of crabgrass or both if necessary to achieve 100% turfgrass cover. The seedling turfgrass shall be mowed at least three times before any herbicide treatment is applied.
- 1.6.14. In areas where turf work has been completed, clear the area of all debris. Any areas damaged during establishment operations must be restored to their original condition.
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 - 1.7.2. Commercial grade power trimmers and power edgers shall be used to trim grass from around headstones, monuments, markers, etc. The Contractor shall use trimmers with a plastic blade attachment to cleanly trim edges around all flat markers. Care must be taken not to chip flat markers with blades.
 - 1.7.3. All mowing equipment shall be cleaned before mowing at the Cemetery to reduce the risk of introducing contaminant weed seeds into the cemetery turf. No equipment will be cleaned on cemetery property.
 - 1.7.4. Cutting blades on mowing and trimming equipment must be kept sharp so that grass tips are cleanly cut and not torn or damaged.

- 1.7.5. Turfgrass Heights: Turf shall be maintained at a height within one (1) inch of the range as specified in Exhibit (D) or as directed by the COR. The height of grass is what is measured to get the correct cutting height. The cutting height of all mowing equipment shall be set to maintain the specified height. At no time will more than one-third (1/3) of leaf blade be removed during any single mowing.
- 1.7.6. Trimming: The base of headstones, trees, monuments, markers, buildings walls, fences, signs and other vertical surfaces shall be trimmed to keep the grass within one (1) inch above the range as specified in Exhibit (D) or as directed by the COR. Trimming operations will be considered a part of mowing and accomplished concurrently with mowing operations. A mowing cycle will not be considered complete until all trimming operations are accomplished. Areas will be mowed first, followed by the trimming operation.
- 1.7.7. Mowing and trimming will be accomplished free of scalping, rutting, bruising, and uneven and rough cutting. Use of cutting equipment that is out of adjustment, thereby causing streaks or irregularities, uneven cutting, plowing, or gouging of the soil is not permitted. After cutting, grass will have a uniform height.
- 1.7.8. Contractor shall be familiar with and utilize different mowing patterns. Changing direction and patterns reduces turf wear, prevents wheel rutting, and provides a neater appearance. All mowing around trees will be accomplished in a manner that prevents a “ringing pattern” around the tree and associated damage to turf.
- 1.7.9. Mowing, trimming and edging operations will not damage headstones, markers, floral or commemorative items, structures, survey monuments, irrigation equipment, etc.
- 1.8. TRASH, DEBRIS & LEAF REMOVAL
- 1.8.1. Debris and Trash: Any item, material, or foreign object not permanently attached to or planted within the cemetery grounds and boundaries. Items include, but are not limited to, fallen twigs and branches that are under ten (10) inches (25.40 cm) in diameter, paper products, cigarette butts, gum, glass and metal products, plastic and any other synthetic items, loose rock and stone over three (3) inches (7.62 cm) in diameter that are not the apparent result of an interment. Not included is the material found within trash receptacles.
- 1.8.2. Contractor shall collect and dispose of all debris and trash before and after each mowing and trimming event within the Cemetery.
- 1.8.3. Any clippings deposited on headstones, flat markers, monuments, roadways, walkways (inside and out), flagpole bases, or other non-turf grass areas, shall be mechanically blown onto nearby turf areas when possible, or collected and disposed of on the same day as the mowing and trimming event that produced them. Any clippings deposited on sidewalks or at public visitor areas including at the Committal Shelter areas shall be

swept or removed using mechanical blowers at same time mowing work is occurring. Clearly visible windrows of clippings, as a result of infrequent mowing, will be removed and disposed of at no extra cost to the Government.

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