

WATERLINE EXTENTION PROJECT
KINAKAPW TO LEHN DIADI

FEDERATED STATES OF MICRONESIA
STATE OF POHNPEI

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SECTION 02 27 40

GROUTED RIPRAP
08/14

PART 1 GENERAL

1.1 SUMMARY

Perform all work in as indicated on the drawings and as specified herein.

1.2 DESCRIPTION

This Work consists of furnishing and placing of cement mortar and rocks to the lines and grades shown on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform the Work in accordance with the "Hawaii Standard Specifications for Road and Bridge Construction 2005" and its amendments.

1.4 RIP RAP

Rip rap shall be grouted rip rap rock.

PART 2 PRODUCTS

2.1 MATERIALS

A. GROUTED RIP RAP

- 1. GROUT: Provide durable grout composed of cement, water and sand mixed in proportions of one part Portland cement to two parts of sand, sufficient water to produce a workable mixture. Mix grout in a concrete mixer. Allow a sufficient mixing time to produce a mixture having a consistency permitting gravity flow into the interstices of the riprap with limited spading and brooming.

B. STONES

- 1. STONES: Shall be clean, free of seams and blemishes or other imperfections, and when tested in accordance with ASTM shall show wear not to exceed 50%. All stones shall be obtained from the same source. All stones shall be moss rock or blue stone (quarried or shattered face exposed). The stones may be variable in sizes, shall not be thicker than the depth of the course being placed.
- 2. Stones required for riprap shall be quarried, field stones or salvaged from an approved source. The source(s) of stones shall be approved by the Engineer prior to the start of construction. Approval of a source of stones shall not be construed as an approval of all material from that source, nor that the source will produce the quantity and size required by this specification.

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PART 3 EXECUTION

3.1 EXAMINATION

Verification of existing conditions before starting work shall be required.

3.2 GENERAL

- A. The Contractor shall use equipment and workmen capable of performing the work specified in this section.
- B. The construction methods which the Contractor intends to use shall be thoroughly discussed with the Engineer and the approval of the methods obtained prior to commencing the operations.

3.3 INSTALLATION

- A. Stones shall be placed to match the limits, elevations, lines and slopes as indicated on the drawings and as specified hereinafter. Stones shall be in pieces generally rectangular in cross section, the least dimension of any piece being not less than one-third its greatest dimension. In general, the stone shall be keyed and fitted tight and placed so that vertical joints are broken with the long axis of the stone set approximately normal to the structure slope and pointing inward toward the center of the structure section. The Contractor shall maintain the placed stone until accepted and any material displaced by any cause shall be replaced at his expense.
- B. Preparation of Ground Surface: Prior to replacement or resetting of stones as shown on the drawings and specified in this section the subgrade shall be compacted to 90%.
- C. Placement: Stones for riprap shall be selected with care as to size and shape and placed in such a manner as to produce the required section as indicated on the drawing. Each stone shall be fitted and keyed with adjacent stones, leaving voids through which underlying stones cannot pass. Resetting of adjacent in-place stone to provide for proper placing of shifted or separated stone shall be considered incidental to this work. All stone shall rest securely upon the underlying stone. The voids between the stone shall not be filled with chink stone. Voids shall not be more than 2 inches in diameter. The placement of stone shall proceed as soon as practicable after placement of the underlying stone to prevent displacement of the underlying stone.
- D. Grouting: Prior to grouting, wet rip-rap surfaces. Grout rip-rap in successive longitudinal strips, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Protect and cure surface for a minimum of 7 days.
- E. Removal of Rejected Stones: If a newly placed stone or reset stone is found defective in quality, size, shape, weight or placement, the Contractor shall promptly remove the defective stone and replace in with a new stone or reset the required stone to the satisfaction of the Engineer, at no increase in contract price.

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.2 PROJECT DESCRIPTION

1.2.1 Demolition Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site and do not allow accumulations. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from project site daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

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1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from the Contractor.

1.3.3 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractors Quality Control. Submit the following:

SD-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G

Notification of Demolition; G

Proposed salvage, demolition, and removal procedures for approval before work is started.

1.6 QUALITY ASSURANCE

Comply with state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.7 PROTECTION

1.7.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.8 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. ReCOd existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a reCOd of existing conditions. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the reCOd document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition of structures. Fill material shall be waste products from demolition until all waste appropriate for this purpose is consumed.

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PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.2 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Fill holes and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.4 CLEANUP

Remove debris and rubbish from excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

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3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable state and local regulations. Storage of removed materials on the project site is prohibited.

3.5.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

3.5.3 Removal from Government Property

Transport waste materials removed from the demolition area from Government property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

SECTION 02 84 30

METAL GUARDRAILS

08/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A307 (2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A525 (2014) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) By The Hot-Dip Process, General Requirements

ASTM E376 (2011) Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 180 (2012) Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail

AMERICAN WELDING SOCIETY (AWS)

AWS D1.72 (2012) Structural Welding Code

1.2 SUMMARY

Perform all work in as indicated on the drawings and as specified herein.

1.3 DESCRIPTION

This section covers the requirements for furnishing and installing galvanized steel guardrails, concrete posts, and all appurtenances.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Posts and Guard Rails: Existing guardrails shall be reinstalled with Concrete posts as shown on the plans.

Unless specified otherwise, metal guard rails, curved and flared ends, shall be corrugated sheet steel beams conforming to AASHTO M 180, ASTM A307, ASTM A525 and ASTM E376. The rail dimensions and gage shall be not less than 12 inches in width, three inches in depth and not less

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than 12 gage thick. See page R-22 and R-23, Standard Details for Public Works Construction, September 1984.

- B. Bolts, Washers, and Nuts shall be stainless steel.
- C. Concrete: See Section 03 30 53 CONCRETE.

PART 3 EXECUTION

3.1 GENERAL

- A. The line and grade of the guardrail shall be true to that shown on the plans. All posts shall be constructed vertically. All joints shall be welded and ground smooth. All shop and field shall conform to AWS "Structural Welding Code: AWS D1.72."
- B. The construction of guardrail shall conform on the plans, and pages R-22 and R-23, Standard Details of Public Works Construction, September 1986.

3.2 STORAGE OF MATERIALS

- A. Guardrail materials shall be stored off the ground on platforms, pallets, or other supports. These materials shall be kept free from grease and dirt and shall be protected from moisture, as far as practicable, until they have been properly installed.

3.3 CONDITION OF MATERIALS

- A. Guardrail materials, before being installed or worked, must be straight. If straightening is necessary, it shall be done by methods that will not injure the appearance or body of the metal. Sharp kinks and bends shall be cause for rejection of the material.

3.4 LAYOUT

- A. Spacing of posts shall be as shown on the Plans.

3.5 FABRICATION AND ERECTION

- A. Concrete Posts and Guardrails. All metal work shall be fabricated in the shop and galvanized before delivery to the job site. The rails shall be free from kinks, twist or bends, and shall be uniform in appearance.
- B. Joining of the Material. Guardrail shall be carefully adjusted prior to being fixed in place to insure proper matching at abutting joints with correct alignment, curvature and camber throughout its length. Guardrail on curves or return bends shall be fabricated to a smooth curve throughout the length of the curve as specified above. All exposed ends or rail shall be covered with an Engineer approved seal.
- C. Bending. To facilitate bending, materials may be heated to a temperature not exceeding 400EF for a period not exceeding 30 minutes.
- D. Cutting. Material of 0.5 inch thickness or less may be sheared, sawed or milled. Cut edges shall be true, smooth and free burrs or ragged breaks. Re-entrant cuts shall be coped for proper fittings and welding. Torch of flame cutting will not be permitted.

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E. Post anchoring shall be accordance with the Plans.

-- End of Section --

SECTION 03 20 00.00 10

CONCRETE REINFORCING
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318 (2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and Commentary

ACI SP-66 (2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A370 (2012a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products

ASTM A615/A615M (2013) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A706/A706M (2013) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2009; 28th Ed) Manual of Standard Practice

1.2 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following:

SD-02 Shop Drawings

Reinforcement; G

1.3 DELIVERY, STORAGE, AND HANDLING

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

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PART 2 PRODUCTS

2.1 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A615/A615M, or ASTM A706/A706M, grades and sizes as indicated.

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

2.2 WIRE TIES

Wire ties shall be 16 gauge or heavier soft or commercial-grade steel tie wire.

2.3 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.4.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with ASTM A370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Zinc-Coated and epoxy-coated bars shall be mill-bent prior to coating. All steel shall be bent cold unless authorized. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all

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exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Placing Tolerances

3.1.2.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 1 inch.

3.1.2.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown.

-- End of Section --

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE
04/08

PART 1 GENERAL

1.1 SUMMARY

Perform all work in as indicated on the drawings and as specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI MCP PACK (2013) Manual of Concrete Practice Part 2

ASTM INTERNATIONAL (ASTM)

ASTM C1064/C1064M (2011) Standard Test Method for
Temperature of Freshly Mixed
Hydraulic-Cement Concrete

ASTM C143/C143M (2012) Standard Test Method for Slump of
Hydraulic-Cement Concrete

ASTM C150/C150M (2012) Standard Specification for Portland
Cement

ASTM C171 Standard Specification for Sheet Materials
for Curing Concrete

ASTM C172/C172M (2010) Standard Practice for Sampling
Freshly Mixed Concrete

ASTM C231/C231M (2010) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Pressure Method

ASTM C260 (2010a) Standard Specification for
Air-Entraining Admixtures for Concrete

ASTM C309 (2011) Standard Specification for Liquid
Membrane-Forming Compounds for Curing
Concrete

ASTM C31/C31M (2012) Standard Practice for Making and
Curing Concrete Test Specimens in the Field

ASTM C33/C33M (2013) Standard Specification for Concrete
Aggregates

ASTM C39/C39M (2014) Standard Test Method for

Compressive Strength of Cylindrical
Concrete Specimens

| | |
|-----------------|--|
| ASTM C494/C494M | (2013) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C685/C685M | (2011) Concrete Made by Volumetric Batching and Continuous Mixing |
| ASTM C920 | (2011) Standard Specification for Elastomeric Joint Sealants |
| ASTM C94/C94M | (2014) Standard Specification for Ready-Mixed Concrete |
| ASTM D75/D75M | (2013) Standard Practice for Sampling Aggregates |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---------------|--|
| COE CRD-C 400 | (1963) Requirements for Water for Use in Mixing or Curing Concrete |
|---------------|--|

1.3 SYSTEM DESCRIPTION

The Construction Manager retains the option to sample and test aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Construction Manager in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with ASTM D75/D75M. Sample concrete in accordance with ASTM C172/C172M. Determine slump and air content in accordance with ASTM C143/C143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C31/C31M. Test compression test specimens in accordance with ASTM C39/C39M. Take samples for strength tests not less than once each shift in which concrete is produced from each class of concrete required. Provide a minimum of three specimens from each sample; two to be tested at 28 days for acceptance, and one will be tested at 7 days for information.

1.3.1 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days. The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, $f'c$, and no individual acceptance test result falls below $f'c$ by more than 500 psi.

1.3.2 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength $f'c$ shall be as shown on the drawings. The maximum nominal size coarse aggregate is 3/4

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inch. The air content shall be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water cement ratio is 0.50. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

1.4 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Air-Entraining Admixture
Water-Reducing or Retarding Admixture
Curing Materials

Manufacturer's literature from suppliers which demonstrates compliance with applicable specifications.

Batching and Mixing Equipment
Conveying and Placing Concrete
Formwork
Forms
Ready-Mix Concrete
Mix Design Data
Air-Entraining Admixtures
Curing Compound

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions
Compressive Strength Testing
Slump

SD-07 Certificates

Cementitious Materials
Aggregates

1.5 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement, Forms, Steel

Reinforcement, Accessories on installation drawings and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

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PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Provide cementitious materials that conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C150/C150M, Type II.

2.1.2 Aggregates

Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C33/C33M Class Designations 4M or better. Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months at the expense of the Contractor at the request of the Construction Manager and will be rejected if test results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260.

2.1.3.2 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C494/C494M, Type A, B, or D.

2.1.4 Water

Use fresh, clean, potable water for mixing and curing, free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.5 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to ASTM C920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.1.6 Formwork

The design and engineering of the formwork as well as its construction,

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will be the responsibility of the Contractor. Submit formwork design prior to the first concrete placement.

2.1.7 Form Coatings

Coat forms, for exposed surfaces, with a nonstaining form oil to be applied shortly before concrete is placed.

2.1.8 Curing Materials

Provide curing materials conforming to the following requirements.

2.1.8.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C171, type optional, except polyethylene film, if used, shall be white opaque.

2.1.8.2 Membrane-Forming Curing Compound

ASTM C309, Type 1-D or 2, Class A or B.

2.2 READY-MIX CONCRETE

- a. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP PACK Part 2. Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C94/C94M.
- b. Slump: 1 to 4 inch according to ASTM C143/C143M and ACI MCP PACK Part 1.
- c. Portland Cement conforming to ASTM C150/C150M, Type II.
- d. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.
- e. Air-Entraining Admixtures conforming to ASTM C260.
- f. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and Water-reducing and retarding admixtures shall conform to ASTM C494/C494M.

2.3 FORMS

Forms shall be of wood, steel, or other approved material and conform to ACI MCP PACK, Parts 2 and 3.

Provide form release conforming to ACI MCP PACK, Part 4.

2.4 CURING COMPOUND

Provide curing compound conforming to ASTM C309.

PART 3 EXECUTION

3.1 PREPARATION

The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove standing or flowing water, loose particles, debris, and

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foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the Government prior to placing.

3.1.1 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

3.1.2 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges, unless otherwise indicated.

3.1.3 Production of Concrete

3.1.3.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C94/C94M except as otherwise specified.

3.1.3.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C685/C685M.

3.1.3.3 Batching and Mixing Equipment

The Contractor has the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. Submit the method of measuring materials, batching operation, and mixer for review, and manufacturer's data for batching and mixing equipment demonstrating compliance with the applicable specifications.

3.2 CONVEYING AND PLACING CONCRETE

Concrete placement is not permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. Convey concrete from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Deposit concrete as close as possible to its final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be prevented. Submit Methods and equipment

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for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement. Perform conveying and placing concrete in conformance with the following:

3.2.1 Consolidation

Consolidate each layer of concrete by internal vibrating equipment.

Systematically accomplish internal vibration by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

3.2.2 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP PACK Part 2, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures taken as quickly as finishing operations will allow.

3.3 FORM REMOVAL

Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

3.4 FINISHING

3.4.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

Remove all fins and loose materials and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured is the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

Float finish all unformed surfaces, that are not to be covered by additional concrete or backfill, to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be

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brought to the elevations shown and left as a true and regular surface. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish as determined by a 10 foot straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

3.4.3.1 Float Finish

Provide float finished surfaces, screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete supports a person's weight without deep imprint, complete floating. Floating shall embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.3.2 Trowel Finish

Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Protect finished surfaces from damage during the construction period.

3.4.3.3 Broom Finish

Screed and float the concrete to required finish plane with no coarse aggregate visible. After surface moisture disappears, broom or brush the surface with a broom or fiber bristle brush in a direction as directed.

3.5 CURING AND PROTECTION

Beginning immediately after placement, and continuing for at least 7 days, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms by one of the following methods:

- a. Continuous sprinkling or ponding.
- b. Application of absorptive mats or fabrics kept continuously wet.
- c. Application of sand kept continuously wet.
- d. Application of impervious sheet material conforming to ASTM C171.
- e. Application of membrane-forming curing compound conforming to ASTM C309, Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days. If

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forms are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 Field Testing Technicians

The individuals who sample and test concrete, as required in this specification, shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.6.2 Inspection Details and Frequency of Testing

3.6.2.1 Preparations for Placing

Inspect forms, and embedded items in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

3.6.2.2 Air Content

Check air content at least once during each shift that concrete is placed for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C231/C231M.

3.6.2.3 Slump

Check slump once during each shift that concrete is produced for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C143/C143M.

3.6.2.4 Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.3 Action Required

3.6.3.1 Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Do not continue placing if any pile is inadequately consolidated.

3.6.3.2 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3.6.3.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

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3.6.4 Reports

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within 3 days after the end of each weekly reporting period.

3.7 STEEL REINFORCING

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.7.1 Fabrication

Shop fabricate steel reinforcement in accordance with ACI MCP PACK Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP PACK Parts 2 and 3.

3.7.2 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.8 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.9 FIELD TESTING

- a. Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with ASTM C172/C172M.
- b. Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to ASTM C31/C31M. Perform Compressive strength testing conforming to ASTM C39/C39M.
- c. Test Slump at the site of discharge for each design mix in accordance with ASTM C143/C143M.
- d. Test air content for air-entrained concrete in accordance with ASTM C231/C231M.
- e. Determine temperature of concrete at time of placement in accordance with ASTM C1064/C1064M.

-- End of Section --

SECTION 04 20 00

MASONRY
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 530/530.1 (2011; Errata 2011; Errata 2013) Building Code Requirements and Specification for Masonry Structures and Related Commentaries

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M (2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C1019 (2013) Standard Test Method for Sampling and Testing Grout

ASTM C1142 (1995; R 2013) Standard Specification for Extended Life Mortar for Unit Masonry

ASTM C144 (2011) Standard Specification for Aggregate for Masonry Mortar

ASTM C150/C150M (2012) Standard Specification for Portland Cement

ASTM C476 (2010) Standard Specification for Grout for Masonry

ASTM C780 (2012a) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C90 (2013) Loadbearing Concrete Masonry Units

ASTM C94/C94M (2013a) Standard Specification for Ready-Mixed Concrete

ASTM C270 Standard Specification for Mortar for Unit Masonry

1.2 SYSTEM DESCRIPTION

1.2.1 Local/Regional Materials

Masonry materials may be locally available.

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1.2.2 Design Requirements

1.2.2.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.2.3 Additional Requirements

- a. Maintain at least one spare vibrator on site at all times.
- b. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

1.3 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Local/Regional Materials

Unit Strength Method

Cement

SD-04 Samples

Concrete Masonry Units (CMU)

SD-05 Design Data

Pre-mixed Mortar

SD-07 Certificates

Concrete Masonry Units (CMU)

Admixtures for Masonry Mortar

Admixtures for Grout

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, stored, handled, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and

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cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C90. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust as per the detail drawings.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination or segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.5.1 Hot Weather Installation

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. Submit sample of colored mortar with applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2 CONCRETE MASONRY UNITS (CMU)

Submit samples and certificates as specified. Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

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- a. Hollow Load-Bearing Units: ASTM C90, made with normal weight aggregate.

2.3 MASONRY MORTAR

Type M mortar shall conform to ASTM C270 and shall be used for foundation walls . Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.3.1 Cement

Portland cement shall conform to ASTM C150/C150M, Type II, . Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume. Additives shall conform to requirements in Section CAST-IN-PLACE .

2.3.2 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C1142, Type RN or RS . Submit pre-mixed mortar composition.

2.3.3 Sand and Water

Sand shall conform to ASTM C144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.4 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water penetration and water absorption of the mortar and masonry units.

2.5 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C476, coarse. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C1019. Use grout subject to the limitations of Table III. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C94/C94M.

2.6 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A615/A615M, Grade 60.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

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3.1.1 Completed Masonry and Masonry Not Being Worked On

- a. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Masonry shall be completely covered with weather resistant membrane for 24 hours.

3.1.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.3 Surfaces

Clean surfaces on which masonry is to be placed of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic.
- b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.
- c. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.
- d. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind

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pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Tolerances

Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Square corners unless noted otherwise.

3.2.4 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp.

3.2.5 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.5.1 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.3 JOINT WIDTHS

Joint widths shall be as follows:

3.3.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.4 MORTAR MIX

Mix mortar in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measure ingredients for mortar by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Mix water with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Retemper mortar that has stiffened because of loss of water through evaporation by adding water to restore the proper consistency and workability. Discard mortar that has reached its initial set or that has not been used within 2.5 hours after mixing.

3.5 REINFORCING STEEL

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.5.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.

3.5.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.6 PLACING GROUT

Fill cells containing reinforcing bars with grout. Walls below grade shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.6.1 Grouting Equipment

3.6.1.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.6.1.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.6.2 Grout Placement

Lay masonry to the top of a pour before placing grout. Do not place grout in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table I. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.6.2.1 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table I.

| TABLE I POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS | | | | |
|---|------------|--------------------|---|---------------------|
| | | | Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells in inches (1,2) | |
| Maximum Grout Pour Height feet (4) | Grout Type | Grouting Procedure | Multiwythe Masonry (3) | Hollow-unit Masonry |
| 1 | Coarse | Low Lift | 1-1/2 | 1-1/2 x 3 |
| 5 | Coarse | Low Lift | 2 | 2-1/2 x 3 |
| 8 | Coarse | High Lift | 2 | 3 x 3 |
| 12 | Coarse | High Lift | 2-1/2 | |
| 24 | Coarse | High Lift | 3 | 3 x 4 |

Notes:

- (1) The actual grout space or cell dimension shall be larger than the sum of the following items:
 - (a) The required minimum dimensions of total clear areas given in the table above;
 - (b) The width of any mortar projections within the space;
 - (c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.
- (3) For grouting spaces between masonry wythes.
- (4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.8 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion

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of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.10 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.11 TEST REPORTS

3.11.1 Field Testing of Mortar

Take at least three specimens of mortar each day. Spread a layer of mortar 1/2 to 5/8 inch thick on the masonry units and allowed to stand for one minute. Prepare and test the specimens for compressive strength in accordance with ASTM C780. Submit test results.

3.11.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days. Submit test results.

-- End of Section --

SECTION 13 41 00

GLASS-FUSED TO STEEL STORAGE TANK WITH ALUMINUM DOME ROOF

08/14

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, quality control inspection, fabrication, material testing and all other incidentals and labor required to design and construct a bolted, factory-applied, glass-fused-to-steel potable tank with an aluminum dome roof and all appurtenances, as specified herein.

B. Description of Tank:

1. The tank shall comply with AWWA D103-97 and shall be a bolted glass-fused-to-steel design with nominal inside diameter and sidewall height as shown on the construction plans. The tank shall have a nominal capacity as shown on the construction plans. The tank shell panels shall be factory rolled to the required radius and shall be a flat panel design with bolted lap-joints using cured-in-place urethane sealant.

2. The tank roof shall be an aluminum dome structure. The dome roof shall conform to AWWA D103-97, Section 13 and shall be a fully triangulated space truss complete with non-corrugated closure panels. The dome shall be clear span and self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring.

3. The Contractor, in accordance with the minimum requirements shown on the Plans and specified, herein, shall provide the foundation. The tank shall be anchored to the foundation to resist seismic and wind forces. The foundation shall be as shown on the Plans and shall be designed by the tank manufacturer's engineering department. An AWWA D-103 Type 2 or 3 foundation shall be acceptable; i.e. tank supported on concrete slab or tank supported within concrete ringwall.

4. All shell, floor and roof penetrations shall be adequately reinforced to transfer vertical, tangential and horizontal stresses, seismic load, and incidental differential settlement.

5. The following appurtenances shall be provided and located as indicated on the Plans (Unless noted otherwise; appurtenances on tank interior shall be Type 316 stainless steel, appurtenances on tank exterior shall be Type 304 stainless steel:

a. The Contractor shall supply an internal overflow with diameter area equal to the area of all inlet pipes. The overflow open end elevation shall be the maximum water surface elevation, as shown on the Plans. Suitable Type 316 stainless steel pipe supports, at approximately 10' intervals, shall be provided to prevent overflow pipe from moving. Nozzles thru the tank wall, if required by the Plans, shall be Type 316 stainless steel, full-face flange. The overflow may pass thru the tank floor and connect underground with the drain or it may pass thru the tank wall to an exterior 316

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stainless steel flap valve (exterior concrete splash pad shall be provided). Overflow pipe shall be Schedule 80 PVC or C905 PVC where in contact with product water.

- b. Separate tank inlet, effluent and washout connections shall be provided in diameters and at locations as shown on the Plans.
- c. At least, one (1) Type 316 stainless steel shell manway with a minimum diameter of 24 inches shall be provided in the sidewall of the reservoir. The manway shall be placed with the centerline approximately 3.0 feet above the reservoir bottom. Manway shall have a watertight seal and the openings shall be suitably reinforced.
- d. One (1) umbrella-type air vent fabricated from aluminum shall be provided. The vent shall be sized to allow a minimum flow of 1900 cubic feet per minute of air at a maximum differential pressure of 0.125" of water column with screens in place. The vent insect and bird screens shall be non-corrosive monofilament polyester.
- e. One (1) outside Type 6061 T-6 aluminum ladder with Type 304 stainless steel cage shall be provided. An aluminum shield gate shall be provided for controlled access to the outside ladder. No inside ladder shall be permitted.
- f. One (1) aluminum watertight, gasketed roof hatch as shown on the Plans and as described later in these specifications.
- g. A tank manufacturer approved cathodic protection system, utilizing suspended sacrificial magnesium anodes, shall be provided to protect the interior wetted surfaces of the tank. The anodes shall be suspended from fiberglass deck mounts which shall be installed using silicone sealant to prevent leakage through the dome. A corrosion engineer shall design the system and submit the design calculations for review by the Engineer. The cathodic protection system shall be designed for 10-year protection prior to anode replacement, based on the conductivity of the water stored and the exposed metallic surfaces.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C633 (2013) Standard Test Method for Adhesion or Cohesion Strength of Thermal Spray Coatings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA D103 (2009; Errata 2010) Factory-Coated Bolted Steel Tanks for Water Storage

1.3 SUBMITTALS

SD-02 Shop Drawings

Shop and Erection Plans

Submit shop and erection Plans along with structural design calculations, stamped by a registered Structural Engineer with current licensing from the State of Hawaii.

Submit foundation Plans along with structural design calculations, stamped by a registered Structural Engineer with current licensing from the State of Hawaii.

Submit a statement by tank engineer approving foundation Plans.

SD-03 Product Data

Tank Materials

Provide data on tank and dome materials, construction and accessories. Submit manufacturer's descriptive literature including accessories, components, and systems. Literature shall include detail specifications, available performance test data, and instruction for application and maintenance.

Tank Color: The exterior ceramic glass color shall be forest green. The interior tank color shall be titanium white.

SD-06 Test Reports

Test Reports

Furnish manufacturer's mil test reports for plate materials.

At conclusion of work, furnish a written report prepared by Contractor certifying that work was inspected in accordance with AWWA D103 Section 9. This report shall meet the requirements of Section 9 and cover hydrostatic test. Include in report a certification that construction conforms to approved Plans and specifications.

SD-07 Certificates

Manufacturer's Certificate: Certify that products meet or exceed specified requirements and are suitable for intended use. Submit manufacturer's certification that tank has been manufactured in accordance with AWWA D103.

Submit a certificate signed by tank manufacturer's registered structural Engineer providing the following information:

1. Description of structural design loading conditions used for design of entire tank including foundation.
2. Description of structural design method and codes used in establishing allowable stresses and safety factors applied in the design.
3. A statement verifying that structural design has been checked by experience engineers specializing in hydraulic structures.

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4. A statement verifying that shop Plans have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with design calculations, dimensions, and fabricating in member sizes, dimensions, and fabricating process as prescribed by ACI and AWWA standards.

Certificate for Microbiological Test

As required under item Testing and Disinfection.

SD-08 Manufacturer's Instructions

Tank Manufacturer

Tank Erector

Installation Crew

Indicate special procedures and installation instructions. Submit manufacturer's instructions for erection of tank. Instructions shall include, but not be limited to, bolt installation, sealant application, coating repair, foundation work and clean up.

Field Measurements

Report: Provide manufacturer's representative field observations.

1.4 PROJECT RECORD DOCUMENTS

Submit project record documents to reflect actual installation conditions.

1.5 QUALIFICATIONS FOR TANK AND DOME MANUFACTURERS AND TANK ERECTORS

Require information to be submitted with Contractor's bid:

- A. Tank Manufacturer: Company specializing in the fabrication of bolted, glass-fused-to-steel water tanks. All uncoiling, punching, radius rolling and glass-furnace operations shall be at one location. The manufacturer shall have fabricated and supplied, at least, ten (10) glass-fused-to-steel tanks of comparable or larger capacity in the past 12 months. Provide a list of current year tanks shipped, with the owner's name, contact persons and phone numbers.
- B. Tank Erector: Company specializing in performing erection of glass-fused tanks with aluminum domes shall have successfully erected a minimum of ten (10) comparable diameter or larger glass-fused tanks with aluminum domes presently in full operational service in the State of Hawaii. Provide a list complying tanks, owners' name, contact person and phone numbers. This information shall be provided with bid.
- C. Installation Crew: Installation of the tank shall be under the direction of the tank erector's factory certified tank builder and shall maintain the same foreman and crew from start to finish of work unless change is approved by Manager. Provide the names of the factory certified tank builders for each of the 10 tanks listed above. This information shall be provided with bid.

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1.6 DESIGN CRITERIA

- A. Dimensions, elevations and location of penetrations and appurtenances shall be as located on the Plans and/or specified herein.
- B. Design Loads
 - 1. Dead load of the tank and its accessories, and live load of the contained static water, shall be as specified in AWWA D103-97. Design water depth shall be as shown on the Plans.
 - 2. Roof Live Load: 20 psf uniform, in conformance with AWWA D103-97.
 - 3. Wind Load: In accordance with AWWA D103-97, Base Wind Velocity 100 MPH or higher, if required on Plans.
 - 4. Seismic Load: Design shall be in accordance with Section 12 of AWWA D103-97 using the effective mass approach in accordance with AWWA D103-97 Seismic Zone 2B or as indicated on the Plans.
- C. Tank Design
 - 1. Allowable design stress of steel for the tank shall be in accordance with AWWA D103-97.
 - 2. No corrosion allowance shall be provided for shell plates. Cathodic protection shall be provided for wetted interior tank surfaces, as called for in these specifications.
- D. Tank Foundation
 - 1. Foundation shall be designed for a maximum allowable soil bearing pressure of 3000 psf or as indicated on the Plans.
 - 2. Minimum depth of structural foundation shall be 12-inches below the finished grade. The top of foundation shall be 6-inches above finished grade.
 - 3. Tank foundation shall be designed by the tank manufacturer's in-house licensed engineer.

1.7 TEST REPORTS

- A. The costs of all tests and reports shall be borne by the Contractor. Copies of the following tests shall be furnished.
- B. Manufacturer's mil test reports for plate and roof framing materials.
- C. Mil thickness test and holiday detection test for glass coating.
- D. At the conclusion of the work, a written report prepared by the Tank Erector certifying that the work was inspected in accordance with Section 9 of AWWA D103-97. This report shall meet the requirement of Section 9 and also cover the hydrostatic test.
- E. Microbiological tests in accordance with this section.

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1.8 PRE-INSTALLATION CONFERENCE

Attendance is to include Manufacturer's representative, Tank Erector, Contractor, Engineer, and representative of other trades affected by work of this Section.

1.9 MATERIAL HANDLING

- A. Deliver, store, protect and handle products with adequate protection against damage, and manufacturer's instructions.
- B. Plates, members and miscellaneous parts shall be packaged for shipment in such a fashion to prevent abrasion or scratching of finished coating system.
- C. Handle and store water storage tank systems, components, and parts to prevent distortions or other damages that could affect their structural or mechanical integrity. Store items that are subject to deterioration by exposure to elements off the ground, in a well-drained location, protected from weather, and accessible for inspection and handling.
- D. Materials furnished for the water tank, which are found to be defective by the Owner's Representative, shall be rejected. All materials rejected must be removed from the project site immediately or within such time as allowed by the Owner's Representative and replaced with material of a quality acceptable to the Owner's Representative. Failure to reject any material or to require removal of any such rejected material shall not relieve the Contractor from responsibility as to the quality and character of material used or as any other obligations imposed upon him by the contract.

1.10 FIELD MEASUREMENTS

Verify that field measurements are as indicated on shop Plans and as instructed by manufacturer.

1.11 COORDINATION

Coordinate work with work of others affected by work of this section.

1.12 SPECIAL WARRANTY

Provide manufacturer's extended performance warranty stating that the wetted surfaces of the tank shall be free of corrosion, fish scaling and spalling for five (5) years from date of installation.

PART 2 PRODUCTS

2.1 TANK MATERIALS

- A. Bolted, Glass-Fused-to-Steel Tank

- 1. Ceramic glass-fused tank

- a. The tank shall be for potable water storage and shall conform to AWWA D103-97 and the additional requirements specified herein.

- b. Tank shall be a Engineered Storage Products Company Aquastore, CST Storage, Temcor Fusion or approved equal, with factory-applied

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glass-fused-to-steel components.

c. The exterior ceramic glass coating shall be forest green color and shall be a minimum of 11 mil in thickness.

d. It shall be free of holidays, fish scaling or other defects.

e. The tank interior ceramic glass shall be titanium white color and shall be 7 to 11 mils in thickness.

2. Steel Sheet. After initial sheet preparation, all full height vertical wall sheets and all rectangular shaped floor sheets shall be beveled. A metal coating of 316 stainless steel shall then be applied to these edges by an arch thermal spray of 1.5 to 5 mils (0.0015 to 0.005 inches) at the discretion of the manufacturer. Where used, the coating shall have a tensile strength of >1500 psi (per ASTM C633-79).

3. Bolt Fasteners

a. Bolts used in tank lap joints shall be ½" - 13 UNC-2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 2.2.

b. Bolt Material

- a) SAE Grade 2 (1" bolt length)
- b) Tensile strength - 74,000 psi Min.
- c) Proof Load - 55,000 psi Min.
- d) Allowable shear stress - 18,163 psi (AWWA D103).
- e) SAE grade 8/ASTM A490 (1.5" - 2.25" bolt length) heat treated to:

- i. Tensile Strength - 150,000 psi Min.
- ii. Proof Load - 120,000 psi Min.
- iii. Allowable shear stress - 36,818 psi (AWWA D103).

f) SAE grade 5/ASTM A325 (1.25" bolt length) heat treated to:

- i. Tensile Strength - 120,000 psi Min.
- ii. Proof Load - 85,000 psi Min.
- iii. Allowable shear stress - 29,454 psi Min.

c. Bolt Finish - Zinc, mechanically deposited.

a) 2.0 Mils Minimum - under bolt head, on shank and threads.

d. Bolt Head Encapsulation

- a) High impact polypropylene copolymer encapsulation of entire bolt head up to the splines on the shank.
- b) Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black. The bolt head encapsulation shall be certified to meet the NSI/NSF Standard 61 for indirect additives.

e. All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

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f. All lap joint bolts shall be properly selected such that threaded portions will not be exposed to the "shear plane" between tank sheets.

g. Bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

h. All lap joint bolts shall include a minimum of four (4) splines on the underside of the bolt head at the shank in order to resist rotation during torquing.

4. Tank Sheet Sealant/Caulk. Tank sheet sealant shall be cured-in-place urethane: Manus Bond, Sika Flex 1A or approved equal. Sealant shall be NSF Standard 61 approved. Rolled gaskets of neoprene or EDPM shall not be acceptable.

B. Aluminum Dome Roof:

1. Tank shall have an aluminum dome roof from one of the following manufacturers, or approved equal:

- a. CST Storage, 345 Harvestore Drive, DeKalb IL 60115
- b. Temcor Corporation, 150 West Walnut Street, Gardena CA 90248
- c. Permadome/Permastore: Eye, IP23 7HS, England.

2. Dome roof shall be constructed of non-corrugated triangular aluminum panels that are sealed and firmly clamped in an interlocking manner to a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a spherical dome structure.

3. The dome surface paneling shall be designed as a watertight system under all design load and temperature conditions. All raw edges of the aluminum panels shall be covered, sealed, and firmly clamped with batten bars in an interlocking manner to prevent slipping or disengagement under all load and temperature changes. The batten to panel sealing must be accomplished with an extruded gasket in full engagement with the formed panel and batten. The gasket engagement detail shall prevent any wiping action between the panel and gasket.

4. The dome shall be clear span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring. The dome dead weight shall not exceed three (3) pounds per square foot of surface area.

5. The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified live loads.

6. Materials:

- a. Triangulated space truss: 6061-T6 aluminum struts and gussets.
- b. Triangular closure panels: .050"t 3003-H16 aluminum sheet.
- c. Tension ring: 6061-T6 aluminum.

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- d. Fasteners: 7075-T73 anodized aluminum or Series 300 stainless steel.
 - e. Sealant and gaskets: 100% Silicone rubber.
7. Roof Vent:
- a. A properly sized vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum possible rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed 0.5" water column.
 - b. The overflow pipe shall not be considered to be a tank vent.
 - c. The vent shall be constructed of aluminum such that the hood can be unbolted and used as a secondary roof access.
 - d. The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including an expanded aluminum screen (2 inch) opening. An insect screen of 23 to 25 mesh polyester monofilaments shall be provided and designed to open should the screen become plugged.
8. Roof Hatch:
- a. Roof hatch shall be 30" square and shall be located as shown on the construction plans.
 - b. Roof hatch shall be aluminum, shall include a lockable hasp and shall be mounted on a 4" curb with a 2" overhang. A gasket shall be provided to prevent entry of rainwater.
9. Safety Handrail:
- a. Handrail shall be 1½" diameter, schedule 40 aluminum pipe. Handrail shall be in compliance with OSHA and HIOSH requirements.
 - b. Handrail shall include a 4" high toe plate at the base of the stanchions.
10. Roof Access:
- a. Roof service area shall be coated in a non-skid material to provide a safe walking surface for maintenance personnel.
 - b. Access from the exterior ladder to the roof shall include an aluminum checker plate gangway.
- C. Concrete:
- 1. Concrete for the ringwall footing shall be in accordance with Water System Standards, State of Hawaii, 2002 and/or modified herein.
 - 2. Reinforcing steel work shall be in accordance with Section 03 20 00.00 10 CONCRETE REINFORCING.
- D. Work Specified in this Section:

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1. The work to be performed under this section shall include the following:
 - a. Furnish all labor, tools, equipment and materials necessary to complete all concrete work, complete in place, as shown on the plans.
 - b. Coordinate work with all trades.
 - c. Install bolts, anchors, metal frames and covers, and other inserts furnished by other trades. All anchors and inserts shall be installed using template.
- E. Vapor barrier shall be 6 mil thick plastic sheets. ½" thick asphaltic impregnated cane board shall be placed over the vapor barrier and below the tank floor.
- F. Base course under tank concrete slab shall conform to Water System Standards 2002.
- G. Tank Accessories and Assemblies:
 1. Ladders, Manway, Roof Hatch and Vent: Ladders, manway, roof hatch and vent shall be as shown on the plans.
 2. All components shall conform to AWWA D103-97, with the ladders and cage meeting all OSHA requirements (State of Hawaii Department of Labor and Industrial Relations, Subtitle 8, Division of Occupational Safety and Health). Exterior ladder shall have a lockable gate at the bottom at ground level.
- H. Pipe straps shall be Type 316 stainless steel for interior straps and for exterior straps, unless indicated otherwise on the plans. Straps shall be placed at maximum intervals indicated on the plans and be of sufficient size for the pipe it supports.

PART 3 EXECUTION

3.1 CONSTRUCTION

- A. Construct tank in accordance with AWWA D103-97 and in strict accordance with manufacturer's instructions. Install liquid level indicator and all other components as shown on the plans and in accordance with manufacturer's instruction, as may be amended by Owner's Representative as part of shop drawing review. Install vapor barrier in accordance with the manufacturer's instructions.
- B. Anchor bolts shall may be post installed if epoxy embedded or be set at the time concrete is placed based on the recommendation of the manufacturer and in the locations indicated on the approved shop Plans. This is required to limit corrosion impacts to concrete reinforcement.

3.2 SITE WORK

- A. Description:

This item of work shall include the furnishing of all labor, materials,

WATERLINE EXTENSION PROJECT
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tools, and equipment, necessary for completing this item of work as called out in SITE WORK of the Water System Standards, State of Hawaii, 2002, and as supplemented hereinafter.

B. Excavation:

1. Excavation for structures shall not be carried below the elevations and beyond the dimensions shown. Over-excavation under structures and appurtenances shall be filled with lean concrete (BWS 2000) or compacted structural fill at no cost to the Owner, as directed by the Owner's Representative. Measurements for structure excavations shall be measured to dimensions of a neat structure line.

2. Bottom of footing trenches shall be compacted before pouring any concrete

3. Foundation Testing. The contractor is responsible for performing all the foundation preparation and probing called for by the Geotechnical Investigation prepared for this tank and to BWS specifications. A copy will be made available to the contractor for construction.

3.3 TESTING AND DISINFECTION

A. Scope: Except as otherwise provided herein, furnish all equipment, labor and materials required for testing and disinfecting the water tank and all new pipelines, including valves and appurtenances. Water for testing and disinfecting shall be provided by Owner at no cost to the Contractor. Disinfection shall be accomplished by chlorination in accordance with applicable AWWA procedures. All chlorinating and testing operations shall be done in the presence of the Owner's Representative. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the Owner's Representative. Results of the bacteriological testing shall be satisfactory with the Owner and the Utility Contractor. Release of water from structures and pipelines, after testing, disinfecting and neutralization of disinfected water have been completed, shall be approved by the Owner's Representative prior to release.

B. Execution:

1. Preliminary Cleaning and Flushing: Prior to both testing and disinfecting, the tank shall be cleaned by thoroughly hosing down all surfaces; all pipelines shall be thoroughly flushed or blown out, using a high volume of water or a cleansing pig.

2. Testing of Tank:

a. General: Testing shall not be performed until construction of the tank has been completed and shall be in accordance to AWWA D103-97. The test shall consist of filling the tank with water to the maximum operating water surface. After testing has been completed, water shall be disposed of as directed by the Owner's Representative. If suitable, water may be utilized in Owner's system.

b. Leakage Test and Repairs: After the tank has been filled and

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the water retained for a minimum of 72 hours, the leakage test shall be performed as follows: An initial water level reading shall be made. The tank shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed 0.75 percent of the total volume of water in the tank. Should the tank fail to pass the test, the test shall be repeated for up to three additional test periods. If, at the end of 28 days, the tank still fails to pass the leakage test, the Contractor shall empty the tank as directed by the Owner's Representative and shall examine the interior for evidence of any condition that might be responsible for the leakage. Any evidence of leakage shall be repaired. Following these operations, the Contractor shall again test the tank.

3. Disinfection of Tank:

a. After all other work, including testing and painting, has been completed; the interior of the reservoir shall be thoroughly cleaned and disinfected in accordance with an appropriate method as included in AWWA C652-92. Disinfection shall not take place until tank sealant is fully cured (e.g. 5 to 8 days at 73E F /50% Relative Humidity).

b. Prior to starting any disinfection work, the Contractor shall submit to the Engineer a detailed outline of the procedures proposed, the coordination and sequence of operation, and the manner of filling and flushing the reservoir. All procedures shall be acceptable to the Engineer.

c. Corrections, when required, shall be in accordance with the requirements of this Specification.

d. The Contractor shall furnish all labor, materials, equipment and incidentals necessary for the cleaning and disinfecting operations. Water shall be supplied as described in the Special Conditions.

e. All water used in cleaning and disinfecting the reservoir and which is to be wasted shall be disposed of in a manner acceptable to the Engineer and in accordance with all local regulatory requirements.

f. After the reservoir has been filled, after disinfection, samples will be taken by the Engineer for bacteriological or aesthetic quality; the reservoir shall be completely drained and re-disinfected by the Contractor.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2010) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)

ASSE 1003 (2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)

ASSE 1011 (2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)

ASSE 1012 (2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)

ASSE 1013 (2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)

ASSE 1020 (2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084 (2005) Standard Methods for the Examination of Water and Wastewater

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|--------------------------------|---|
| AWWA B300 | (2010; Addenda 2011) Hypochlorites |
| AWWA B301 | (2010) Liquid Chlorine |
| AWWA C203 | (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |
| AWWA C606 | (2015) Grooved and Shouldered Joints |
| AWWA C651 | (2014) Standard for Disinfecting Water Mains |
| AWWA C652 | (2011) Disinfection of Water-Storage Facilities |
| AWWA C700 | (2015) Standard for Cold Water Meters - Displacement Type, Bronze Main Case |
| AWWA C701 | (2012) Standard for Cold-Water Meters - Turbine Type for Customer Service |
| AMERICAN WELDING SOCIETY (AWS) | |
| AWS A5.8/A5.8M | (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding |
| ASME INTERNATIONAL (ASME) | |
| ASME A112.1.2 | (2012) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors) |
| ASME B1.20.1 | (2013) Pipe Threads, General Purpose (Inch) |
| ASME B16.15 | (2013) Cast Copper Alloy Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2012) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2011) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME B16.22 | (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.24 | (2011) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 |
| ASME B16.3 | (2011) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.34 | (2013) Valves - Flanged, Threaded and Welding End |
| ASME B16.39 | (2014) Standard for Malleable Iron |

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Threaded Pipe Unions; Classes 150, 250,
and 300

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings:
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B40.100 (2013) Pressure Gauges and Gauge
Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M (2012) Standard Specification for Carbon
Steel Forgings for Piping Applications

ASTM A183 (2003; R 2009) Standard Specification for
Carbon Steel Track Bolts and Nuts

ASTM A193/A193M (2012a) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM F412 (2015) Standard Terminology Relating to
Plastic Piping Systems

ASTM A47/A47M (1999; R 2009) Standard Specification for
Ferritic Malleable Iron Castings

ASTM A515/A515M (2010) Standard Specification for Pressure
Vessel Plates, Carbon Steel, for
Intermediate- and Higher-Temperature
Service

ASTM A516/A516M (2010) Standard Specification for Pressure
Vessel Plates, Carbon Steel, for Moderate-
and Lower-Temperature Service

ASTM A53/A53M (2012) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A536 (1984; R 2009) Standard Specification for
Ductile Iron Castings

ASTM A733 (2003; E 2009; R 2009) Standard
Specification for Welded and Seamless
Carbon Steel and Austenitic Stainless
Steel Pipe Nipples

ASTM B117 (2011) Standard Practice for Operating
Salt Spray (Fog) Apparatus

ASTM B32 (2008) Standard Specification for Solder
Metal

ASTM B370 (2012) Standard Specification for Copper
Sheet and Strip for Building Construction

ASTM B42 (2010) Standard Specification for Seamless

Copper Pipe, Standard Sizes

| | |
|------------|--|
| ASTM B43 | (2009) Standard Specification for Seamless Red Brass Pipe, Standard Sizes |
| ASTM B584 | (2013) Standard Specification for Copper Alloy Sand Castings for General Applications |
| ASTM B813 | (2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM B828 | (2002; R 2010) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings |
| ASTM B88 | (2009) Standard Specification for Seamless Copper Water Tube |
| ASTM B88M | (2005; R 2011) Standard Specification for Seamless Copper Water Tube (Metric) |
| ASTM C564 | (2012) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C920 | (2011) Standard Specification for Elastomeric Joint Sealants |
| ASTM D1505 | (2010) Density of Plastics by the Density-Gradient Technique |
| ASTM D1693 | (2015) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics |
| ASTM D1785 | (2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D1998 | (2013) Polyethylene Upright Storage Tanks |
| ASTM D2000 | (2012) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D2235 | (2004; R 2011) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings |
| ASTM D2239 | (2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter |
| ASTM D2241 | (2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |

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|-------------------|--|
| ASTM D2447 | (2003) Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter |
| ASTM D2464 | (2013) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D2466 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D2467 | (2013) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D2564 | (2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D2672 | (1996a; R 2009) Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D2683 | (2010; E 2013) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing |
| ASTM D2737 | (2012a) Polyethylene (PE) Plastic Tubing |
| ASTM D2765 | (2011) Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics |
| ASTM D2822 | (2005) Asphalt Roof Cement |
| ASTM D2837 | (2011) Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products |
| ASTM D2846/D2846M | (2009; E 2011) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems |
| ASTM D2855 | (1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D3035 | (2012; E 2012) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| ASTM D3122 | (1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings |
| ASTM D3138 | (2004; R 2011) Solvent Cements for |

Transition Joints Between
Acrylonitrile-Butadiene-Styrene (ABS) and
Poly(Vinyl Chloride) (PVC) Non-Pressure
Piping Components

| | |
|-----------------|---|
| ASTM D3139 | (1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D3212 | (2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D3261 | (2012) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM D3892 | (1993; R 2009) Packaging/Packing of Plastics |
| ASTM D618 | (2013) Standard Practice for Conditioning Plastics for Testing |
| ASTM D638 | (2014) Standard Test Method for Tensile Properties of Plastics |
| ASTM D790 | (2015; E 2016; E 2016) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| ASTM D883 | (2011) Terminology Relating to Plastics |
| ASTM F2389 | (2010) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems |
| ASTM F437 | (2009) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F438 | (2009) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM F439 | (2012) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F441/F441M | (2012) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80 |
| ASTM F442/F442M | (2012) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR) |
| ASTM F477 | (2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining |

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Plastic Pipe

- ASTM F493 (2010) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
- ASTM F877 (2011a) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
(IAPMO)

- IAPMO PS 117 (2005b) Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing
- IAPMO UPC (2003) Uniform Plumbing Code

INTERNATIONAL CODE COUNCIL (ICC)

- ICC IPC (2012) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

- MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- MSS SP-25 (2013) Standard Marking System for Valves, Fittings, Flanges and Unions
- MSS SP-44 (2010; Errata 2011) Steel Pipeline Flanges
- MSS SP-58 (1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
- MSS SP-69 (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
- MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and Threaded Ends
- MSS SP-71 (2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends
- MSS SP-72 (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
- MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends
- MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves

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MSS SP-83 (2014) Class 3000 Steel Pipe Unions Socket
Welding and Threaded

MSS SP-85 (2011) Gray Iron Globe & Angle Valves
Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on
Underground or Submerged Metallic Piping
Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2014) Plastics Piping System Components
and Related Materials

NSF/ANSI 372 (2011) Drinking Water System Components -
Lead Content

NSF/ANSI 61 (2015) Drinking Water System Components -
Health Effects, Including Annex F and G

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.106 Flammable and Combustible Liquids

40 CFR 50.12 National Primary and Secondary Ambient Air
Quality Standards for Lead

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for information only. When
used, a designation following the "G" designation identifies the office
that will review the submittal for the Government. The following shall be
submitted:

SD-03 Product Data

Pumps; G

Backflow prevention assemblies; G

SD-06 Test Reports

Tests, Flushing and Disinfection

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Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

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1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

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1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform

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to the following:

- a. Coupling for Steel Pipe: AWWA C606.
- b. Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12) Malleable Iron ASTM A47/A47M, Grade 32510. Copper ASTM A536.
- c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- f. Solder Material: Solder metal shall conform to ASTM B32.
- g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.
- j. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.
- k. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- l. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.
- m. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.
- n. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D2235.
- o. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.
- p. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.
- q. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

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- r. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.
- s. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.
- t. Copper tubing shall conform to ASTM B88, Type K, L or M.
- u. Heat-fusion joints for polypropylene piping: ASTM F2389.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.
- b. Copper, Sheet and Strip for Building Construction: ASTM B370.
- c. Asphalt Roof Cement: ASTM D2822.
- d. Hose Clamps: SAE J1508.
- e. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- f. Hypochlorites: AWWA B300.
- g. Liquid Chlorine: AWWA B301.
- h. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. All valves exposed to the weather shall have fusion bonded polyester resin coating or similar finish on valve exterior. All valves for domestic water service shall be NSF/ANSI 61 certified lead free, and conform to NSF/ANSI 372. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged ductile iron body and bonnet. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

| Description | Standard |
|--|-----------|
| Gray Iron Gate Valves, Flanged and Threaded Ends | MSS SP-70 |

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| Description | Standard |
|---|---------------------|
| Cast-Iron Swing Check Valves, Flanged and Threaded Ends | MSS SP-71 |
| Ball Valves with Flanged Butt-Welding Ends for General Service | MSS SP-72 |
| Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends | MSS SP-110 |
| Cast-Iron Plug Valves, Flanged and Threaded Ends | MSS SP-78 |
| Bronze Gate, Globe, Angle, and Check Valves | MSS SP-80 |
| Steel Valves, Socket Welding and Threaded Ends | ASME B16.34 |
| Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends | MSS SP-85 |
| Vacuum Relief Valves | ANSI Z21.22/CSA 4.4 |
| Water Pressure Reducing Valves | ASSE 1003 |

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.2 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.4 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

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2.5 SUBMERSIBLE PUMPS, MOTORS AND CONTROLS

2.5.1 Scope

- a. The Submersible pump and motor shall be designed for continuous submerged operation.
- b. The pump shall be driven by a motor attached below the pump section.

2.5.2 Pump Design

- a. There shall be a check valve integrally designed into the pump discharge housing.
- b. The pump shall have integrated protection against upthrust.
- c. The pumping downthrust shall be absorbed by the motor thrust bearing.
- d. Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic losses.
- e. A filter screen shall be included as part of the suction inlet assembly.

2.5.3 Pump Materials of Construction

- a. The pump bowls, impellers, guide vanes, strainer, and check valve shall be 300 Series stainless steel. The shaft and coupling shall be 300 or 400 Series stainless steel. No moving parts shall be constructed from plastic or other brittle materials.
- b. The intermediate and top bearings shall be Nitrile Rubber (NBR).

2.5.4 Motor Design

- a. The motor shall be a Squirrel-Cage induction motor designed for continuous underwater operation in conformance to NEMA standards.
- b. The motor shall have a Kingsbury-type or Michell thrust bearing capable of carrying the maximum pump thrust loads.
- c. The motor shall be water filled for cooling and lubrication. No oils or grease lubrication shall be used.
- d. A flexible diaphragm shall be provided to permit expansion and contraction of the internal motor fluid when the motor heats and cools during operation.
- e. Shaft seal shall be provided to ensure the internal motor fluid is not mixed with the pumped fluid.

2.5.5 Motor Materials of Construction

- a. The motor diaphragm shall be Nitrile Rubber or Type 100 Hydrin.
- b. The shaft seal shall be a Nitrile Rubber or Type 100 Hydrin.
- c. The motor shall be of 200 or 300 Series stainless steel.

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2.5.6 Variable Frequency Drive

2.5.6.1 General

- a. Provide and install a Variable Frequency Drive (VFD) system on each submersible pump system. VFD system shall be designed and installed in accordance with these specifications.
- b. The VFD shall be continuous duty. All components shall be ETL or UL listed, CSA certified NEMA and IEC. The VFDs and associated equipment shall be provided as a complete panel package. The pump supplier shall be responsible for all startup and warranties concerning the VFDs. The variable frequency drive shall convert three-phase, A-C power for stepless motor control from 10 percent to 110 percent of base speed. The VFD shall be manufactured by Graham, AAB, or Vee Arc.
- c. The VFD shall be a voltage source type with PWM output utilizing power transistor semiconductors. VFD shall have manual by-pass circuit to permit manual full-speed operation of motor with VFD shut-down or de-energized.
- d. The VFD together with all options and modifications shall mount within standard NEMA 3R fiberglass enclosure suitable for all continuous operation at a maximum ambient temperature of 40 C. All high voltage components within enclosure shall be isolated with steel covers. The complete unit shall be UL, ETL, or CSA approved and labeled. Total harmonic distortion shall not exceed FCC standards of 5 percent. If THD standards are not met then line reactors shall be provided with enclosures.
- e. The VFD shall have adjustable carrier frequency to enable quiet motor operation as well as quiet AFC operation. Six step waveform units are not acceptable.
- f. VFD shall be capable of starting into a 100 percent rotating load, forward or reverse, without delay. Protective circuits shall cause instantaneous trip (IET) should any of the following faults occur: 100 percent of AFC maximum current rating is exceeded, output phase to phase and phase to ground (ground fault) short circuit condition, high input line voltage, loss of input phase, external fault. This protective circuit shall permit, by means of the terminal strip, wiring of remote NC safety contacts such as high static, pressure, firestat, etc., to shut down the drive.
- g. The VFD shall be microprocessor controlled and shall utilize no potentiometer to provide settings. The following adjustments shall be available in the controller and retained in non-volatile memory: Maximum frequency (15 to 400 Hz) factory set at 60 Hz, maximum frequency (3 to 60 Hz) factory set at 6 Hz, acceleration (0.1 to 360 seconds) factory set at 20 seconds, deceleration (0.1 to 360 seconds) factory set at 20 seconds, volts/Hertz ratio factory set for 208 volts at 60 Hz, voltage offset of boost factory set at 100 percent torque, current limit (50 percent to 100 percent sine wave current rating) factory set at 100 percent current.
- h. The VFD shall be capable of following 0-5, 1-5, 4-20, 10-50 mA; 0-5 or 0-10 VDC ungrounded signal.
- i. The VFD shall have an electronic overload designed to protect one A-C

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- motor, operated on VFD output, from extended overload operation.
- j. The VFD shall provide true ground fault protection in all modes, starting and running, without any component failure.
 - k. VFD shall be furnished with door mounted operator controls consisting of auto/manual switch, start/stop (reset) switch, and program keypad with LCD display/interface, motor winding temperature indication (motors will be provided with thermistors). In the manual mode, the VFD will follow the programmable set point to limit RPM as entered into the keypad. In automatic mode, VFD will follow an external signal and respond to remote start-stop contact (CCMS control) wired to terminal strip. While in auto mode the VFD will attempt up to ten restarts after a power dip, drive fault or external fault. Drive manufacturer's to state control methods for handling brownout conditions in the bid proposal. Assume brownout to be 25 percent drop in incoming line voltage for a duration of 5 seconds. Manufacturers without a specific plan for maintaining operation through a brown-out will be rejected from this bid.
 - l. The VFD shall have three critical frequency avoidance bands.
 - m. The VFD shall have a first fault LED panel or LCD user interface panel which shall indicate current, faults, voltage, frequency, percent load or percent speed.
 - n. Line Reactors - A 3-phase gapped, iron core reactor shall be provided in the incoming power lines to the variable speed drive to minimize the effects of "line notching" due to the switching of power semiconductor devices for controlled rectifier type drives. Prevent over voltage trips and/or damage to the driver itself due to transients (i.e. utility power capacitor switching, etc.) on the variable speed incoming power lines. Reduce input harmonic currents thereby improving the total power factor of the drive system.
 - o. Line reactors shall meet the following requirements: Prove a minimum of 1 1/2 percent line dependence. Be capable of handling a 150 percent current overload for at least 1 minute. Have a saturation rating which is not less than 2.5 times the rated maximum continuous current rating (at saturation, rated inductance is decreased by 50 percent). Be UL recognized and/or CSA certified and be included in the unit UL testing and labeling
 - p. EMI/RFI Filters - An EMI/RFI filter shall be provided internal to the drive, in the incoming power lines of the variable speed drive to: Help prevent conducted radio frequency noise generated by the variable speed drive from interfering with other sensitive electronic equipment (such as lighting systems, telecommunications equipment, instrumentation, etc.). Help the variable speed drive meet RFI limits as specified by FCC Docket 20780 (Part 15, subpart J) for conducted emissions. Meet IEE 519 guidelines. Meet IEE 519 guidelines. The EMI/RFI filter shall be capable of handling a 150 percent current overload for at least 1 minute.
 - q. The following special or protective requirements shall be provided: Power on LED or light to indicate the VFD is being supplied power by the line. Fault LED's and two sets of Form C dry contacts to indicate the VFD is in fault mode, two sets of Form C dry contacts to indicate when the VFD is in the run or standby mode. When input power returns to

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normal following a fault trip for undervoltage, overvoltage, or phase loss the VFD shall automatically start. The VFD shall not automatically start following trips due to overload or overcurrent. Engraved nameplate with pump designation in 1 inch high letters (white letters on black phenolic background). Separate overload relay. Protection against input power undervoltage, overvoltage and phase loss. Protection against overtemperature overload and overcurrent. Protection against over-temperature within the VFD enclosure. Protection against overvoltage on the DC bus. Any disconnect switches between the VFD and the motor shall include an auxiliary contact interlock to the VFD fault trip circuit. DC bus discharge circuit for protection of service personnel. Insensitive to incoming power phase sequence. AC line voltage variation - 208 volt +/- 10 percent. Provide all mounting assemblies (wall or floor mounting kits) as necessary for the installation. Provide NEMA 3R or NEMA 4 enclosure for each VFD and 4 inches round screened ventilation ports non-metallic. Provide an RS 232 port for Drive Communication, testing and setup. Provide software to the user for a user furnished PC.

- r. Provide each VFD with a discharge pipe mounted pressure transducer that controls the pump discharge pressure with maximum (built-in) flow characteristics.
- s. The following spare parts for each drive: Factory recommended minimum level spare fuse kit, Input circuit breaker, 1 each of each type of circuit boards, 3 each of each type of transistor ISCR pole unit and 3 of each size/type of fuse/
- t. Main input circuit breaker: Provide a positive disconnect between the controller and all phases of incoming line as well as providing 65,000 symmetrical amps fault withstand capability. It shall be a molded case circuit breaker with provisions for padlocking.
- u. Start-up service: The VFD manufacturer shall maintain and staff nationwide service centers. These service engineers shall be employed by the manufacturer and provide start-up service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.
- v. Start-up Service: The service technician shall verify correct installation, start up the drive and check for proper operation. At that time, provide owner's representative a minimum of four hours of instruction. After the pumps are all in operation, the manufacturer's service technician shall provide an additional 8 hours of training to the maintenance staff.
- w. Extended Warranty: The VFD shall be warranted by the manufacturer for a period of thirty-six months from the date shipment. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized service.

2.6 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, indicating cubic feet. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

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Provide electronic digital flow meter accessory for each well, to provide proportional 5-20mA signal to actual water meter flow rate. Digital flow meter shall also have sealable pulse output, and instantaneous display of flow rate and accumulated total flow.

2.7 CHEMICAL FEED PUMP

2.7.1 General

Chemical metering pumps shall be variable speed peristaltic type pumps that are ETL and WQA tested and certified against NSF/ANSI 61 - Section 8. Output volume shall be adjustable while pumps are in operation from zero to maximum capacity.

Chemical metering pumps shall be capable of injecting solutions against pressures up to 125 PSIG.

Adjustment shall be by LON, a factory mounted LCD display with intuitive programming functions, selections and clearly displayed operating parameters.

2.7.2 Drive

The pump drive shall be a sealed gear train. Electrical power consumption shall not exceed 50 watts per hour under full speed and maximum pressure conditions. Pump weight shall not exceed 10 lbs (4.6 kg).

2.7.3 Material

Chemical metering pump housing shall be ABS. All exposed fasteners shall be stainless steel. Pump head shall be of transparent acrylic material capable of resisting the pumped chemical. Fittings and connections at pump head shall be PVC.

2.7.4 Check Valves and Tubing

A total of 16 ft (4.8 m) of polyethylene tubing shall be provided per pump complete with compression connections. A foot valve with integral one piece strainer shall be provided for the suction line, and an injection check/back pressure valve with 1/2 inch NPT male connection for the injection point. The injection check valve shall incorporate a dilating orifice which prohibits scale formation and accumulation of crystalline deposits.

2.8 CHEMICAL INJECTION UNIT

Non-retractable Schedule 40 stainless steel solution tube, EDPM seal, 1/2 inch MPT inlet, 1.5 to 1.75 inches insertion length, integral stainless steel check valve.

2.9 POLYETHYLENE UPRIGHT OPEN TOP STORAGE TANK

2.9.1 Scope

This specification covers upright, cylindrical, flat bottom open top tanks molded in one-piece seamless construction by rotational molding. The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. Included are requirements for

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materials, properties, design, construction, dimensions, tolerances, workmanship, and appearance. Comply with the following Standards or Testing Procedures: ASTM D883, ASTM D1998, ASTM F412

2.9.2 Classifacation

Tank shall be HDLPE (High Density Linear Polyethylene Construction).

2.9.3 Materials

The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. All polyethylene resin material shall contain a minimum of a U.V. 8 stabilizer as compounded by the resin manufacturer. Polyethylene storage tank materials shall comply with the following Standards or Testing Procedures: ASTM D618, ASTM D638, ASTM D790, ASTM D1505, ASTM D1693, ASTM D2765.

2.9.4 Design Requirements

The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

$$T = P \times 0.D./2 SD = 0.433 \times S.G. \times H \times 0.D./2 SD$$

T = Wall Thickness

SD = Hydrostatic Design Stress, PSI

P = Pressure (.433 x S.G. x H), PSI

H = Fluid Head, ft.

S.G. = Specific Gravity, g/cm³

O.D. = outside Diameter, in.

The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for HDLPE materials. In accordance with the formula above, the tank shall have a stratiform (tapered wall thickness) wall.

The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

The standard design specific gravity shall be 1.9.

The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.

The open top shall have an integrally molded top tank flange to provide optimum rigidity and strength.

Tanks shall have molded-in gallon and liter markers to provide permanent gallonage indication for the life of the tank.

2.9.5 Dimensions And Tolerances

All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

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The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.

The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

2.9.6 Workmanship

The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable to the degree in which they do not interfere with proper fusion of the resin melt. Comply with the following Standards or Testing Procedures: ARM Low Temperature Impact Resistance.

All cut edges where openings are cut into the tanks shall be trimmed smooth.

2.9.7 Tank Attachments - Hinged Lid Assembly

Hinged lid assembly shall be constructed of polyethylene material and allow access to the tank interior without having to remove the entire lid. The polyethylene hinged lid shall be attached to the tank with two stainless steel bolts connecting to embedded threaded inserts in the raised rib section of the tank cover.

2.9.8 Marking, Packing and Packaging

The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.

The proper caution or warning signs as prescribed by OSHA Standard 29 CFR 1910.106 shall be supplied.

All packing, packaging, and marking provisions of ASTM D3892 shall apply to this standard.

2.10 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls. Provide internal wiring for components of packaged equipment as an integral part of the equipment.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

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Power wiring and conduit for field installed equipment shall be provided .

2.11 MISCELLANEOUS PIPING ITEMS

2.11.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.11.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors.

2.11.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.11.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.11.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.11.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.11.5 Labels

Provide labels for all pumps and controls. Include the following information on each label:

- a. Identification of the pump/control designation and its operation with graphic description.

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- b. Rated gpm/head/horsepower.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Exterior underground utilities shall be at least 24 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to equipment. The supply line to each item of equipment shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the materials and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

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3.1.1.5 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.2 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.3 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic

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rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/2 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.5 Supports

3.1.5.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

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3.1.5.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified as shown. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided.

3.1.5.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- h. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.5.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.6 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged,

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flared for improvement of flow where attached to the run, and reinforced against external strains. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.2 BACKFLOW PREVENTION DEVICES

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with IAPMO UPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3 IDENTIFICATION SYSTEMS

3.3.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inches minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces.

3.4.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.4.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

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The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.4.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.5 TESTS, FLUSHING AND DISINFECTION

3.5.1 Wells

- a. Contractor shall remove well caps, and video camera each well to full depth of well and document, in standard format, condition of existing wells prior to start of new work. Contractor shall submit videos on DVD of all existing wells to Contracting Officer, along with a memo summarizing findings.
- b. Contractor shall test, document in writing, and submit to Contracting Officer for review, each well for existing water level following the procedure outlined and diagrammed in the mechanical drawings.
- c. Each existing well shall be flow tested to the original specified flow rates prior to ordering any new well equipment. Each well flow test shall be for a 24-hour period and both flow rate (gpm) and dynamic water level shall be documented, in a report, in 4-hour increments. To measure water level, repeat the procedure from Section 22 00 00, Paragraph 3.5.1 b. Flow rates by well are to be within 10 percent of

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the original specified flow rates at the start of each test.

3.5.2 Plumbing System

The following tests shall be performed on the plumbing system in accordance with IAPMO UPC.

a. Water Supply Systems Tests.

3.5.2.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

| | |
|------------------------|---------------------------------------|
| Data on Device | Data on Testing Firm |
| Type of Assembly | Name |
| Manufacturer | Address |
| Model Number | Certified Tester |
| Serial Number | Certified Tester No. |
| Size | Date of Test |
| Location | |
| Test Pressure Readings | Serial Number and Test Data of Gauges |

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.5.3 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.5.4 System Flushing

3.5.4.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines

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are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.5.4.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1).

3.5.5 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the pump discharge under rated flow conditions.
- c. Pump amperage of rated flow conditions.
- d. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.5.6 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

- a. Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

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- b. Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

- c. Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.
- d. Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer.

Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

- e. Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.6 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.7 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

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3.8 TABLES

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|---|---------|-----|-----|-------|
| | | A | B | C | D |
| 1 | Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a | X | X | X | X |
| | b. Same as "a" but not galvanized for use with Item 4b | | | X | |
| 2 | Grooved pipe couplings, ferrous pipe ASTM A536 and ASTM A47/A47M, non-ferrous pipe, ASTM A536 and ASTM A47/A47M, | X | X | X | |
| 3 | Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M, for use with Item 2 | X | X | X | |
| 4 | Steel pipe: a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B | X | X | X | X |
| | b. Seamless, black, ASTM A53/A53M, Type S, Grade B | | | X | |
| 5 | Seamless red brass pipe, ASTM B43 | X | X | | X |
| 6 | Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7 | X | X | | X |
| 7 | Seamless copper pipe, ASTM B42 | X | X | | X |
| 8 | Seamless copper water tube, ASTM B88, ASTM B88M | X** | X** | X** | X**** |
| 9 | Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7 | X | X | | X |
| 10 | Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8 | X | X | X | X |
| 11 | Cast copper alloy solder-joint pressure fittings, | X | X | X | X |

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TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|---|---------|---|---|---|
| | | A | B | C | D |
| | ASME B16.18 for use with Item 8 | | | | |
| 12 | Bronze and sand castings grooved joint pressure fittings for non- ferrous pipe ASTM B584, for use with Item 2 | X | X | X | |
| 13 | Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D2447 | X | | | X |
| 14 | Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035 | X | | | X |
| 15 | Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239 | X | | | X |
| 16 | Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 14, 15, and 16 | X | | | X |
| 17 | Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 15 | X | | | X |
| 18 | Polyethylene (PE) plastic tubing, ASTM D2737 | X | | | X |
| 19 | Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M | X | X | | X |
| 20 | Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M | X | X | | X |
| 21 | Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M | X | X | | X |
| 22 | Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437, for use with Items 20, and 21 | X | X | | X |
| 23 | Socket-type chlorinated polyvinyl | X | X | | X |

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TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|--|---------|---|---|---|
| | | A | B | C | D |
| | chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22 | | | | |
| 24 | Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22 | X | X | | X |
| 25 | Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785 | X | | | X |
| 26 | Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241 | X | | | X |
| 27 | Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466 | X | | | X |
| 28 | Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27 | X | | | X |
| 29 | Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464 | X | | | X |
| 30 | Joints for IPS PVC pipe using solvent cement, ASTM D2672 | X | | | X |
| 31 | Polypropylene (PP) plastic pipe and fittings; ASTM F2389 | X | X | | X |
| 32 | Steel pipeline flanges, MSS SP-44 | X | X | | |
| 33 | Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828 | X | X | | |
| 34 | Carbon steel pipe unions, socket-welding and threaded, MSS SP-83 | X | X | X | |
| 35 | Malleable-iron threaded pipe unions ASME B16.39 | X | X | | |
| 36 | Nipples, pipe threaded ASTM A733 | X | X | X | |
| 37 | Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F877 | X | X | | X |

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TABLE II
 PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|----------------------------|---------|---|---|---|
| | | A | B | C | D |
| 38 | Press Fittings | X | X | | |

A - Cold Water Service Aboveground

B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

** - Type L - Hard

*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

**** - In or under slab floors only brazed joints

-- End of Section --

SECTION 22 35 00

SOLAR POWERED, IN-RESERVOIR WATER CIRCULATION EQUIPMENT

04/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-B-8565 Battery, Storage, Aircraft, Medium-Rate,
Type 1, Maintenance-Free, 24-Volt,
35-Ampere-Hour

MIL-I-45208 Military Specification: Inspection System
Requirements

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

DOT HMR49 Hazardous Materials Regulations 49

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60364 Electrical Installations for Buildings

IEC 61215 Crystalline Silicon Terrestrial
Photovoltaic (PV) Modules, Design
Qualification and Type Approval

IEC #896-2 Stationary Valve Regulated Lead Acid
Batteries, Structure, Application Mode and
Compliance

UNDERWRITERS LABORATORIES (UL)

UL 1703 Standard for Safety Flat-Plate
Photovoltaic Modules and Panels

UL 1989 Standard for Standby Batteries

1.2 EQUIPMENT OVERVIEW

These specifications provide the requirements to furnish, install and place into operation the solar powered in-reservoir circulation equipment.

1.3 QUALITY ASSURANCE

- a. Continuous Operation Equipment. The circulation equipment shall operate continuously, all day and all night, during all seasons including winter.
- b. No Visual Defects. The circulation equipment shall have no visual defects, and shall have high quality welds and assembly, corrosion

resistant finish, and site specific operational controls.

- c. Qualified US Manufacturer. The manufacturer of the equipment shall have extensive experience in the production of such equipment, and the equipment shall be manufactured in the continental United States.
- d. Warranty. The circulation equipment shall be warranted to be free of defects in materials and workmanship for a period of 2 years. In addition the motor shall be warranted for a period of 10 years, and the photovoltaic modules for 25 years. A copy of the warranty shall be included with the submittal.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following:

The Contractor shall provide 5 copies of the following documents. Upon acceptance of these documents by the Engineer, the Contractor may then proceed to order and install the equipment.

SD-02 Shop drawings

circulation equipment

SD-08 Manufacturer's Instructions

Manufacturer's literature, illustrations and specification sheets defining materials of construction, dimensions, and weights including the following:

- (a) Digital controller diagnostic LED indication chart.
- (b) Digital controller daily operation schedule example.
- (c) Digital controller software update instruction sheet.
- (d) Digital controller stored log example.
- (e) Digital controller SCADA output specifications.
- (f) Type 316 Stainless Steel Certification.
- (g) Battery specifications.
- (h) Motor specifications.

SD-02 Shop Drawings

A diagram and listing of replacement parts.

SD-07 Certificates

A qualification statement demonstrating compliance with Section 1.3.

A copy of the warranty statement.

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SD-11 Closeout Submittals

Following installation, additional Submittals shall include a complete operation and maintenance manual.

1.5 FIELD SERVICES

- a. The installation and startup shall be performed by installation personnel trained in the operation of the circulation equipment.
- b. Safety. Installation personnel shall have received job-specific safety training on (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, and (f) DOT Compliance.

PART 2 PRODUCTS

2.1 MANUFACTURER

2.1.1 Specified Equipment

The circulation equipment shall be model SB500PWc solar powered mixer manufactured by SolarBee, Inc. of Dickinson, ND, or be a pre-approved alternative.

2.2 PERFORMANCE AND FEATURES

- a. Minimum Hatch Requirement and Intake Hose Sizing. The following equipment shall fit through the minimum hatch size and contain an intake hose as listed.

| SolarBee Base Model | Minimum Hatch Size Clear, Unobstructed | Hose Inside Diameter Inches, in (Centimeters, cm) |
|---------------------|--|---|
| SB500PWc v18 | 18 Inch Diameter (46cm) Round | 6 in (15.2 cm) |

- b. Continuous Operation With Solar Power Only. The circulation equipment shall operate continuously during day, night, and extended overcast conditions, 365 days per year. Continuous operation when used in this section shall be defined as operating a minimum of 97 percent of the total hours during the course of one year, on solar power, without reliance on any connection to the A.C. power grid.
- c. Stainless Steel Construction. The circulation equipment shall be constructed primarily of Type 316 stainless steel metal for strength and superior corrosion resistance. Each machine shall also undergo a passivation bath, also known as stainless steel pickling, to restore corrosion resistance to the welds and other areas of imperfections.
- d. Motor. The circulation equipment shall be mechanically operated by a motor that meets the following criteria.
 - 1. Brushless, and using hall effect commutation, to avoid brush replacement.
 - 2. Direct Drive, with no gearbox, to avoid lubrication maintenance.

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3. Stainless Steel Bearings, requiring no scheduled lubrication, rated bearing life expectancy greater than 100,000 hours continuous operation.
4. Designed for marine environment by having a sealed housing with polymeric encapsulated internal windings for superior corrosion resistance. Capable of withstanding the following environment conditions.
 - (a) -40 degrees F to 140 degrees F (-40 degrees C to 60 degrees C) ambient temperature range, freeze resistant
 - (b) 100 percent humidity
 - (c) Condensation resistant
 - (d) Splash resistant
5. Designed for Continuous Operation without overheating or compromising motor life expectancy.
6. Less Than 48 volts DC power requirement, to avoid risk of electrocution.
7. 10 Year Replacement Warranty.
- e. Controller. The circulation equipment shall be supplied with a motor controller and power management with the following features.
 1. Digital Electronic Control System, with firmware and software that is easily re-programmable to optimize the level of water quality achieved in the reservoir.
 2. Anti-Jam Reverse, automated self-clearing for locked rotor triggered by high current occurrences caused from jammed impeller.
 3. Operation Schedule, with daily and seasonal scheduling for motor speed and direction.
 4. Scheduled Reverse Cycles, with daily reverse impeller cycling for self-clearing of impeller to minimize fouling.
 5. Motor Health Status Monitoring and Recording, including scheduled speed, commanded speed, actual speed, motor current, motor voltage, and motor controller errors.
 6. Fully Potted And Encapsulated Motor Control Circuit, for superior corrosion resistance in marine environment.
 7. SD (Secured Digital) Card Reprogrammable features, so digital controller is capable of being field programmable using an SD card for uploading new firmware and changing programmed operations.
 8. Manual On/Off Switch, to shut power off to the motor. On/Off switch shall be rated for marine environment and have yellow and red color markings for indicating emergency shut off.
 9. Fused Main Power Line, for added protection against power surge through motor controller and motor.

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10. Temperature Compensated Charging, so that battery charging parameters are automatically adjusted based on battery temperature.
 11. Maximum Power Point Tracking (MPPT), so the charging algorithm is automatically adjusted for optimum results based on solar power input and battery capacity.
 12. Power Conservation & Continued Operation Mode, a programmed algorithm for reducing motor load and continuing operation by incremental speed reduction. This feature to be automatically enabled when extended low sunlight conditions occur or battery reserve power is reduced.
 13. Low Voltage Shut Off, a programmed shut off switch to disconnect motor load before reaching damaging depth of battery discharge. The motor load automatically re-connects when battery capacity is restored.
 14. NEMA 4 Enclosure, for protection against condensation and moisture in a marine environment. The internal circuit boards shall be conformal coated for added protection against moisture.
 15. Circulation equipment shall be supplied with supplemental AC power as a secondary power source. Solar power shall remain primary power source. This accessory requires a 120 VAC power source, 15 Amp rated outlet located at the digital controller of the circulation equipment. 120 VAC power source shall be supplied by others and not the circulation equipment manufacturer.
- f. Battery. The battery power storage shall meet the following criteria.
1. Single Battery, multiple batteries are not allowed unless connected in series, to avoid charging problems leading to failed batteries.
 2. Battery Capacity Rating, at a 24 hour discharge rate, in watt hours, shall be at least 50 times the motor load in watts during normal operation (full speed, peak load).
 3. Battery shall comply with DOT HMR49, non-spillable battery, for transport.
 4. Battery shall be ULListed, compliant to UL 1989.
 5. Battery shall have a pressure relief Safety Valves for each cell that incorporates a flame-arrester for safety, and rated as Explosion Resistant.
 6. Battery shall be Maintenance Free and not require re-watering.
 7. Battery shall contain 10 AWG Power Conductors constructed of multi strand power wire having a flexible outer jacket, all contained inside stainless steel sheathing for protection from the elements and from rodents.
 8. Battery shall be Freeze Tolerant for frigid conditions.
 9. Battery shall have a Self-Discharge Rate of less than 1 percent per month.

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10. Battery shall have a Temperature Sensor monitoring battery housing temperature, not ambient temperature, to optimize charging cycles and extend battery life.

11. Battery shall be manufactured to the following quality standards:

(a) U.S. MIL-B-8565

(b) U.S. MIL-I-45208

12. Battery shall Not Emit more than 1 percent hydrogen during a MIL-B-8565 gas emission test after being heated to 55oC and overcharged to 16.1 V.

13. Battery Cycle Life test per the IEC #896-2 Endurance Testing shall be:

| Percent Depth Of Discharge, D.O.D. | Number of Cycles |
|------------------------------------|------------------|
| 10 percent | 8100 |
| 20 percent | 4800 |
| 30 percent | 3500 |
| 50 percent | 2050 |

14. Battery shall be encased in Double Wall Plastic, and mounted in a Stainless Steel Cage, for safety and battery protection purposes.

g. Photovoltaic Modules (PV modules, Solar Panels). The PV modules shall meet the following criteria.

1. To ensure continuous operation of the motor and impeller in all seasons, the total Nominal Wattage Rating of the PV modules shall be a minimum of 5 times the normal operating wattage of the motor.

2. To ensure adequate power collection during low sunlight conditions, photovoltaic modules shall be Mono-Crystalline, not multi-crystalline.

3. Photovoltaic modules shall contain 16 AWG Power Conductors constructed of multi strand power wire having a flexible outer jacket, and shall be contained inside stainless steel sheathing for protection from the elements and from rodents.

4. Photovoltaic modules shall be certified to the following quality and safety standards:

(a) UL 1703, Class C

(b) IEC 61215 and IEC 60364

5. Photovoltaic modules shall have 25 Year Manufacturer Performance Warranty.

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- h. System Operation Monitoring. The digital controller shall have the following monitoring features.
 - 1. LED (Light Emitting Diode) Flash Code, flashing LEDs in the control box readily accessible by service personnel shall provide continuous electrical diagnostics so the state of the power system can easily be determined.
 - 2. SCADA (Supervisory Control and Data Acquisition), the digital controller shall output system state of health and operation monitoring using RS-232 serial communication (Modbus RTU), DB9 male connection point. A protocol document shall be provided for local network (PLC or RTU) programming assistance.
 - 3. Operation Back Log, the digital controller shall store within controller memory a 30 day rolling log of all primary machine operation parameters.
- i. Horizontal, Low Velocity Intake: The circulation equipment shall be supplied with an intake capable of being positioned at the lowest elevation of the tank or reservoir floor. The intake level setting shall bring water into the circulation equipment at horizontal layer within 1 inch (2.5 cm) of the tank or reservoir floor. The intake shall include a singular hose of adequate length to reach the required intake depth setting. The flow through the hose and intake shall not exceed 1 foot per second (0.3 meter per second).
- j. Chlorine Boosting Line: The circulation equipment shall be supplied with a 1/2 inch (1.3 cm) diameter hose with supply end positioned where accessible at the top, inside of the tank or reservoir. The accessible supply end shall be equipped with quick connect fittings and valve. The injection end shall terminate within the intake of the circulation equipment to provide quick delivery, dilution, and distribution of boosted chlorine throughout the tank or reservoir by it entering into the direct flow of the circulation equipment. The boosting line components shall be rated for contact with 12.5 percent Sodium Hypochlorite solution.
- k. The circulation equipment shall be NSF / ANSI Standard 61 and NSF Annex G listed for safe contact with potable water.
- l. Maintenance Requirements. The circulation equipment shall operate normally with the following maintenance features.
 - 1. No scheduled lubrication is required of any system components including motor and motor bearing.
 - 2. No brush replacement, gearbox replacement, or motor replacement shall be expected or required during the 25 year expected life of the circulation equipment.
 - 3. No spare parts shall be required to be kept on hand.
 - 4. No tools beyond normal cleaning supplies and a few common hand tools shall be required for scheduled maintenance.
 - 5. Impeller assembly shall be removable without requiring any tools.
 - 6. Circulator shall be equipped with a bird deterrent system to

minimize bird roosting, droppings on photovoltaic modules.

7. Impeller assembly and motor shall not be damaged when operating if tank or reservoir is drained and without water.

m. Flotation: The circulation equipment shall contain a flotation system meeting the following criteria.

1. Flotation Capacity, flotation shall have a total buoyancy to support the circulation equipment weight with a safety factor greater than 1.5.

2. For Flotation Longevity, flotation shall contain Expanded Polystyrene Foam (EPS) beads that are steamed together to minimize water adsorption and provide a solid float core for structural strength. The EPS contents shall have a 0.9-1.2 pounds per cubic foot density with water adsorption not to exceed three pounds per cubic foot in accordance with the Hunt Water Adsorption Test. The flotation shall not sink should the float encasement be punctured.

3. Each Flotation Encasement shall be constructed of a linear polyethylene resin containing ultraviolet (UV) inhibitors to prevent accelerated deterioration in this marine environment. The float encasement shall offer a balance of toughness, rigidity, environmental stress-crack resistance and low temperature impact performance. Resin shall also be in compliance with FDA title 21. Resin shall be made of a food grade material that will not contaminate the waterways and is recyclable. Encasements shall be rotationally molded for seamless, one-piece construction and shall have a nominal minimum wall thickness of 0.15 inches (4 mm). Encasements shall be resistant to damage by animals, ice, bumps by watercraft, contact deterioration from petroleum products and suitable for marine use.

n. Prevention of movement and rotation of circulation equipment: The circulation equipment shall be prevented from movement and rotating by the weighted intake assembly that is connected to the water intake hose and rests on the tank or reservoir floor.

PART 3 EXECUTION

3.1 INSTALLATION

- a. The circulation equipment shall be installed by personnel experienced with the Installation, Startup, and On-Site Water Testing Services to insure (a) proper machine spatial placement in the reservoir, and (b) proper intake depth setting.
- b. The field services shall be performed by personnel experienced in the operation of this equipment, and who have completed safety trainings required for this type of installation in compliance with OSHA regulations including (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, and (f) DOT Compliance.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Use latest published edition unless earlier edition is legally adopted and applicable to Project.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 11, EQUIPMENT, Division 13, SPECIAL CONSTRUCTION, and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

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1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 208/120 volts, three phase, four wire. Final connections to the power distribution system shall be made by the Utility Company at their transformer or other selected connection point. Coordinate exact requirements for complete supply, service and distribution electrical system with the Utility Company.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", "AHJ" or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated. Provide materials of size, configuration arrangement, capacity, rating and characteristics as shown on drawings and specified herein.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

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1.6.2.1 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise. In all cases, regardless of date of manufacturer and/or delivery, all materials shall be as required and bear the current UL or other label indicating suitability for the application.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period required in the Contract Documents.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.
- f. Emergency and non-emergency contract information, safety and maintenance organizations.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align

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lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. Use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall be stainless steel 316 or of higher corrosion-resistance which shall meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections. Special attention to quality control and proper assembly prior to packaging for shipment.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

If required, paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be in accordance with the directions of the Contracting Officer and will be subject to his approval.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as suitable or indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL
11/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Use latest published edition unless earlier edition is legally adopted and applicable to Project.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 The Authoritative Dictionary of IEEE Standards Terms

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 American National Standard for Safety--Color Code

ANSI/NEMA FB 1 Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

ANSI/NEMA OS 1 Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA PB 1 Panelboards

NEMA RN 1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA WD 6 Wiring Devices Dimensions Specifications

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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1242 Standard for Electrical Intermediate Metal
Conduit -- Steel

UL 489 Molded-Case Circuit Breakers, Molded-Case
Switches, and Circuit-Breaker Enclosures

UL 6 Electrical Rigid Metal Conduit-Steel

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading. Rating shall be designated for the entire assembly configuration when fully assembled and installed as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceways and Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

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SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway and Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Do not use aluminum. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts shall be corrosion-resistant stainless steel.

1.5 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices

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shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. See Paragraph 1.8 POSTED OPERATING INSTRUCTIONS in Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS for additional requirements.

1.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.8 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1.

Fittings for rigid steel conduit shall be threaded and shall be PVC coated.

2.1.2 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 be galvanized and be PVC coated.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type XHHW. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid.

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2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved insulated electrical type wire.

Make all splices in AWG No. 6 and larger with indenter crimp-type connectors and compression tools or bolted clamp-type connectors. While either method is acceptable, use only one method throughout the Project. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor. In addition, all joints shall be encapsulated to increase corrosion resistance and mitigate moisture intrusion.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing (where shown) as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Provide terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be specification grade toggle type, single, double-pole, three or four-way two-position devices rated 20 amperes at 125/277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be specification grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with ANSI/NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not

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acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 4X, in accordance with NEMA PB 1. Provide enclosure fronts with latchable and lockable hinged doors.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 240 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 120-volt operation as indicated and be program-start electronic type of 10 percent THD or less. Ballasts shall be "A" sound rated. Fluorescent lamps shall be standard reduced wattage type as indicated.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace it.

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Conduit stubbed-up through concrete shall project up 6 inches above finish concrete and sealant shall be placed around points of penetration. Conduits installed for future use shall be terminated with a coupling and plug.

3.1.2 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only where NEC indicates it is acceptable for installation in lieu of Rigid Steel Conduit.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

| <u>CONDUCTOR</u> | <u>COLOR AC</u> |
|-------------------|-----------------|
| Phase A | Black |
| Phase B | Red |
| Phase C | Blue |
| Neutral | White |
| Equipment Grounds | Green |

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with colored plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

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Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

| <u>LOCATION</u> | <u>MOUNTING HEIGHT</u> |
|----------------------------|------------------------|
| Receptacles | 48 inches |
| Switches for light control | 48 inches |

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and type written.

3.8 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

3.9 PAINTING

Where required all exposed materials shall be thoroughly cleaned and painted.

3.10 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

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Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Breakers, disconnects and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8 AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair. Provide phase-rotation tests in accordance with published standards and manufacturer's recommendations and instructions for all rotating machinery. Make corrections required to establish correct rotation. Document procedures and submit to Contracting Officer.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

- ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
- ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
- ASTM D2434 (1968; R 2006) Permeability of Granular Soils (Constant Head)
- ASTM D2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D422 (1963; R 2007; E 2014) Particle-Size Analysis of Soils
- ASTM D4318 (2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D698 (2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600

kN-m/cu. m.))

ASTM G57

(2013) Standard Practice

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the CO when encountering any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136, ASTM D422, and ASTM D1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas is defined as:

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or

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jack hammers for removal.

1.2.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.8 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.9 Select Granular Material

1.2.9.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, or SP by ASTM D2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D1140. Provide a minimum coefficient of permeability of 0.002 feet per minute when tested in accordance with ASTM D2434.

1.3 SYSTEM DESCRIPTION

1.3.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.3.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.3.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.4 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following:

SD-01 Preconstruction Submittals

Shoring; G

Dewatering Work Plan; G

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Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G

Rock Excavation

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project.

SD-06 Test Reports

Testing

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.

PART 2 PRODUCTS

2.1 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 6 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Blue: Water Systems

2.1.1 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.

2.2 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.3 MATERIAL FOR RIP-RAP

2.3.1 Grout

Provide durable grout composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.

2.3.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase SECTION 31 00 00 Page 21 the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of the risk of deterioration from natural causes. Provide fragments sized so that no individual fragments exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight consist of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation in a manner and sequence that will provide proper drainage at all times.

3.2.1 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

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3.2.2 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.

3.2.3 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls 12 inches above the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 6 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Excavate trench walls which are cut back to at least the angle of repose of the soil. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the CO.

3.2.3.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. All pipes shall have 6-inch minimum bedding material below the pipes. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.3.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material 8 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.3.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.4 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the CO. Report damage to utility lines or subsurface construction immediately to the CO.

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3.3 SHORING

3.3.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.4 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.5 BURIED TAPE AND DETECTION WIRE

3.5.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape to depth as shown on the drawings.

3.6 BACKFILLING AND COMPACTION

Place backfill and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

3.6.1 Trench Backfill

Backfill trenches to the grade shown. Do not backfill the trench until all specified tests are performed.

3.6.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material.

3.6.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.6.1.3 Bedding and Initial Backfill (Same Material)

Provide bedding of the type and thickness shown. The various materials used for pipe bedding are natural sand, manufactured sand, coral, and crushed

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screenings. Cinders are not allowed.

- a. Natural sand shall be free from hard lumps, debris, salt, and other foreign matter.
- b. Manufactured sand shall be approximately equal to that specified under concrete Work.
- c. Coral shall be dredged coral, free from salt, silt, clay and other deleterious substances.
- c. Crushers screenings "S4C" shall have a minimum amount of fines and shall conform to Table I.

| Table I - S4C for PIPE BEDDING | |
|--------------------------------|---------------------------------|
| Sieve Size | Total Percent Passing By Weight |
| 1/2" | 100 |
| 3/8" | 90-100 |
| No. 16 | 25-45 |
| No. 100 | 5-15 |
| No. 200 | </- 2.5 |
| 0.006 mm | </- 1.5 |

The pipe bedding material shall have a resistivity of 5000 ohm-cm or greater when saturated with distilled water and measured using the soil box method explained in ASTM G57. Pipe bedding material shall have a pH greater than 6.0. Pipe bedding material shall contain no hazardous substances above its corresponding regulatory action level. Hazardous substances include, but not limited to, lead, asbestos, mercury, chromium, cadmium, zinc, strontium and polychlorinated biphenyls (PCB). The Contractor shall submit a soil certification that high resistant bedding material has a resistivity greater than 5000 ohm-cm.

Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe.

3.6.1.4 Final Backfill

Fill the remainder of the trench with satisfactory material. Place backfill material and compact as follows:

- a. Roadways: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit

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backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.7 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.7.1 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.8 RIP-RAP CONSTRUCTION

Construct rip-rap on existing ground as shown on the drawings in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.8.1 Stone Placement

Place rock for rip-rap on the existing ground to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above. For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material.

3.8.2 Grouting

Prior to grouting, wet rip-rap surfaces. Grout rip-rap in successive longitudinal strips, approximately 10 feet in width, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Take precautions to prevent grout from penetrating bedding layer. Protect and cure surface for a minimum of 7 days.

3.9 TESTING

Perform testing by the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the CO. Determine field in-place density in accordance with ASTM D1556. When test results indicate, as determined by the CO, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil Engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if

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performed at the appropriate time, will be the minimum acceptable for each type operation.

3.9.1 Backfill Material Gradation

Determine gradation of fill and backfill material in accordance with ASTM C136.

3.9.2 In-Place Densities

One test per 1000 square feet, or fraction thereof, of each lift of backfill areas compacted by hand-operated machines.

3.10 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for backfilling, brush, refuse, stumps, roots, and timber shall be removed from the project site as directed by the CO.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
08/08

PART 1 GENERAL

1.1 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor's quality control approval. Submit the following:

SD-04 Samples

Tree wound paint

Samples in cans with manufacturer's label.

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the CO immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the CO in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obstruct, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING.

Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Prune and trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as approved by the CO. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, shall be disposed of in the designated waste disposal area outside the limits of Government-controlled land at the Contractor's responsibility.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C33/C33M (2013) Standard Specification for Concrete Aggregates

ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2321 (2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

ASTM D2434 (1968; R 2006) Permeability of Granular Soils (Constant Head)

ASTM D2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D4318 (2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D6938 (2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM D698 (2012) Laboratory Compaction Characteristics of Soil Using Standard

Effort (12,400 ft-lbf/cu. ft. (600
kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1

(2008; Errata 1-2010; Changes 1-3 2010;
Changes 4-6 2011; Change 7 2012) Safety
and Health Requirements Manual

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698 or ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.2 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.3 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing

backfill test

Select material test

Density tests

Moisture Content Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX, and full TCLP including ignitability, corrosivity, and reactivity. Backfill shall not contain shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

1.6 QUALITY ASSURANCE

1.6.1 Shoring and Sheet Piling Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

1.6.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.6.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

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PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than three inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 15 when tested in accordance with ASTM D4318.

2.1.5 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.6 Select Material

Provide materials classified as GW, GP, SW, or SP by ASTM D2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. Coefficient of permeability shall be a minimum of 0.002 feet per minute when tested in accordance with ASTM D2434.

2.2 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

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- a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.3 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

| Warning Tape Color Codes | |
|--------------------------|---------------|
| Blue: | Water Systems |

2.3.1 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.4 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring and sheeting where indicated. In addition to Section 25 A and B of EM 385-1-1, include provisions in the shoring and sheeting plan that will accomplish the following:

- a. Prevent undermining of pavements, foundations and slabs.
- b. Prevent slippage or movement in banks or slopes adjacent to the excavation.
- c. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the work is completed. In these areas, backfill the

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excavation to within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and

rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 95 percent of ASTM D698 ASTM D1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with satisfactory material and compact to 95 percent of ASTM D698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.2 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench.

3.5 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

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3.6 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape as shown in the drawings.

3.7 DISPOSITION OF SURPLUS MATERIAL

Remove from project site surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.8 FIELD QUALITY CONTROL

3.8.1 Sampling

Take the number and size of samples required to perform the following tests.

3.8.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.8.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.8.2.2 Select Material Testing

Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.8.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M.

3.8.2.4 Density Tests

Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Include density test results in daily report.

Bedding and backfill in trenches: One test per 100 linear feet in each lift.

-- End of Section --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|-----------------|--|
| ASTM A116 | (2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric |
| ASTM A121 | Standard Specification for Metallic-Coated Carbon Steel Barbed Wire |
| ASTM A702 | (2013) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought |
| ASTM A780/A780M | (2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A90/A90M | (2013) Standard Test Method for Weight and Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings |
| ASTM C94/C94M | (2014) Standard Specification for Ready-Mixed Concrete |
| ASTM F567 | (2011a) Standard Practice for Installation of Chain Link Fence |
| ASTM F626 | (2008; R 2013) Standard Specification for Fence Fittings |
| ASTM F883 | (2013) Padlocks |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---------------|--|
| FS RR-F-191 | (Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) |
| FS RR-F-191/1 | (Rev F) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) |
| FS RR-F-191/2 | (Rev E) Fencing, Wire and Post, Metal (Chain-Link Fence Gates) |
| FS RR-F-191/3 | (Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) |

FS RR-F-191/4

(Rev F) Fencing, Wire and Post, Metal
(Chain-Link Fence Accessories)

1.2 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following:

SD-02 Shop Drawings

Fence Assembly

Location of Gate, Corner, End, and Pull Posts

Gate Assembly

Gate Hardware and Accessories

Erection/Installation Drawings

SD-03 Product Data

Fence Assembly

Gate Assembly

Gate Hardware and Accessories

Recycled Material Content

Zinc Coating

Fabric

Stretcher Bars

Concrete

SD-04 Samples

Fabric Posts

Braces

Line Posts

Sleeves

Top Rail

Bottom Rail

Tension Wire

Stretcher Bars

Gate Posts

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Gate Hardware and Accessories

Padlocks

Wire Ties

Barbed Wire

Barbed Wire Supporting Arms

SD-07 Certificates

Certificates of Compliance

SD-08 Manufacturer's Instructions

Fence Assembly

Gate Assembly

Hardware Assembly

Accessories

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating.

1.5.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

- a. Zinc coating
- b. Fabric
- c. Stretcher bars
- d. Gate hardware and accessories

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e. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 2.0 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 FABRIC

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage. Mesh size, 2 inches.

Provide selvage knuckled at top and bottom.
Height of fabric, as indicated.

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, with 2.0 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights.

2.4 TOP AND BOTTOM SELVAGES

Provide top and bottom knuckled selvages.

2.5 POSTS, TOP RAILS, BOTTOM RAILS AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces and rails; Class 1, steel pipe, Grade A, in minimum sizes listed in FS RR-F-191/3 for each class and grade, unless otherwise indicated on the drawings.

2.6 LINE POSTS

2.00 inch N.D. pipe weighing 3.65 pounds per linear foot.

2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

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2.00 inch N.D. pipe weighing 3.65 pounds per linear foot.

2.7.1 Accessories

- a. Provide accessories conforming to ASTM F626. Ferrous accessories shall be zinc coated.
- b. Provide barbed wire supporting arms of the 45 degree inward angle 3 - strand arm type and of the design required for post furnished.
- c. Furnish truss rods with turnbuckles as shown.
- d. Furnish post caps in accordance with manufacturer's standard accessories.

2.8 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.9 TOP RAIL

Provide a minimum of 1.25 inches N.D. pipe rails weighing 2.72 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.10 BOTTOM RAIL

Provide bottom rail conforming to minimum sizes specified in FS RR-F-191/3 for each class and grade unless members are to be oversized.

2.11 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.25 inches N.D. pipe weighing 2.72 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.12 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F626.

2.13 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.14 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

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2.15 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

3-1/2 inch N.D. pipe Grade A weighing 9.11 pounds per linear foot.

2.16 GATES

FS RR-F-191/2; Type II, double swing. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Provide gate frames and braces of minimum sizes Steel pipe frames are a minimum of 1-1/2 inches N.D, and intermediate braces are 1.25 inches N.D., minimum of 2.72 lbs/ft and 2.27 lbs/ft respectively. Gate fabric, is as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Provide fork type gate latches. Provide truss rods or intermediate braces for gate leaves less than 8 feet wide. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 16 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.17 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F626, and be as specified:

Provide malleable iron hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.18 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.19 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts, spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center.

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Manufacturer's standard procedure will be accepted if of equal strength and durability.

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.20 CONCRETE

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 2,500 psi.

2.21 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.22 PADLOCKS

Provide padlocks conforming to ASTM F883, with chain.

2.23 BARBED WIRE

Provide barbed wire conforming to ASTM A121, zinc coated, Type Z, Class 3, with 12.5 gauge wire with 14 gauge, round, 4-point barbs spaced not more than 5 inches apart.

2.24 BARBED WIRE SUPPORTING ARMS

Barbed wire supporting arms shall be the 45 degree inward angle 3-strand arm type and of the design required for the post furnished. Arms shall be secured by riveting.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or as directed.

When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

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If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated except in bedrock. Compact concrete to eliminate voids, and finish to a dome shape. In bedrock, set posts with a minimum of 1 inch of grout around each post. Work grout into hole to eliminate voids, and finish to a dome shape.

3.3.2 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod.

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under

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proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.7 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 2-1/2-inches above the ground line. Pull fabric taut and tied to posts, and rails, with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.8 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with stretcher bands spaced 16 inches on center.

3.9 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Adjust hardware for smooth operation and lubricated where necessary.

3.10 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.11 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.12 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of

1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.13 SITE PREPARATION

3.13.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.14 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded

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areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.14.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.15 ACCESSORIES INSTALLATION

3.15.1 Post Caps

Install post caps as recommended by the manufacturer.

3.15.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.16 SUPPORTING ARMS AND BARBED WIRE

Install barbed wire supporting arms and barbed wire as indicated on the drawings and as recommended by the manufacturer. Anchor supporting arms to the posts with 3/8 inch diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. Use a minimum of two studs per support arm. Pull barbed wire taut and attach to the arms with a clips or other means that will prevent easy removal.

3.17 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|------------------|--|
| AWWA C104/A21.4 | (2013) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C110/A21.10 | (2012) Ductile-Iron and Gray-Iron Fittings for Water |
| AWWA C111/A21.11 | (2012) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C115/A21.15 | (2011) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C151/A21.51 | (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water |
| AWWA C153/A21.53 | (2011) Ductile-Iron Compact Fittings for Water Service |
| AWWA C500 | (2009) Metal-Seated Gate Valves for Water Supply Service |
| AWWA C503 | (2005) Wet-Barrel Fire Hydrants |
| AWWA C509 | (2009) Resilient-Seated Gate Valves for Water Supply Service |
| AWWA C600 | (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances |
| AWWA C800 | (2012) Underground Service Line Valves and Fittings |
| AWWA C901 | (2008) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service |
| AWWA C906 | (2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission |

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ASME INTERNATIONAL (ASME)

ASME B16.1 (2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM INTERNATIONAL (ASTM)

ASTM A536 (1984; R 2009) Standard Specification for Ductile Iron Castings

ASTM B62 (2009) Standard Specification for Composition Bronze or Ounce Metal Castings

ASTM C94/C94M (2014) Standard Specification for Ready-Mixed Concrete

ASTM D1785 (2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D2464 (2013) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2467 (2013a) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2657 (2007) Heat Fusion Joining Polyolefin Pipe and Fittings

ASTM D2774 (2012) Underground Installation of Thermoplastic Pressure Piping

ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves

UNDERWRITERS LABORATORIES (UL)

UL 246 (2011; Reprint Feb 2013) Hydrants for Fire-Protection Service

UL 262 (2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service

1.2 CO REQUIREMENTS

In the implementation of the project, the contractor shall have the flexibility to adjust the location of service stub outs, Fire Hydrants, ARV's, BOV's and Main line gate valves that best fit in the field. The contractor must assure accurate updates in the plan to record as-built conditions.

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For all Fire Hydrants and PRV's, install bollards as necessary as determined by the terrain. A minimum of two bollards adjacent to the roadways are required. Utilize four bollards if located in open area.

All stub out services shall be installed to the edge of Right-of-Way (ROW) and all meters and meter boxes shall be turned over to CO at the end of project. Meters will be installed by CO when customer applies for service.

1.3 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will be made under this section for excavation, trenching, and backfilling.

1.3.1 Measurement

The length of water lines to be paid for will be determined by measuring along the centerlines of the pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting, from center of water distribution line to end of service connection, and from center of water distribution line to center of hydrant. No deduction will be made for the space occupied by valves or fittings.

1.3.2 Payment

Payment will be made for water lines at the contract unit price per linear foot and will be full compensation for all pipes, joints, specials, and fittings, complete in place. Payment for fire hydrants, blow-off valves, tapping sleeve, gate valves, valve boxes, and standard valve manholes will be made at the respective contract unit price each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

1.4 DESIGN REQUIREMENTS

1.4.1 Water Distribution Mains

Provide water distribution mains indicated as 4, 8 and 10 inch nominal diameter lines of HDPE pipe. PE 4710, DR 13.5 (160 psi), Ductile Iron Pipe Size (D.I.P.S) for belowground installation and Ductile Iron (D.I) Class 52 for aboveground installation and at bridge and culvert crossings. Provide water main accessories, gate valves, blow-off valves, ARV, valve boxes, fire hydrants, etc. as specified and where indicated. Submit design calculations of water piping.

1.4.2 Service Stub Outs

Provide service stub outs as shown from water distribution main to building/house service at the point approximately indicated. Final location of SSO shall be as directed by PUC. Service stub outs shall be ultra-high molecular weight polyethylene (PE), meeting the requirements of ASTM material classification PE 3408.

Provide service stub outs appurtenances as shown on the drawings.

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1.5 SUBMITTALS

CO approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor's quality control approval. The following shall be submitted:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service lateral piping, fittings, joints, valves, and coupling

Hydrants

Corporation stops

Gate valves

Air Relief Valves

Blow-off valves

Service Saddles

Tapping sleeve

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for butt fusion and transition joints.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service lateral piping, fittings, joints, valves, and coupling

Fire hydrants

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and

that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage and handling

Installation of Pipelines

Installation procedures for water piping

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.6.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.6.2.1 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

- a. Pipe and Fittings: Pipe, AWWA C151/A21.51, Thickness Class 52.

Fittings, AWWA C110/A21.10 or AWWA C153/A21.53. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

- b. Joints and Jointing Material:

- (1) Joints: Joints for D1 to D1 pipe shall be restrained mechanical joint and HDPE mechanical joint adapter connections to D1 fittings and/or HDPE flanges connections to D1 fittings.
- (2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.
- (3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.
- (4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

2.1.1.2 HDPE Pipes and Fittings

HDPE pipe and fittings shall conform to AWWA C906. Pipe shall be made from high density polyethylene resin conforming to ASTM D3350, with cell classification of 445574C/E and is listed with the PPI, TR4. Color shall be black, and material shall be UV-Stabilized. Standards Dimension Ratio (SDR) shall be 13.5 to give pressure class of 160 psi, Type D.I.P.S. Joints shall be butt fusion welded type complying with ASTM D2657.

Fittings generally shall be molded. Where the CO permits the use of fabricated fittings that are subject to rerating, such fittings shall be provided with reinforcing concrete encasement. The CO may at its option provide fabricated fittings of an increased pressure class and which of the adjoining pipe, subject to the approval of the CO.

Branches on "Tee" fittings normally shall be provided with stubs suitable for butt fusion welding. Where flanged branches suitable for connection to a molded flange adapter are shown on the Drawings, back up rings shall be fiberglass, and bolts shall be Type 316 stainless steel. gaskets shall be suitable for use in potable water.

Where pipes are to be built in to structures, termination, sealing and anchoring shall be carried out strictly in accordance with the manufacturer's recommendations, and to the approval of the CO.

HDPE Pipes and Fittings shall be manufactured by Plexo, Driscopipe, USA or approved equivalent.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or flange joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends, and (3) UL 262 shall be inside-screw type with

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operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 175 psi, and shall have mechanical-joint ends or flange joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Valve ends and gaskets for connection to HDPE piping shall conform to the applicable requirements specified for the joint. Valves shall be of one manufacturer.

2.1.2.2 Tapping Sleeve

Mechanical joint tapping sleeve shall be similar to model series 2800-C as manufactured by American Flow Control or approved equal.

2.1.2.3 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts. PRV shall be CLAVAL MDLM 90-01/690-01 (with internal bypass and strainer) as shown in the drawing or approved equal.

2.1.2.4 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.5 Fire Hydrants (Clow Valve Co. Model 860 or approved equal)

Wet-barrel type. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

- a. Wet-Barrel Type Fire Hydrants: Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 6 inch inlet, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves. Inlet shall have mechanical-joint end only; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as indicated.

2.1.2.6 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall

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be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.7 Valve Pits

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown.

2.1.2.8 Water Meters

To be provided by the Contractor and turn-over to CO for the latter's future connection.

2.1.2.9 Meter Box

To be provided by the Contractor and turn-over to CO for the latter's future connection.

2.2 WATER SERVICE LATERAL MATERIALS

2.2.1 Piping Materials

Polyvinyl Chloride (PVC) Plastic Pipe: Pipe tubing, and fittings shall conform to ASTM D1785 schedule 80, and ASTM D2464 and ASTM D2467.

2.2.1.1 Plastic Tubing

All plastic tubing shall be approved by the CO and shall be Polyvinyl Chloride (PVC), copper tubing size as specified on the plans and specification.

2.2.2 Water Service Lateral Appurtenances

2.2.2.1 Corporation Stop

Corporation Stop shall conform to the requirements of AWWA C800 and the following:

- a. Components shall be constructed of bronze conforming to ASTM B62.
- b. Shall have a rated pressure of 300 psig.
- c. Shall be full port, straight through design. Ball corp waterway shall be the same size as the corp. For example: 1 inch ball corp shall have 1 inch waterway.
- d. Inlet threads shall be AWWA taper (Mueller) threads.
- e. Ball shall be Polyethylene (PTFE) coated, capable of full 360 degrees rotation with nitrile (Buna-N) seals that provide shut-off from either direction.
- f. Shall have double O-Ring seals at top.
- g. Head shall have a raised boss or groove indicating the position of the ball.

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- h. Shall have a blowout proof stem design.
- i. Shall have suitable marking indicating the manufacturer.

2.2.2.2 Curb Stop

Curb Stop shall conform to the requirements of AWWA C800 and the following:

- a. Components shall be constructed of bronze conforming to ASTM B62.
- b. Shall have a rated pressure of 300 psig.
- c. Shall be full port, straight through design. Waterway shall be the same size as the stop. For example: 1 inch ball stop shall have a 1 inch waterway.
- d. Ball shall be PTFE coated, capable of full 360 degrees rotation with two nitrile (Buna-N) seals that provide shut-off from either direction. Seals shall be blow-off proof to the atmosphere.
- e. Shall have double O-Ring seals at top.
- f. Head shall have a raised boss or groove indicating the position of the ball.
- g. Shall have a blowout proof stem design.
- h. Shall have suitable marking indicating the manufacturer.

2.2.2.3 Service Saddles

Double bronze strap, Model 306H and 306, as manufactured by Romac Industries Inc. or approved equal.

2.2.2.4 Gate Valves in Concrete Valve Box

MSS SP-80, Class 150, solid wedge, inside screw, rising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve and a handwheel operator.

2.2.2.5 Valve Boxes

Provide a valve box for each gate valve. Valve boxes shall be of precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 3 to 5

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feet from the building/house unit, unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines, fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate joints. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints

with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.

- b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.
- c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C94/C94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.2 Installation of Polyethylene (PE) Plastic Piping (HDPE)

- a. General Installation: PE pipes shall be installed in accordance with ASTM D 2774.
- b. Jointing: Jointing shall comply with ASTM D 2657, Technique II-Butt Fusion.
- c. Offsets: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.2.3 Installation of Valves and Hydrants

- a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.
- b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble

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joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface.

3.1.3 Installation of Water Service lateral Piping

3.1.3.1 Location

Terminate water service lateral approximately 3 to 5 feet from the building/house unit line at the points indicated; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines 1 inch size to the main by a double strap service saddle or shown on the drawings.

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D2774, unless otherwise specified.

- a. Jointing: Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and curb stop in accordance with the recommendations of the plastic pipe manufacturer.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The CO will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of

AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints, flanged joints and mechanical joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

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| | | 02 41 00 | SD-01 Preconstruction Submittals | | 1.5 | | | | | | | | | | | | |
| | | | Existing Conditions | | 1.8 | G | | | | | | | | | | | |
| | | | SD-07 Certificates | | 1.5 | | | | | | | | | | | | |
| | | | Demolition Plan | | 1.5 | G | | | | | | | | | | | |
| | | | Notification of Demolition | | 1.5 | | | | | | | | | | | | |
| | | 03 20 00.00 10 | SD-02 Shop Drawings | | 1.2 | | | | | | | | | | | | |
| | | | Reinforcement | | 2.1/3.1 | G | | | | | | | | | | | |
| | | 03 30 53 | SD-02 Shop Drawings | | 1.4 | | | | | | | | | | | | |
| | | | Installation Drawings | | 1.4/1.5 | | | | | | | | | | | | |
| | | | SD-03 Product Data | | 1.4 | | | | | | | | | | | | |
| | | | Air-Entraining Admixture | | 1.4/2.1.3.1 | | | | | | | | | | | | |
| | | | Water-Reducing or Retarding Admixture | | 1.4/2.1.3.2 | | | | | | | | | | | | |
| | | | Curing Materials | | 1.4/2.1.8 | | | | | | | | | | | | |
| | | | Batching and Mixing Equipment | | 1.4/3.1.3.3 | | | | | | | | | | | | |
| | | | Conveying and Placing Concrete | | 1.4/3.2 | | | | | | | | | | | | |
| | | | Formwork | | 1.4/2.1.6/3.1.2 | | | | | | | | | | | | |
| | | | Forms | | 1.4/2.3 | | | | | | | | | | | | |
| | | | Ready-Mix Concrete | | 1.4/2.2 | | | | | | | | | | | | |
| | | | Mix Design Data | | 1.4/2.2 | | | | | | | | | | | | |
| | | | Air-Entraining Admixtures | | 1.4 | | | | | | | | | | | | |
| | | | Curing Compound | | 1.4/2.4 | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | 1.4 | | | | | | | | | | | | |
| | | | Aggregates | | 1.4/2.1.2 | | | | | | | | | | | | |
| | | | Concrete Mixture Proportions | | 1.4/1.3.2 | | | | | | | | | | | | |
| | | | Compressive Strength Testing | | 1.4/3.9 | | | | | | | | | | | | |
| | | | Slump | | 1.4/3.6.2.3 | | | | | | | | | | | | |
| | | | SD-07 Certificates | | 1.4 | | | | | | | | | | | | |
| | | | Cementitious Materials | | 1.4/2.1.1 | | | | | | | | | | | | |
| | | | Aggregates | | 1.4/2.1.2 | | | | | | | | | | | | |
| | | 04 20 00 | SD-02 Shop Drawings | | 1.3 | | | | | | | | | | | | |
| | | | Detail Drawings | | 1.3 | | | | | | | | | | | | |
| | | | SD-03 Product Data | | 1.3 | | | | | | | | | | | | |
| | | | Local/Regional Materials | | 1.3 | | | | | | | | | | | | |

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| | | 04 20 00 | Unit Strength Method | | 1.3 | | | | | | | | | | | | | |
| | | | Cement | | 1.3 | | | | | | | | | | | | | |
| | | | SD-04 Samples | | 1.3 | | | | | | | | | | | | | |
| | | | Concrete Masonry Units (CMU) | | 1.3/2.2 | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | 1.3 | | | | | | | | | | | | | |
| | | | Pre-Mixed Mortar | | 1.3/2.3.2 | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | 1.3 | | | | | | | | | | | | | |
| | | | Concrete Masonry Units (CMU) | | 1.3 | | | | | | | | | | | | | |
| | | | Admixtures for Masonry Mortar | | 1.3 | | | | | | | | | | | | | |
| | | | Admixtures for Grout | | 1.3 | | | | | | | | | | | | | |
| | | 13 41 00 | SD-02 Shop Drawings | | 1.3 | | | | | | | | | | | | | |
| | | | Shop and Erection Plans | | 1.3 | | | | | | | | | | | | | |
| | | | Foundation Plans | | 1.3/1.6 | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | 1.3 | | | | | | | | | | | | | |
| | | | Tank Materials | | 1.3/2.1 | | | | | | | | | | | | | |
| | | | Color | | 1.3/2.1 | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | 1.3 | | | | | | | | | | | | | |
| | | | Test Reports | | 1.3/1.7 | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | 1.3 | | | | | | | | | | | | | |
| | | | Manufacturer's Certificate | | 1.3 | | | | | | | | | | | | | |
| | | | Microbiological Test | | 1.3/1.7 | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer's Instructions | | 1.3 | | | | | | | | | | | | | |
| | | | Tank Manufacturer | | 1.3/1.5 | | | | | | | | | | | | | |
| | | | Tank Erector | | 1.3/1.5 | | | | | | | | | | | | | |
| | | | Installation Crew | | 1.3/1.5 | | | | | | | | | | | | | |
| | | | Field Measurements | | 1.3 | | | | | | | | | | | | | |
| | | 22 00 00 | SD-03 Product Data | | 1.2 | | | | | | | | | | | | | |
| | | | Pumps | | 1.2/2.5 | G | | | | | | | | | | | | |
| | | | Backflow prevention assemblies | | 1.2/3.5.1.1 | G | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | 1.2 | | | | | | | | | | | | | |
| | | | Tests, Flushing and Disinfection | | 1.2/3.5 | | | | | | | | | | | | | |
| | | | Test of Backflow Prevention Assemblies | | 1.2/3.5.1.1 | G | | | | | | | | | | | | |

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| ACTIVITY | TRANSMITTAL | SPECIFICATION | DESCRIPTION | ITEM | PARAGRAPH | CONTRACTOR SCHEDULE DATES | | | CONTRACTOR ACTION | | APPROVING AUTHORITY | | | | | REMARKS | |
| | | | | | | APPROVED NEEDED BY | MATERIAL NEEDED BY | DATE OF ACTION | DATE FWD TO APPR AUTH/DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD TO OTHER REVIEWER | ACTION | DATE OF ACTION | MAILED TO CONTR/ DATE RCD FROM APPR AUTH | | | |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) | (n) | (o) | (p) | (q) | (r) |
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| | | | Panelboards | | 1.3/2.7 | | | | | | | | | | | | |
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| | | | | | | | SUBMIT | APPROVED NEEDED BY | MATERIAL NEEDED BY | ACTION | DATE OF ACTION | DATE FWD TO APPR AUTH/DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD TO OTHER REVIEWER | ACTION | | DATE OF ACTION | MAILED TO CONTR/ DATE RCD FROM APPR AUTH |
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| | | | Splices and Connectors | | 1.3/2.3 | | | | | | | | | | | | | |
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| | | | SD-06 Test Reports | | 1.3 | | | | | | | | | | | | | |

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| | | | | | | | SUBMIT | APPROVED BY | MATERIAL NEEDED BY | ACTION | DATE OF ACTION | DATE FWD TO APPR AUTH/DATE RCD FROM CONTR | DATE FWD TO OTHER REVIEWER | DATE RCD TO OTHER REVIEWER | ACTION | | DATE OF ACTION | MAILED TO CONTR/DATE RCD FROM APPR AUTH |
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| ACTIVITY | TRANSMITTAL | SPEC SECTION | DESCRIPTION | ITEM | PARAGRAPHS | CONTRACTOR SCHEDULE DATES | | | CONTRACTOR ACTION | | APPROVING AUTHORITY | | | | | REMARKS | |
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| | | | SD-07 Certificates | | 1.2 | | | | | | | | | | | | |
| | | | Certificates of Compliance | | 1.2/1.5.2 | | | | | | | | | | | | |
| | | | SD-08 Manufacturer's Instructions | | 1.2 | | | | | | | | | | | | |
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| | | | Gate Assembly | | 1.2/1.3 | | | | | | | | | | | | |
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| | | | Accessories | | 1.2/1.3/2.7.1 | | | | | | | | | | | | |
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TEST/REQUIREMENTS LIST

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This report lists all the test requirements cited in the text.

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| SECTION: 22 00 00 | SUBPART: 3.5 | Plumbing System |
| SECTION: 22 00 00 | SUBPART: 3.5.5 | Operational Test |
| SECTION: 26 05 00.00 40 | SUBPART: 3.10 | Insulation-resistance test |
| SECTION: 26 05 00.00 40 | SUBPART: 3.10 | continuity test |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.1 | Take the number and size of samples required to perform the following tests. |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.2 | Perform one of each of the following tests for each material used. Provide additional tests for each source change. |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.2.1 | Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable. |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.2.2 | Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable. |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.2.3 | Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M. |
| SECTION: 31 23 00.00 20 | SUBPART: 3.8.2.4 | Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. |