

SECTION 33 10 00
WATER UTILITIES

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.
4. Sites for national cemeteries may have full, limited, or no access to existing potable water supply sources from existing government operated campus type water systems, or from connection to municipal water systems. Adjust this specification section according to the conditions applicable for the potable water supply for the specific project site.
5. Fire protection for NCA cemetery facilities may be provided from the same potable water supply sources as that for the buildings, from onsite ponds, or from the irrigation system which may only be available for the portion of the year when the irrigation system is operational. Modify this specification section accordingly, based upon the conditions applicable for the specific project site.
6. The "Safe Drinking Water Act" (SDWA) was originally passed into law in 1974. It was amended several times. The "Reduction of Lead in Drinking Water Act" was passed in January 2011 and amends the SDWA to the new lead free standard to include NSF 61 and NSF 372.

PART 1 - GENERAL

SPEC WRITER NOTE: Retain following Description paragraph 1.1 and modify as appropriate for the project.

1.1 DESCRIPTION

- A. Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing potable water supply.

B. Definitions:

SPEC WRITER NOTE: Modify the definitions to reflect the site specific conditions regarding which type of services are to be provided from the potable water supply source.

1. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout the site, as applicable, and in the building areas that provides water from the potable water supply source for the project, including //hydrants, // valves, and other appurtenances used to supply water for domestic, //and fire-fighting/fire protection// purposes only when required due to Life Safety issues.
2. Water Service Line: Pipe line connecting building piping to water distribution lines.

SPEC WRITER NOTE: Add or delete paragraphs that are applicable to the potable water utilities for the project.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS. Erosion and Sediment Control.
- F. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- G. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- H. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- I. Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- J. Section 09 91 00, PAINTING.

SPEC WRITER NOTE: If Section 21 12 00 is included in this project the section shall be obtained from VA Masters.

- K. Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- L. //Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Building Plumbing starting 1500 mm (5 feet) outside of the building.//

M. Section 31 20 00, EARTH MOVING: Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing.

SPEC WRITER NOTE: Coordinate the work for the Water Utilities to ensure connection is made between the water utility and the building where applicable, at 1500 mm (5 feet) outside of the building.

N. //Section 32 30 00, SITE FURNISHINGS: Flower Watering Spigot Assemblies.//

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

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

B. American Society of Mechanical Engineers (ASME):

- A112.6.3-2016.....Floor and Trench Drains
- B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250
- B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings
- B16.26-2013.....Cast Copper Alloy Fittings for Flared Copper Tubes
- B18.2.2-2015.....Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
- B18.5.2.1M-2006 (R2011).Metric Round Head Short Square Neck Bolts
ASME Boiler and Pressure Vessel Code -
- BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society of Safety Engineers (ASSE):

- 1003-2009 Water Pressure Reducing Valves

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

- A36/A36M-2014.....Standard Specification for Carbon Structural Steel
- A47/A47M-1999 (R2014)...Standard Specification for Ferritic Malleable Iron Castings
- A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings
- A148/A148M-2015a.....Standard Specification for Steel Castings, High Strength, for Structural Purposes
- A307-2014.....Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- A536-1984(R2014).....Standard Specification for Ductile Iron Castings
- A563-2015.....Standard Specification for Carbon and Alloy Steel Nuts
- B61-2015.....Standard Specification for Steam or Valve Bronze Castings
- B62-2015.....Standard Specification for Composition Bronze or Ounce Metal Castings
- B88-2014.....Standard Specification for Seamless Copper Water Tube
- B117-2011.....Standard Practice for Operating Salt Spray (Fog) Apparatus
- B633-2013.....Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- C443-2012.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C857-2014.....Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- C858-2010e1.....Standard Specification for Underground Precast Concrete Utility Structures
- D1785-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2000-2012.....Standard Classification System for Rubber Products in Automotive Applications

- D2464-2015.....Standard Specification for Threaded Poly(Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- D2467-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2672-2014.....Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- F437-2015.....Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F439-2013.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F441/F441M-2015.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F593-2013a.....Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- E. American Water Works Association (AWWA):
- B300-2010.....Hypochlorites
- B301-2010.....Liquid Chlorine
- C104-2013.....Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C111-2012.....Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C115-2011.....Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- C150-2014.....Thickness Design of Ductile-Iron Pipe
- C151-2009.....Ductile-Iron Pipe, Centrifugally Cast
- C153-2011.....Ductile-Iron Compact Fittings
- C502-2014.....Dry-Barrel Fire Hydrants

- C504-10.....Rubber-Seated Butterfly Valves
- C508-2009.....Swing-Check Valves for Waterworks Service, 50
mm thru 600 mm (2 inches through 24 inches) NPS
- C509-2009.....Resilient-Seated Gate Valves for Water Supply
Service
- C510-2007.....Double Check Valve Backflow Prevention Assembly
- C511-2007.....Reduced-Pressure Principle Backflow Prevention
Assembly
- C512-07.....Air Release, Air/Vacuum and Combination Air
Valves
- C550-2013.....Protective Interior Coatings for Valves and
Hydrants
- C600-2010.....Installation of Ductile Iron Water Mains and
Their Appurtenances
- C605-2013.....Underground Installation of Polyvinyl Chloride
(PVC) and Molecularly Oriented Polyvinyl
Chloride (PVC0) Pressure Pipe and Fittings
- C651-2014.....Disinfecting Water Mains
- C700-2015.....Cold-Water Meters - Displacement Type, Metal
Alloy Main Case
- C701-2015.....Cold-Water Meters - Turbine Type, for Customer
Service
- C702-2015.....Cold-Water Meters - Compound Type
- C706-2010(Withdrawn)....Direct-Reading, Remote-Registration Systems for
Cold-Water Meters
- C707-2010.....Encoder-Type Remote-Registration Systems for
Cold-Water Meters
- C800-2014.....Underground Service Line Valves and Fittings
- C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 100 mm Through 300 mm (4
inches Through 12 inches), for Water
Transmission and Distribution
- C906-15.....Polyethylene (PE) Pressure Pipe and Fittings, 4
In. (100 mm) Through 64 In. (1,600 mm), for
Water Distribution and Transmission
- F. American Welding Society (AWS):
- A5.8/A5.8M-2011.....Specification for Filler Metals for Brazing and
Braze Welding

- G. Copper Development Association, Inc. (CDA):
A4015.....Copper Tube Handbook
- H. National Fire Protection Association (NFPA):
24-2016.....Standard for the Installation of Private Fire
Service Mains and Their Appurtenances
- I. NSF International:
61-2014a.....Drinking Water System Components-Health Effects
- J. University of Southern California Foundation for Cross Connection
Control and Hydraulic Research (USC FCCCHR):
9th Edition.....Manual of Cross-Connection Control

SPEC WRITER NOTE: Review and edit the following submittal listing, as applicable, for the specific conditions of the project site. Fire Hydrant Assemblies are included in this section for submittal, even though they may be installed and connected to the irrigation system at the project site. If the project site is an existing facility with potable water and fire protection uses from the same system, then the fire hydrants are typically included in the NCA water utilities.

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 10 00, WATER UTILITIES", with applicable paragraph identification.
- C. Make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval by VA will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly

integrated their equipment and controls to provide a complete and efficient installation.

- F. Provide lists of previous installations by the installing contractor. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.

SPEC WRITER NOTE: Modify the list in the following paragraph to include those items relevant for this specific project. Add any items that may be missing and delete those not being utilized and renumber.

- G. Manufacturers' Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit all items as one package. Ductile iron pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and AWWA C605 respectively.

1. Piping.
2. Fittings
3. Gaskets.
4. Valves.
5. Fire hydrants.
6. Meter.
7. Vaults, frames and covers.
8. Steps.
9. Backflow Preventer
10. Post indicator.
11. Valve boxes.
12. Corporation and curb stops.
13. Curb stop boxes.
14. Joint restraint.
15. Disinfection products.
16. Warning Tape
17. Link/sleeve seals.

- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a compatible and efficient installation. Final review and approvals will be made only by groups.

- I. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

SPEC WRITER NOTE: Modify the following paragraph to indicate all of the testing certifications that will be required for this work. Clarify whether the Contractor is required to submit the procedures to be followed, timing for the work in the project, and who will be performing the certifications and what will be certified. Clarify how much of the above is required during the submittal process for this section and whether it is required as part of the all-inclusive submittal.

- J. Testing Certifications:
 - 1. Certification of Backflow Devices.
 - 2. Hydrostatic Testing.
 - 3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.
- K. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- L. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

1.5 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply, and servicing of the specified products for at least 5 years. However, digital electronics devices, software, and systems such as controls, instruments, and computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.

2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within ____ km (___miles) // 160 km (100 miles)// of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail, or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail, e-mail addresses, and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation, and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability, and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the (COR).
5. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be the product of one manufacturer.
6. Assembled Units: Ensure that manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
8. Use of asbestos containing products, equipment, or materials is prohibited.

SPEC WRITER NOTE: Edit, delete and or modify Paragraphs B and C, as required, to reflect the conditions for providing a potable water supply source for the

project site. Delete as required and renumber accordingly.

- B. //Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.//
- C. //Comply with all rules and regulations of Federal, State, and Local //Health Department// //Department of Environmental Quality// having jurisdiction over the design, construction, and operation of potable water systems.//
- D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed //electronic// copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- E. Welding: Before any welding is performed, submit a certificate certifying that welders comply with the following requirements:
 - 1. Qualify welding processes and operators for piping according to ASME BPVC Section IX.
 - 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 - 3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 - 4. All welds shall be stamped according to the provisions of the American Welding Society.
- F. Execution (Installation, Construction) Quality:
 - 1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
 - 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely

- accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.
3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
 5. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.
- G. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading, and welding of piping shall be removed.
 2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
 3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, and fixture faucets shall be flushed of debris prior to final acceptance.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.
- H. All material surfaces in contact with potable water shall comply with NSF 61.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until final acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall

not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter with double thickness cement mortar lining interior, interior asphaltic seal coat, and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.

SPEC WRITER NOTE: Modify the following paragraph and clarify which conditions are applicable for the project. If restrained joint pipe is required, modify to provide information describing the approved restrained joints.

2. Below Grade: Supply pipe in lengths not in excess of a nominal 6.1 m (20 feet) with rubber ring type push-on joints, mechanical joint, or approved restrained joint. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.

SPEC WRITER NOTE: Modify or delete the following based upon the determination of soil characteristics as indicated in SPEC WRITER NOTE for paragraph DUCTILE IRON PIPE in PART 3.

3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation, and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter.
//Provide flange joint pipe where shown on the drawings.// Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 861 kPa (125 psi) or 1724 kPa (250 psi) standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and as herein specified in paragraph LINK/SLEEVE SEALS.
3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
4. Rubber Ring Gaskets: Full face type, AWWA C111, 1.6 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.

SPEC WRITER NOTE: Modify as required to identify what the paint color shall be, based upon the location for the pipe.

5. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop-primed on the outside with one coat of the pipe manufacturer standard color of rust inhibitive primer or equal. Finished paint color shall be as selected for the location.

SPEC WRITER NOTE: Modify the following and identify where the two identified types of bolt assemblies are to be used. Connections that will periodically be opened for maintenance should use the stainless steel.

6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.

- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2413 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148/A148M. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 861 kPa (125 psi) or

1724 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.

- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Class-Rated Polyvinyl Chloride (PVC) Pipe: Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working pressure, and production code.

- 1. PVC pipe and accessories 100 mm to 355 mm (4 inches to 14 inches) in diameter, AWWA C900, Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
- 2. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441/F441M.

B. Joints:

- 1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F477.
- 2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D2464) or solvent welded (ASTM D2672). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

- 1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153. Mechanical joint fittings shall include retainer glands, unless otherwise noted.
- 2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. Solvent welded fittings shall conform to ASTM D2467. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.3 MECHANICAL JOINT RETAINER GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances conforming to either AWWA C111 or AWWA C153, shall conform to the following:
1. Restraint devices for nominal pipe sizes 75 mm (3 inch) through 900 mm (36 inch) shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of AWWA C110.
 2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
 3. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 Brinell Hardness Number (BHN).
 4. An identification number consisting of year, day, plant, and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. All components shall be manufactured in the United States.
 5. Mechanical Joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 6. Mechanical joint restraints shall be listed by Underwriters Laboratories, and approved by Factory Mutual in the 75 mm (3 inch) through 300 mm (12 inch) sizes.
 7. All casting bodies shall be surface pretreated with a phosphate wash, rinse, and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester-based powder to provide corrosion, impact, and UV resistance.

2.4 COPPER PIPE AND TUBING

- A. Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8/A5.8M, Classification BCuP. Fittings for compression-type joint, ASME B16.26, flared tube type.

SPEC WRITER NOTE: Modify and/or delete the following paragraphs based upon the valve types applicable for the project.

2.5 VALVES

A. Gate:

1. Unless otherwise specified, valves shall conform to AWWA C509 with mechanical-joint ends. Valves 75 mm (3 inches) and greater shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type, turning counter-clockwise to open, with a minimum 1380 kPa (200 psi) WOG. The resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Asbestos packing is prohibited.
2. Operator:
 - a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation.
 - b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

B. Check Valve: Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, and trademark shall be cast on the body of each valve. Valves 50 mm (2 inches) and greater shall be //outside lever and spring// //outside lever and weight// // // type.

1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or ASTM B62, 1380 kPa (200 psi) WOG.
2. 100 mm (4 inches) and Greater: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1380 kPa (200 psi) WOG. Check valves shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.

- C. Corporation Stops and Saddles: Ground key type; bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.
- D. Curb or Service Stops: Ground key, round way, inverted key type; made of bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow. Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1380 kPa (200 psi) WOG per AWWA C800.
- E. Vacuum and Air Relief Valves: Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Valves shall be rated for the same operating pressure as the pipeline.
- F. Pressure Reducing Valves: Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for // // kPa (// // psi) operating pressure on the inlet side, with outlet pressure set for // // kPa (// // psi). The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be //threaded// //flanged//. Valve bodies shall be bronze, cast iron, or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

SPEC WRITER NOTE: The following two paragraphs shall be modified or deleted, as applicable based upon the project conditions. The final water utility pipe installation shall be locatable by the NCA staff with appropriate locating equipment, and the warning detection tape

shall be present when excavating down on top of the water utility pipeline or appurtenances.

2.6 TRACER WIRE FOR NONMETALLIC PIPING

- A. Provide bare copper or aluminum wire not less than 2.5 mm (0.10 inch) in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.7 WARNING TAPE

- A. Standard, 0.10 mm (4-mil) polyethylene 75 mm (3 inch) wide tape, //detectable// //non-detectable// type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

SPEC WRITER NOTE: Modify or delete the following paragraph according to the project conditions. For existing NCA facilities, the Spec Writer shall determine if the NCA has suitable equipment for the purposes of utility location, and if not, or if the equipment doesn't perform the required location capabilities, revise this paragraph and those in Part 3 to require that the Contractor provide appropriate location equipment.

2.8 //LOCATOR EQUIPMENT

- A. Provide location equipment (device and appurtenances) suitable for locating tracer wire and/or detectable warning tape placed above water utility lines at the actual depths for this project. The locator device shall be capable of locating the detectable warning tape from above the tape without making physical contact with the detectable warning tape. Before acceptance, the equipment shall be demonstrated at various locations and conditions for the project to confirm the functionality for its intended purpose.//

2.9 CURB STOP BOX

- A. Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 600 mm (2 feet) above top of deepest stop box.

2.10 VALVE BOX

SPEC WRITER NOTE: Indicate how many "T" handles are to be provided by the Contractor; it is recommended that a minimum of 2 be provided.

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide // // "T" handle socket wrenches of 18 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box. The least diameter of the shaft of the box shall be 135 mm (5-1/4 inches). Cast iron box shall have a heavy coat of bituminous paint. Valve box and cover shall be installed where indicated on the drawings to be utilized as access points for the tracer wire or detectable warning tape.

2.11 POST INDICATOR VALVE

- A. Valve: Valve shall conform to the specifications listed in paragraph VALVES for gate valves. The Post Indicator shall conform to NFPA 24 and shall be fully compatible with the valve and all the supervisory switches.

2.12 FIRE HYDRANTS

- A. Size of main valve opening of each hydrant shall be 135 mm (5-1/4 inches), minimum. Hose thread, size of fire apparatus connection, and shape, size, and direction of rotation of operating head of hydrant shall be identical with //present local fire department and/or water department standards// //those in use at the facility//.
- B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:
1. Interior removable without digging up hydrant; can be packed under pressure; one 115 mm (4-1/2 inch) pumper connection and two 65 mm (2-1/2 inch) hose connections with caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 50 mm (2 inches) above finished grade. All fire hydrants shall have 150 mm (6 inch) bottom connection. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502.

2. Provide fire hydrants with a finish paint identical to the existing fire hydrants. If there are no existing hydrants, contact the nearest fire department responder (fire department) to the site for appropriate color.

SPEC WRITER NOTE: Indicate how many operating wrenches are to be provided by Contractor. It is recommended that a minimum of 2 be provided.

- C. Provide // // wrenches with handles not less than 355 mm (14 inches) long.

2.13 TAPPING SLEEVES

- A. Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, stainless steel or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings, and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of //1035// // // kPa //(150// //(// psi). Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 67.8 Newton-meters (50 foot-pounds).

SPEC WRITER NOTE: Modify the following to make pipe sleeves under roadways to be in compliance with the local State Department of Transportation standards, or for a selected local town, or specify on the drawings the size, material, thickness, length, etc.

2.14 PIPE SLEEVES

- A. Cast gray ductile iron or zinc coated steel.

2.15 SLEEVE-TYPE MECHANICAL COUPLINGS

- A. Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward

each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. //For //ductile iron// //and// //PVC plastic// pipe, the middle ring shall be of cast iron //or steel; and the follower rings shall be of malleable or ductile iron//.// //For steel piping, the middle ring shall be of steel and the follower rings shall be of steel or malleable iron.// //Cast iron, ASTM A48/A48M not less than Class 25.// Malleable and ductile iron shall conform to ASTM A47/A47M and ASTM A536, respectively. //Steel shall have a strength not less than that of the pipe.// Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1Mor with hex nuts, ASME B18.2.2. Bolts shall be 18 mm (5/8 inch) in diameter; minimum number of bolts for each coupling shall be // // for // // mm (// // inch) pipe, // // for // // mm (// // inch) pipe, and // // for // // mm (// // inch) pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.16 BACKFLOW PREVENTER

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 103 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 24.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.

- D. Backflow preventers shall be approved by the Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR) of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous, or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance, and repair. Access and clearance shall require a minimum of 300 mm (1 foot) between the lowest portion of the assembly and grade, floor, or platform. Installations elevated more than 1500 mm (5 feet) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

SPEC WRITER NOTE: Retain only one applicable Water Meter paragraph and modify to include the name of the Water Service Utility, and the flow rate parameters for sizing the flow meter, as applicable.

2.17 //WATER METER

SPEC WRITER NOTE: Modify the following and provide flow rate information for sizing the meter. Select the appropriate paragraph 1 and modify as required.

- A. Furnished and set by Contractor for use by Owner. Meter shall be a :
 - 1. //Turbine Type Meters: Shall conform to AWWA C701 //Class I//
//Class II//. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed, and shall read in //liters// //cubic meters// //(U.S. gallons)// //(cubic feet)//. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements of AWWA C701.//
 - 2. //Displacement Type Meters: Shall conform to AWWA C700. Registers shall be straight-reading and shall read in //liters// //cubic meters// //(U.S. gallons)// //(cubic feet)//. //Meters in sizes 15 mm through 25 mm (1/2 inch through 1 inch) shall be frost-protection

- design.// Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be //a direct reading remote register designed in accordance with AWWA C706// //or// //an encoder type remote register designed in accordance with AWWA C707//. Meters shall comply with the accuracy and capacity requirements of AWWA C700.//
3. //Compound Type Meters: Shall conform to AWWA C702// and shall be furnished with strainers//. The main casing shall be //bronze// //cast iron protected by corrosion resistant coating// with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be //permanently sealed// //open// and shall read in //liters// //cubic meters// //(U.S. gallons)// //(cubic feet)//. //The meter shall be equipped with a coordinating register.// Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be //a direct reading remote register designed in accordance with AWWA C706// //or// //an encoder type remote register designed in accordance with AWWA C707//. Meters shall comply with the accuracy and capacity requirements of AWWA C702.//

2.18 //WATER METER

- A. Furnished and set by Water Service Utility.//

2.19 //WATER METER

- A. Furnished by Water Service Utility and installed by Contractor.//

2.20 //WATER METER

- A. Furnish and install meter approved by Water Service Utility. Forward approval.//

2.21 WATER METER BOXES

SPEC WRITER NOTE: Select one of the paragraphs in this section.

- A. Cast iron body and cover for water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

SPEC WRITER NOTE: Delete subparagraph below if not permitted.

1. Base section may be cast iron, PVC, PE, or other pipe.
- B. Cast iron body and double cover for water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between

covers; and slotted, open-bottom base section of length to fit over service piping.

SPEC WRITER NOTE: Use meter box in paragraph below in walks or unpaved areas away from traffic; do not use in roadways.

- C. Polymer-concrete body and cover for water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping, vertical and lateral design loadings of 6800 kg minimum over 254 mm by 254 mm (15,000 lb minimum over 10 by 10 inches) square.

SPEC WRITER NOTE: Modify the following paragraph to include compliance with the local water purveyor's standards, if applicable. Whenever possible, install meters and backflow devices inside of buildings. Next choice for backflow devices is in above ground locations, especially where weather conditions allow.

2.22 CONCRETE VAULTS

- A. Precast, reinforced-concrete vault: ASTM C858, designed for AASHTO HS20-44 load designation.
1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 2. Drain: ASME A112.6.3, cast iron floor drain with outlet. Include body anchor flange, light-duty cast iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

SPEC WRITER NOTE: Retain one of the two following paragraphs. Alternate load designations are defined in ASTM C857.

3. //Manhole Frame and Cover: ASTM A48/A48M, Class No. 35A minimum tensile strength, gray cast iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//
4. //Manhole Frame and Cover: ASTM A536, Grade 60-40-18, ductile iron, 600 mm (24 inch) minimum diameter, unless otherwise indicated.//

SPEC WRITER NOTE: Modify the cover assemblies for large meter and/or backflow preventer assemblies in underground vaults, when applicable, to require suitable hatches for access to the vault rather than manholes, whenever possible.

2.23 CAST IRON FRAME AND COVER, STEPS, ETC.

- A. Frames and Covers: Shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181 Kg (400 lbs.). The word "WATER" shall be stamped or cast into covers so that it is plainly visible.
- B. Manhole Steps: Plastic or rubber coated, pressure-molded to the steel. Plastic coating shall conform to ASTM D4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs are prohibited. Steps are not required in manholes less than 1.2 m (4 feet) deep.

2.24 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.25 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5 gram tablets, and shall contain 65 percent chlorine by weight.

2.26 LINK/SLEEVE SEALS

- A. The seal assemblies shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and have the following properties as designated by ASTM: 1) coloration shall be throughout elastomer for positive field inspection; 2) each link shall have a permanent identification of the size and manufacturer's name molded into it.
 1. For Standard Service Applications: EPDM = ASTM D2000 M3BA510, Color = Black
 2. For Hydrocarbon Service Applications: Nitrile = ASTM D2000 M1BF510, Color = Green
 3. For High Temperature of Fire Seal Applications: Silicone = ASTM D2000 M1GE505, Color = Gray

- B. The modular seal hardware for fastening the links shall be sized according to the manufacturer's recommendations for the service intended. Bolts, flange hex nuts shall be:

SPEC WRITER NOTE: Spec Writer shall generally select the first paragraph 1. for conditions where the presence of groundwater on the outside of the penetration is not anticipated. Select the second paragraph 1. for conditions where groundwater, or other standing water, is anticipated on the outside of the penetration. The second paragraph 1. should be selected for any other conditions where the designer has concerns of long term corrosion of the fasteners.

1. //Mild Steel with a 415 MPa (60,000 psi) minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B633 and Organic Coating, tested in accordance with ASTM B117 to pass a 1,470 hour salt spray test.//
2. //316 Stainless Steel per ASTM F593, with a 585 MPa (85,000 psi) average tensile strength.//

- C. Quality Assurance: Manufacturer's modular seal components and systems shall be domestically manufactured at a plant with a current ISO-9002 registration. Copy of the ISO-9002 registrations shall be provided with the submittal for these items.

SPEC WRITER NOTE: Determine the appropriate wall opening (i.e. steel sleeve, Thermoplastic (HDPE) sleeve, cored hole or formed hole.) The wall opening size and/or type shall be selected according to recommendations found in the most recent modular seal catalog of the manufacturer. For openings that require water stops use the following:

- D. Water Stop Wall Sleeve: Unless otherwise shown or specified, install molded non-metallic high density polyethylene sleeves having an integrally formed hollow water stop. Water stop shall be sized a minimum of 100 mm (4 inches) larger than the outside diameter of the sleeve itself and allowing 1/2 movement between wall forms to resist pour forces. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve itself installed at each end of the sleeve so as to prevent deformation during the initial concrete pour

and to facilitate attaching the sleeve to the wall forms. End caps shall remain in place to protect the opening from residual debris and rodent entry prior to pipe insertion. The wall sleeve shall be manufactured by the same company as the modular seal assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 BUILDING SERVICE LINES

- A. Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed, provide temporary caps.

3.3 REGRADING

- A. Raise or lower existing valve and curb stop boxes, or any other applicable water system facilities, to finish grade in areas being graded.

3.4 PIPE LAYING, GENERAL

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as recommended by the manufacturer in order to maintain the product performance as if it were undamaged.
- B. All pipe and fittings shall be inspected just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost or time to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.
- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown. If elevations are not indicated, pipe shall have a minimum depth of cover of // // m (// // feet).
- D. Exercise extreme care when installing piping to shore up and protect from damage all existing utilities and structures.

- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth compacted in place to a depth of at least 300 mm (12 inches) over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends, and hydrants installed on underground pipe shall be anchored. See paragraph PIPE SUPPORTS.
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water, and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.

SPEC WRITER NOTE: Coordinate and modify this paragraph with the other paragraphs where warning tape, identification wire and Locator Equipment are described.

- M. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade above buried water pipes, or at bottom of subbase where roadways exist, whichever is deeper with overall depth not exceeding 600 mm (24 inches). Detectable warning tape shall be locatable by the NCA staff from the finish grade above the pipe, utilizing existing locating equipment, or the approved locator equipment provided by the Contractor to the Owner (NCA Staff) as specified in paragraph LOCATOR EQUIPMENT.
- N. Trench excavation and compaction of backfill shall comply with the requirements of Section 31 20 00, EARTH MOVING.

3.5 DUCTILE IRON PIPE

SPEC WRITER NOTE: Modify the following paragraph based upon testing of the soils. If soils are determined to be corrosive when tested in accordance with Appendix A of AWWA C105, then it is recommended that polyethylene encasement in accordance with the AWWA C105 standard be installed for corrosion protection.

Adjust the following paragraph accordingly.

- A. Installing Pipe: Lay pipe in accordance with AWWA C600// with polyethylene encasement, if required, in accordance with AWWA C105//. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.

SPEC WRITER NOTE: Modify the following paragraph to select the allowable procedure(s) for cutting the pipe in the field.

- C. When cutting pipe is required, the cutting shall be done by //machine,// //an appropriate industry standard method,// leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell in order to conform to the manufactured spigot end. Cement lining shall be undamaged// or perform cutting following manufacturer's recommendations for field cutting of pipe//.
- D. Jointing Ductile-Iron Pipe:
1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home following industry standard procedures or manufacturer's approved means.
 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque. For new construction, all mechanical joints at valves and fittings shall be secured with an approved mechanical joint retainer glands suitable for the pipe.
 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of

structures, the socket end shall be at the structure and ball end assembled to the socket.

4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.6 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.

SPEC WRITER NOTE: Modify or delete the following paragraph for the project conditions and coordinate with the other paragraphs for tracer wire, warning tape, and locator equipment in this section.

- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (984 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

SPEC WRITER NOTE: Modify the following according to the project conditions and coordinate with the other paragraphs regarding identification wire, warning tape and locator equipment in this section.

3.7 TRACER SYSTEM INSTALLATION

- A. Install with all buried water main piping.
- B. Begin and terminate system at all connections to existing mains.
- C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 50 mm (2 inch) wide, 0.25 mm (10 mil) thickness polyethylene pressure sensitive tape.

- D. Install splices only as authorized by the COR. Allow the COR to inspect all below-grade splices of tracer wire prior to backfill.
- E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the COR.
- F. Bring two wires to the surface at each hydrant designated location within a valve box and cover and terminate with an accessible tracer wire termination.
- G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair any discontinuities.

3.8 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

3.9 PIPE SUPPORTS

- A. All piping shall be properly and adequately supported. Hangers, supports, base elbows, tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on center and at each fitting.
- B. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
- C. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
- D. Where hangers cannot be used, provide pipe saddle supports with pipe column and floor flange.

3.10 RESTRAINED JOINTS

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1380 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be as specified herein in paragraph MECHANICAL JOINT RETAINER GLANDS or approved equal.
- D. Thrust blocks shall be required, unless otherwise noted.
- E. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- F. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with the specified Mechanical Joint Restrainer Gland, or approved equal.

3.11 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
 - 1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary, or sewer service connection.
 - 2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
 - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
 - b. The water main invert is at least 457 mm (18 inches) above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
 - 3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile

iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 457 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 3 m (10 feet) horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in (1) above; or
 - b. The water main passes under a sewer or drain.
3. A vertical separation of 457 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.12 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 457 by 457 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Set curb stop box and cover for access to identification wire and/or detectable warning tape with a 300 by 300 by 75 mm (12 by 12 by 3 inches) at approximately the depth of the warning tape and bring the tape and/or identification wire into the box and coil extra length sufficient to allow the tape or wire to be uncoiled and extended 1500 mm (5 feet) above finish grade at the location.

- E. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.13 SETTING OF FIRE HYDRANTS

- A. Set center of each hydrant not less than 600 mm (2 feet) nor more than 1829 mm (6 feet) back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 457 mm (18 inches) above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.
- B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 381 mm (15 inches) square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of all foreign matter before installation.

3.14 PIPE SLEEVES

- A. Install where water lines pass through retaining walls, building foundations, and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.15 HYDROSTATIC TESTING

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, provide and install all required temporary thrust restraints required to safely conduct the test.
- E. Install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.

SPEC WRITER NOTE: Modify the pressure and leakage test pressure readings, as applicable to meet or exceed the requirements of the local water purveyor, or use 1.5 times the operating pressure for the water main, whichever is greater, and if no other information is available, use the value in the paragraph.

F. Perform pressure and leakage tests for the new system for 2 hours to 1380 kPa (200 psi). Leakage shall not exceed the following requirements.

1. Copper Tubing: No leaks.
2. Ductile Iron Pipe: AWWA C600. Provide to COR office.
3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COR office.

SPEC WRITER NOTE: Edit the following section to conform to governing Health Department/Department of Environment Quality Regulations.

3.16 FLUSHING AND DISINFECTING

- A. Flush and disinfect new water lines in accordance with AWWA C651.
- B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/s (2.5 f/s) at 276 kPa (40 psi) residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 76 cm/sec (2.5 ft/sec)(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. mm (in.)			
				25(1)	38(1 1/2)	51(2)	64(2 1/2)
mm	(In)	L/sec	(gpm)	Number of taps on pipe			
100	(4)	6.3	(100)	1	--	--	1
150	(6)	12.6	(200)	--	1	--	1
200	(8)	25.2	(400)	--	2	1	1
250	(10)	37.9	(600)	--	3	2	1
300	(12)	56.8	(900)	--	--	3	2
400	(16)	100.9	(1600)	--	--	4	2

Note: The backflow preventers shall not be in place during the flushing.

- C. Provide the water source for filling, flushing, and disinfecting the lines; only potable water shall be used. Provide all required temporary

pumps, storage facilities required to complete the specified flushing, and disinfection operations.

- D. Dispose of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.
- E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the //Health Department// //Department of Environmental Quality// of the State. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.17 BACKFLOW PREVENTOR TESTING

- A. All backflow preventers shall be installed, tested, and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COR.

3.18 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.19 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.20 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

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