**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated January 2021**
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SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

**02/18**

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SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING
**02/18**

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**NOTE: This guide specification covers the requirements for potable and non-potable (i.e., raw water, sea, salt water) systems, in which the largest size pipe is 1200 mm 60 inches in diameter and the maximum system working pressure is 1000 kPa 150 psi. This maximum working pressure depends on piping materials and appurtenances listed in this specification. Ensure that the pressure class of piping materials and appurtenances exceeds the maximum working pressure of the system. This section covers water systems for use outside of buildings, including water mains, water transmission mains and water service lines to a point approximately 1.5 m 5 feet from the perimeter of buildings or structures.. Water lines within 1.5 m 5 feet of the building are typically covered by Division 22 specifications and occasionally Division 40 specifications.**

**When control systems are used to monitor water utility systems include Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.**

**For areas outside of the United States (U.S.), U.S. Territories and Possessions determine if required materials are suitable or if an equivalent host nation standard is required. Design must comply with the applicable U.S. & Host Nation norms, regulations and all applicable U.S. Military criteria. Where a host nation standard is required, an equivalent host nation standard may supersede the required material indicated in this specification. Equivalency and compliance statement in duel languages must be provided and certified by the Host Nation engineer, registered on the country's professional rolls.**

**For corrosive soils select materials, coatings or cathodic protection systems in accordance with UFC 3-230-01. When cathodic protection is used include Section 26 42 13.00 20 CATHODIC PROTECTION BY**

**GALVANIC ANODES.**

**When piping is beneath open piers and other exposed locations is subject to freezing temperatures, include requirements for insulation and protective coverings in the project specification. Information on this subject related to open piers may be found in Technical Report R593, September 1968, "Freeze Protection for Freshwater and Sanitary Piping Under Open Piers," by the Naval Facilities Engineering Services Center, 560 Center Drive, Port Hueneme, California 93043-4328.**

**Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.**

**Remove information and requirements not required in respective project, whether or not brackets are present.**

**Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).**

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**NOTE: For Army and Air Force, impress current cathodic protection(ICCP) may be used. When ICCP is used include Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT).**

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**NOTE: For Navy, comply with CNIC Instructions 5090.1, 5090.2 and 5090.3 for areas outside of the U.S.**

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# PART 1 GENERAL

## 1.1 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the Contract payment schedules.

### 1.1.1 Measurement

The length of water lines will be determined by measuring along the centerlines of the various sizes of pipe provided. Pipe will be measured from center of fitting to center of fitting, from center of water main to center of fire hydrant and from center of water main to end of service connection. No deduction will be made for the space occupied by valves or

fittings.

1.1.2 Payment

Payment will be made for water lines at the Contract unit price per linear meter foot for the various types and sizes of water lines, and will be full compensation for all pipes, joints, specials, and fittings, complete and in place. Payment for fire hydrants, valves, and valve boxes will be made at the respective Contract unit price each for such items complete and in place. Payment will include providing all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

## 1.2 REFERENCES

**********

**NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.**

**Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.**

**References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.**

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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 HB-17 | (2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges |

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

| | |
|---|---|
| AREMA Eng Man | (2017) Manual for Railway Engineering |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B1.20.1 | (2013; R 2018) Pipe Threads, General Purpose (Inch) |
| ASME B1.20.3 | (1976; R 2013) Dryseal Pipe Threads (Inch) |

| | |
|---|---|
| ASME B16.1 | (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250 |
| ASME B16.3 | (2016) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.4 | (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.18 | (2018) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.26 | (2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B18.2.2 | (2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
| ASME B18.5.2.1M | (2006; R 2011) Metric Round Head Short Square Neck Bolts |
| ASME B18.5.2.2M | (1982; R 2010) Metric Round Head Square Neck Bolts |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA B300 | (2018) Hypochlorites |
| AWWA B301 | (2010) Liquid Chlorine |
| AWWA C104/A21.4 | (2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C105/A21.5 | (2018) Polyethylene Encasement for Ductile-Iron Pipe Systems |
| AWWA C110/A21.10 | (2012) Ductile-Iron and Gray-Iron Fittings for Water |
| AWWA C111/A21.11 | (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C115/A21.15 | (2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C151/A21.51 | (2017) Ductile-Iron Pipe, Centrifugally Cast |
| AWWA C153/A21.53 | (2019) Ductile-Iron Compact Fittings for Water Service |
| AWWA C200 | (2012) Steel Water Pipe - 6 In. (150 mm) and Larger |
| AWWA C203 | (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |

| | |
|---|---|
| AWWA C205 | (2018) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied |
| AWWA C206 | (2017) Field Welding of Steel Water Pipe |
| AWWA C207 | (2018) Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm) |
| AWWA C208 | (2017) Dimensions for Fabricated Steel Water Pipe Fittings |
| AWWA C209 | (2019) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines |
| AWWA C210 | (2007) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| AWWA C213 | (2015) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines |
| AWWA C300 | (2016) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C301 | (2014) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C303 | (2017) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type |
| AWWA C500 | (20019) Metal-Seated Gate Valves for Water Supply Service |
| AWWA C502 | (2018) Dry-Barrel Fire Hydrants |
| AWWA C503 | (2018) Wet-Barrel Fire Hydrants |
| AWWA C504 | (2015) Standard for Rubber-Seated Butterfly Valves |
| AWWA C508 | (2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS |
| AWWA C509 | (2015) Resilient-Seated Gate Valves for Water Supply Service |
| AWWA C511 | (2017) Reduced-Pressure Principle Backflow Prevention Assembly |
| AWWA C512 | (2015) Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service |
| AWWA C515 | (2015) Reduced-Wall, Resilient-Seated Gate |

| | |
|---|---|
| | Valves for Water Supply Service |
| AWWA C550 | (2017) Protective Interior Coatings for Valves and Hydrants |
| AWWA C600 | (2017) Installation of Ductile-Iron Mains and Their Appurtenances |
| AWWA C602 | (2011) Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger |
| AWWA C604 | (2011) Installation of Buried Steel Water Pipe—4 In. (100 mm) and Larger |
| AWWA C605 | (2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings |
| AWWA C606 | (2015) Grooved and Shouldered Joints |
| AWWA C651 | (2014) Standard for Disinfecting Water Mains |
| AWWA C655 | (2009) Field Dechlorination |
| AWWA C700 | (2015) Cold-Water Meters - Displacement Type, Metal Alloy Main Case |
| AWWA C701 | (2015) Cold-Water Meters - Turbine Type for Customer Service |
| AWWA C702 | (2019) Cold-Water Meters - Compound Type |
| AWWA C703 | (2019) Cold-Water Meters - Fire Service Type |
| AWWA C704 | (2019) Propeller-Type Meters for Waterworks Applications |
| AWWA C706 | (2010) Direct-Reading, Remote-Registration Systems for Cold-Water Meters |
| AWWA C707 | (2010; R 2016) Encoder-Type Remote-Registration Systems for Cold-Water Meters |
| AWWA C800 | (2014) Underground Service Line Valves and Fittings |
| AWWA C900 | (2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm) |
| AWWA C906 | (2015) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 65 In., (1,575 mm) for Water Distribution and Transmission |

| | |
|---|---|
| AWWA C909 | (2016) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger |
| AWWA C950 | (2020) Fiberglass Pressure Pipe |
| AWWA M6 | (2012) Water Meters - Selection, Installation, Testing, and Maintenance |
| AWWA M9 | (2008; Errata 2013) Manual: Concrete Pressure Pipe |
| AWWA M11 | (2016) Steel Pipe: A Guide for Design and Installation |
| AWWA M23 | (2020) Manual: PVC Pipe - Design and Installation - Third Edition |
| AWWA M41 | (2009; 3rd Ed) Ductile-Iron Pipe and Fittings |
| AWWA M45 | (2013; 3rd Ed) Fiberglass Pipe Design |
| AWWA M55 | (2006) PE Pipe - Design and Installation |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A47/A47M | (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A48/A48M | (2003; R 2016) Standard Specification for Gray Iron Castings |
| ASTM A53/A53M | (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A276/A276M | (2017) Standard Specification for Stainless Steel Bars and Shapes |
| ASTM A307 | (2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength |
| ASTM A536 | (1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings |
| ASTM A563 | (2015) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A563M | (2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric) |
| ASTM A746 | (2018) Standard Specification for Ductile Iron Gravity Sewer Pipe |
| ASTM B32 | (2020) Standard Specification for Solder |

| | |
|---|---|
| | Metal |
| ASTM B61 | (2015) Standard Specification for Steam or Valve Bronze Castings |
| ASTM B62 | (2017) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B88 | (2020) Standard Specification for Seamless Copper Water Tube |
| ASTM B88M | (2020) Standard Specification for Seamless Copper Water Tube (Metric) |
| ASTM B584 | (2014) Standard Specification for Copper Alloy Sand Castings for General Applications |
| ASTM C94/C94M | (2020) Standard Specification for Ready-Mixed Concrete |
| ASTM C150/C150M | (2020) Standard Specification for Portland Cement |
| ASTM C1433 | (2020) Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers |
| ASTM D1599 | (2014; E 2015) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings |
| ASTM D1784 | (2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D1785 | (2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D2241 | (2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D2466 | (2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D2467 | (2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D2774 | (2012) Underground Installation of Thermoplastic Pressure Piping |
| ASTM D2855 | (2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl |

| | |
|---|---|
| | Chloride) (PVC) Pipe and Fittings |
| ASTM D3035 | (2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| ASTM D3139 | (2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D3261 | (2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM D3839 | (2014) Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D4161 | (2014) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals |
| ASTM F402 | (2005; R 2012) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings |
| ASTM F477 | (2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F714 | (2013; R 2019) Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter |
| ASTM F1483 | (2017) Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe |
| ASTM F1674 | (2011) Standard Test Method for Joint Restraint Products for Use with PVC Pipe |
| ASTM F1962 | (2011) Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings |
| ASTM F2164 | (2018) Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure |
| ASTM F2620 | (2019) Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings |

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

| | |
|---|---|
| FCCCHR List | (continuously updated) List of Approved |

| | |
|---|---|
| | Backflow Prevention Assemblies |
| FCCCHR Manual | (10th Edition) Manual of Cross-Connection Control |

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

| | |
|---|---|
| MSS SP-80 | (2019) Bronze Gate, Globe, Angle and Check Valves |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 24 | (2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances |
| NFPA 1961 | (2013) Standard on Fire Hose |

NSF INTERNATIONAL (NSF)

| | |
|---|---|
| NSF 372 | (2016) Drinking Water System Components - Lead Content |
| NSF/ANSI 14 | (2019) Plastics Piping System Components and Related Materials |
| NSF/ANSI 61 | (2020) Drinking Water System Components - Health Effects |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-600-01 | (2016; with Change 5, 2020) Fire Protection Engineering for Facilities |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 246 | (2011; Reprint Jul 2020) UL Standard for Safety Hydrants for Fire-Protection Service |
| UL 262 | (2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service |
| UL 312 | (2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service |

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

| | |
|---|---|
| UBPPA UNI-PUB-08 | (2016) Tapping Guide for PVC Pressure Pipe |

## 1.3 DEFINITIONS

### 1.3.1 Water Transmission Mains

Water transmission mains include water piping having diameters greater than 350 mm 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

### 1.3.2 Water Mains

Water mains include water piping having diameters 100 through 350 mm 4 through 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

### 1.3.3 Water Service Lines

Water service lines include water piping from a water main to a building service at a point approximately 1.5 m 5 feet from building or the point indicated on the drawings, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

### 1.3.4 Additional Definitions

For additional definitions refer to the definitions in the applicable referenced standard.

## 1.4 SUBMITTALS

**********

**NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.**

**For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.**

**The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.**

**Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.**

**********

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are

[for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Connections; G[, [_____]]

SD-03 Product Data

Pipe, Fittings, Joints and Couplings; G[, [_____]]

Ball And Socket Joint; G[, [_____]]

Valves; G[, [_____]]

Valve Boxes; G[, [_____]]

Fire Hydrants; G[, [_____]]

Pipe Restraint; G[, [_____]]

Tapping Sleeves; G[, [_____]]

Corporation Stops; G[, [_____]]

Backflow Preventer; G[, [_____]]

Railroad Crossing Casing Pipe; G[, [_____]]

Precast Concrete Thrust Blocks; G[, [_____]]

Disinfection Procedures; G[, [_____]]

SD-06 Test Reports

Backflow Preventer Tests; G[, [_____]]

Bacteriological Samples; G[, [_____]]

Post-Construction Fusion Report; G[, [_____]]

Hydrostatic Sewer Test

Leakage Test

Hydrostatic Test

SD-07 Certificates

Pipe, Fittings, Joints and Couplings

Shop-Applied Lining [and Coating]

Lining

Lining for Fittings

Valves

Fire Hydrants

Backflow Prevention Training Certificate

Backflow Tester Certification

Fusion Technician Qualifications; G[, [_____]]

Turbine Type Meters

Propeller Type Meters

Displacement Type Meters

Compound Type Meters

Fire Service Type Meters

Backflow Certificate

SD-08 Manufacturer's Instructions

Ductile Iron Piping

PVC Piping

PVCO Piping

Polyethylene (PE) Pipe

Fiberglass Pipe, Fittings, Joints And Joint Materials

Concrete Pressure Pipe

Prestressed Concrete Pressure Pipe

Reinforced Concrete Cylinder Pipe

PVC Piping For Service Lines

Copper Pipe For Service Lines

## 1.5 QUALITY CONTROL

### 1.5.1 Regulatory Requirements

**********

**NOTE: Effective January 2014, the Safe Drinking Water Act (SDWA) requirements for "lead free" were updated. The amended definition of "lead free*" is 0.20 percent max lead for solder and flux; 0.25 percent max lead for products by weighted average; Multiple component products are calculated to address total wetted exposure based upon wetted surface area of each component and that component's lead content by percentage**

**NSF/ANSI 61 was revised in 2008 to establish Annex G for requirements when a 0.25 percent lead content requirement needed to be met since some states (California, Vermont, Maryland, and Louisiana) incorporated these requirements prior to the SDWA. In 2010 the lead content evaluation procedures of Annex G were moved to NSF/ANSI 372.**
**********

Comply with NSF/ANSI 14 or NSF/ANSI 61 and NSF 372 for materials for potable water systems; comply with lead content requirements for "lead-free" plumbing as defined by the U.S. Safe Drinking Water Act effective January 2014. Provide materials bearing the seal of the National Sanitation Foundation (NSF) for potable water service.

Comply with NFPA 24 for materials, installation, and testing of fire main piping and components.

1.5.2 Qualifications

1.5.2.1 Backflow Preventers

1.5.2.1.1 Backflow Preventer Certificate

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

[1.5.2.1.1.1 Backflow Tester Certificate

**********
**NOTE: Keep the bracketed text when a third party backflow tester is required by State or local regulations or desired as a project specific requirement.**
**********

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency.[ Tester must not be affiliated with any company participating in any other phase of this Contract.]

]1.5.2.1.1.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.5.2.2 Fusion Technician Qualifications

Submit a certificate from the manufacturer of the fusible pipe that shows the fusion technician is fully qualified to install fusible pipe of the types and sizes being used. Qualification must be current as of the actual date of fusion performance on the project.

## 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 and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, fire hydrants, and other accessories free of dirt and debris.

### 1.6.2 Handling

Handle pipe, fittings, valves, fire hydrants, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place other material, hooks, or pipe inside a pipe or fitting after the coating has been applied. Inspect the pipe for defects before installation. 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. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace defective material without additional expense to the Government. Store rubber gaskets, not immediately installed, under cover or out of direct sunlight.

Handle ductile iron pipe, fittings, and accessories in accordance with AWWA C600 and AWWA M41. Handle PVC and PVCO pipe, fittings, and accessories in accordance with AWWA C605. Handle PE pipe, fittings, and accessories in accordance with AWWA M55. [Handle fiberglass pipe, fittings, and accessories in accordance with AWWA M45. ][Handle steel pipe, fittings and accessories in accordance with AWWA C604.]

# PART 2 PRODUCTS

## 2.1 MATERIALS

**********

**NOTE: Specify fittings to withstand the hydrostatic test pressure specified in paragraphs TESTING PROCEDURE, and SPECIAL TESTING REQUIREMENTS FOR FIRE SERVICE.**

**Show the following information on the project drawings:**

**Location of all new pipelines, diameter of pipe, fittings and appurtenances including but not limited to valves, fire hydrants, yard hydrants, thrust blocks, restrained joints and details where necessary;**

**Location, size, and type of service of existing connecting, intersecting, and adjacent pipelines and other utilities;**

**Paved areas and railroads which pass over new**

**pipelines;**

**Connection of service line to water main, if different from that specified;**

**Where different materials are required, show the material, class or thickness of pipe and limits where class or thickness must be different for different sections of pipeline;**

**Bedding conditions;**

**Location of flanged joints, joints made with sleeve-type mechanical couplings, grooved and shouldered type joints, and insulating joints;**

**Size and shape of fire hydrant operating nut and cap nuts if nonstandard nuts are required; dimensions of threads (major diameter, minor diameter, pitch diameter, thread form, and number of threads per inch) on fire hydrant hose and pumper connections if nonstandard threads are required.**

**Refer to fire suppression Sections for items such as fire department connections and post indicator valves.**

**********

Provide all materials in accordance with AWWA C800 and as indicated herein. Provide valves and fittings with pressure ratings equivalent to the pressure ratings of the pipe.

### 2.1.1 Pipe, Fittings, Joints And Couplings

**********

**NOTE: Contaminated Areas:**

**AWWA Standards indicate that the selection of materials is critical for water pipe in locations where there is likelihood the pipe will be exposed to significant concentrations of pollutants composed of low-molecular-weight petroleum products or organic solvents or their vapors. Documented research has shown that pipe materials (such as polyethylene, polyvinyl chloride, and asbestos cement) and elastomers used in mechanically joined piping systems (such as those used in jointing gaskets and packing glands) may be subject to *permeation* by lower molecular weight organic solvents or petroleum products. If a water pipe must pass through such a contaminated area or an area subject to contamination, consult with the manufacturer regarding permeation of pipe walls, jointing materials, and so forth, *before* selecting materials for use in that area and refer to AWWA standards and AWWA, Water Research Foundation, report Number 91204 Impact of Hydrocarbons on PE/PVC Pipes and Gaskets.**

**Use tailoring options to select all piping materials for water transmission mains, water mains and water service lines which are suitable for use in the project.**

**Refer to the appropriate Unified Facilities Criteria, AWWA Standards and pipe manufacturer's information when evaluating suitability.**

**Pipe materials which are known to be unsuitable for particular local conditions (i.e., corrosion, deterioration, etc.) should not be deleted without consideration of protective coatings, where economically feasible.**

**********

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on [and rubber-gasketed bell-and-spigot] joints. Include information concerning gaskets with submittal for joints and couplings.

#### 2.1.1.1 Ductile-Iron Piping

**********

**NOTE: AWWA C151/A21.51, AWWA C115/A21.15 and AWWA C153/A21.53 include 80 mm through 1600 mm 3 in through 64 in ductile iron pipe or fittings. AWWA C110/A21.10 include 80 mm through 1200 mm 3 in through 48 in ductile iron fittings.**

**Insert the necessary Pressure Class/Thickness Class to meet project conditions, as determined from AWWA C151/A21.51, Tables for Pressure Class and Thickness Class.**

**Materials rated for a minimum of 1000 kPa 150 psi pipe will typically be specified for water systems. In some cases a higher classification may be required, comply with the minimum requirements in this specification and as required by the authority having jurisdiction.**

**Class 150 pipe is furnished with wall thickness suitable for installation with a standard design depth of cover and compacted backfill without blocks.**

**Cement-mortar linings with twice the standard thickness may be specified for ductile-iron pipe conveying unusually aggressive waters. Consideration will be given to the service life of the pipe and the potential for changes in treatment methods.**

**Polyethylene encasement will apply where soil conditions warrant, in accordance with AWWA C105/A21.5.**

**When pipe will be installed in contaminated ground conditions, select appropriate gasket material based**

**on type and concentration of contaminants. Refer to AWWA C600.**

**For Army and Air Force: Coordinate with the cathodic protection engineer before using polyethylene encasement.**

**********

2.1.1.1.1 Pipe and Fittings

**********

**NOTE: Ductile iron piping may be used for transmission.**

**********

Pipe, [except flanged pipe,] AWWA C151/A21.51, [Pressure Class [_____]] [Thickness Class [_____]].[ Flanged pipe, AWWA C115/A21.15.] Fittings, AWWA C110/A21.10 or AWWA C153/A21.53[; fittings with push-on joint ends are to meet the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design]. Provide fittings with pressure ratings equivalent to that of the pipe. Provide compatible pipe ends and fittings for the specified joints. Provide cement-mortar lining, AWWA C104/A21.4, [twice the] standard thickness on pipe and fittings.

2.1.1.1.2 Joints and Jointing Material

**********

**NOTE: Push-on joint or mechanical joint may be used except when the greater deflection afforded by the mechanical joint (as compared to the push-on joint) is considered necessary for all joints in the water system. See AWWA C600 for allowable deflection on each type of joint.**

**When mechanical joints, flanged joints, joints using sleeve-type mechanical couplings, grooved or shouldered type joints, and insulating joints are specified as exceptions to the basic jointing method, indicate their location(s) on the project drawings.**

**Show flanged joints, grooved joints, and shouldered joints on buried pipelines in valve pits or chambers on the drawings.**

**********

[Provide [push-on joints[ or mechanical joints]] for pipe and fittings [unless otherwise indicated].] [Provide mechanical joints where indicated.] [Provide flanged joints where indicated.] [Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated.] [Provide [grooved] [or] [shouldered] type joints where indicated.] [Provide insulating joints where indicated.] [Sleeve-type mechanical couplings in lieu of push-on joints are acceptable, subject to the limitations specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.] [Utilize [grooved] [or] [shouldered] type joints in lieu of [flanged joint or] push-on joint, except where joint is buried.]

a. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly as recommended in AWWA C111/A21.11.

b. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets as recommended in AWWA C111/A21.11.

c. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in Appendix A of AWWA C115/A21.15. Provide AWWA C115/A21.15 ductile iron flanges and conform to ASME B16.1, Class 125. [Provide ASTM A536 epoxy coated steel set screw flanges. Gasket and lubricants for set screw flanges, in accordance with mechanical-joint gaskets specified in AWWA C111/A21.11.]

d. Insulating Joints: Designed to prevent metal-to-metal contact at the joint between adjacent sections of piping. Provide flanged type joint with insulating gasket, insulating bolt sleeves, and insulating washers. Provide full face dielectric type gaskets, as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

e. Sleeve-Type Mechanical Coupled Joints: As specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

[ f. [Grooved] [and] [Shouldered] Type Joints: [Grooved] [and] [shouldered] pipe ends and couplings, AWWA C606. Joint dimension as specified in AWWA C606 for rigid joints [, joint dimensions as specified in AWWA C606 for flexible joints].

]2.1.1.2 Plastic Piping

**********

**NOTE: Do not use plastic pipe when it will be subject to temperature in excess of 37.8 degrees C 100 degrees F in installed usage or exposed to a source of heat from adjacent lines or equipment.**

**Do not use plastic piping in areas subject to potential spillage of aromatic hydrocarbons without consulting with the pipe manufacturer and referring to AWWA Standards. Aromatic hydrocarbons such as benzene and toluene will dissolve some types of plastic pipes.**

**When using plastic pipe in areas with contaminated soil or groundwater, consult with the manufacturer regarding permeation of pipe walls. When pipe is installed in contaminated soil or groundwater consult with the manufacturer regarding selection of appropriate gasket material based on type and concentration of contaminants and refer to AWWA C605.**

**********

2.1.1.2.1 PVC and PVCO Piping

2.1.1.2.1.1 PVC Piping

**********

**NOTE: AWWA C900 includes 100 mm through 1500 mm 4 in through 60 in PVC pipe and fabricated fittings. Use a minimum Pressure Class 150 (DR 27.55). See**

**Appendix A to AWWA C900. Do not include PVC water main pipe when pipe of greater strength than Pressure Class 305 is required.**

**AWWA C905 has been withdrawn. AWWA C900 includes PVC pressure pipe up to a diameter of 1500 mm 60 in.**

**Ductile iron pipe size = cast iron pipe size; abbreviation DIOD=DIPS=CIOD=CIPS.**

**********

AWWA C900 plain end or gasket bell end pipe meeting or exceeding ASTM D1784 cell class 12454, with a minimum Pressure Class [150 (DR27.5)], [165 (DR25)], [200 (DR21)], [235 (DR 18)], [250 (DR17)] [305 (DR 14)] with ductile iron outside diameter (DIOD).

2.1.1.2.1.2 PVCO Piping

**********

**NOTE: AWWA C909 includes 100 mm through 600 mm 4 in through 24 in PVCO pipe. Use a minimum Pressure Class 165. Do not include PVCO water main pipe when pipe of greater pressure class 305 is required.**

**********

AWWA C909, ASTM F1483 plain end or gasket bell end pipe meeting or exceeding ASTM D1784 cell class 12454, Pressure Class [165] [_____] PVCO pressure pipe, with ductile iron outside diameter (DIOD).

2.1.1.2.1.3 Fittings for PVC and PVCO Pipe

Gray iron or ductile iron fittings, AWWA C110/A21.10 with special fittings in accordance with Appendix B or AWWA C153/A21.53, with cement-mortar lining for fittings, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends are to conform to the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design compatible for use with PVC pipe as specified.

**********

**NOTE: Delete this option when using gray or ductile iron fittings.**

**********

[ Fittings from material that meets or exceeds ASTM D1784 cell class 12454 and is the same material as the pipe with elastomeric gaskets, in conformance with AWWA C605 and AWWA C900.

]2.1.1.2.1.4 Joints and Jointing Material for PVC and PVCO Piping

a. Push-on joints: Use jointing material in accordance with ASTM D3139 and AWWA C111/A21.11 between pipes, pipes and metal fittings, valves, and other accessories or compression-type joints/mechanical joints. Provide each joint connection with an elastomeric gasket compatible for the bell or coupling used. Gaskets for push-on joints for pipe, ASTM F477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints.

b. Mechanical Joint: Use mechanically coupled joints having a sleeve-type mechanical coupling, as specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS, as an optional jointing method for plain-end PVC pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling as specified for compression-type joints in ASTM D3139. Provide jointing material in accordance with AWWA C111/A21.11 between pipe and sleeve-type mechanical couplings.

2.1.1.2.2 PVC Piping for Service Lines

**********
**NOTE: Delete bracketed wording where piping will be installed at or exposed to temperatures below 4.5 degrees C 40 degrees F.**
**********

2.1.1.2.2.1 Pipe and Fittings

Provide ASTM D1784 cell class 12454 pipe and fittings of the same PVC material.

a. ASTM D1785, Schedule 40 with ASTM D2466 Schedule 40 or ASTM D2467 Schedule 80 fittings.

b. ASTM D2241 pipe and fittings with SDR as necessary to provide 1000 kPa 150 psi minimum pressure rating with ASTM D2466 Schedule 40 or ASTM D2467 Schedule 80 fittings.

2.1.1.2.2.2 Joints and Connections

Fittings may be joined by the solvent-cement method or threading.

2.1.1.2.2.3 Solvent Joining

Provide solvent joints in accordance with ASTM D2855.

2.1.1.2.3 Polyethylene (PE) Pipe

**********
**NOTE: Polyethylene (PE) pipe is subject to oxidative degradation by many variables including pH, the concentration and type of disinfectant, water temperature, installation procedure and conditions. Disinfectants like chlorine, chloramines, chlorine dioxide, ozone and others may create an Oxidation Reduction Potential (ORP) in PE Pipe. Review PPI Technical Note, LONG TERM RESISTANCE OF AWWA C906 POLYETHYLENE (PE) PIPE TO POTABLE WATER DISINFECTANTS, TN-44/2015, and compute service life for potable water systems based on project conditions.**

**AWWA C906 includes 100 mm through 1650 mm 4 in through 65 in PE pipe and fittings. Use PE4710, CC2 with a minimum Pressure Class 200 (DR 11). Select either CC2 or CC3 based on computed service life; see TN-44/2015. Use AWWA M55 and** https://plasticpipe.org/pdf/ppi-position-paper-hdpe-potable-water-pc-pipe-si

**********

AWWA C906, ASTM D3035, PE4710, material designation code[CC2] [CC3] with a minimum Pressure Class [200 (DR11)] [250 (DR 9)] [335 (DR 7)] with ductile iron outside diameter (DIOD).

2.1.1.2.3.1 Fittings For PE Pipe

AWWA C906, AWWA M55, ASTM D3035, molded and manufactured to comply with ASTM F714.

2.1.1.2.3.2 Joints and Jointing Materials

Mechanical Joint: AWWA C111/A21.11 DIOD Mechanical joint adapter and gaskets for mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories.

2.1.1.3 Fiberglass Pipe, Fittings, Joints and Joint Materials

**********

**NOTE: AWWA C950 includes 25 mm through 4000 mm 1 in through 156 in fiberglass pipe. Both glass-fiber-reinforced thermosetting-resin pipe (RTRP; Grades 1 and 2) and glass-fiber-reinforced polymer-mortar pipe (RPMP; Grades 3 and 4) are included in this specification.**

**Fiberglass pipe can be used for potable water systems. Some advantages of fiberglass include durability, corrosion resistance, and eliminating the need for interior or exterior lining or coatings. However, special attention should be made to bedding and pipe support requirements. Pipe leaks are difficult to locate due to the manufacturing process. Refer to AWWA M45 for design considerations.**

**Types refer to the method of manufacturing. Type I is filament bound. Type II is centrifugally cast. Grade is determined by construction (glass-fiber-reinforced or glass-fiber-reinforced mortar) and bonding materials (epoxy or polyester). Grade 1 is glass-fiber reinforced epoxy (RTRP epoxy). Grade 2 is glass-fiber-reinforced polyester (RTRP polyester). Grade 3 is glass-fiber reinforced epoxy mortar (RPMP epoxy). Grade 4 is glass-fiber reinforced polyester mortar (RPMP polyester). Liner classification is determined by whether or not a liner is used and, if used, what type. Liner A is no liner. Liner B is a thermoplastic liner. Liner C is a reinforced thermoset polyester liner. Liner D is a nonreinforced thermoset polyester liner. Liner E is a reinforced thermoset epoxy liner. Liner F is a nonreinforced thermoset epoxy liner.**

**********

AWWA C950, Type [I] [II], Pressure Class 150 with a minimum pipe stiffness of 248 kPa 36 psi, Grade [1] [2] [3] [4], Liner [A] [B] [C] [D] [E] [F].

a. Provide pipe with a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test is to meet the requirements of ASTM D1599.

b. Provide fittings and specials compatible with the pipe supplied. Filament wound or molded fittings up to 150 mm 6 inches are to conform to AWWA C950. Provide cement-mortar lined iron fittings in accordance with AWWA C104/A21.4 and conforming to AWWA C110/A21.10 and AWWA C111/A21.11.[ Provide fittings and specials required for closures, curves, bends, branches and connections to valves, pipe, or structures consistent with the details furnished by the manufacturer and to AWWA C300, AWWA C301, or AWWA C303.] Provide fittings that will withstand working and testing pressures specified for the pipe.

c. Provide bell and spigot joints with elastomeric gaskets in accordance with ASTM D4161. Provide mechanically coupled joints with elastomeric gasket, flanged, threaded and bonded coupling, or bell and spigot with compatible adhesive, provided they are compatible with the pipe and convey water at the pressure and temperature of the pipe.

2.1.1.4 [Concrete Pressure Pipe] [Prestressed Concrete Pressure Pipe (PCCP)] [and] [Reinforced Concrete Cylinder Pipe (RCCP)]

**********

**NOTE: AWWA C300 includes Reinforced Concrete Cylinder Pipe (RCCP), steel-cylinder type, in sizes 760 mm to 3660 mm 30 in to 144 in.**

**AWWA C301 includes prestressed concrete pressure pipe (PCCP) manufactured with a steel cylinder and wire reinforcement in sizes 410 mm to 3660 mm 16 in to 144 in.**

**AWWA C303 includes concrete pressure pipe, reinforced with a steel cylinder that is helically wrapped with mild steel bar reinforcement, in sizes 250 mm to 1830 mm 10 in to 72 in.**

**Verify pipe sizes required. In the Pacific Coast, Rocky Mountain, and Southwest States, concrete pipe is available in 250 mm 10 inch diameter and larger, pretensioned type only in sizes less than 400 mm 16 inches. In other parts of the country, concrete pipe may not be available in sizes below 400 mm 16 inch diameter.**

**For projects in the Pacific Coast, Rocky Mountain, and Southwest states where only piping of less than 400 mm 16 inch size is involved, delete requirements which are referenced to AWWA C300 and AWWA C301.**

**Use 1000 kPa 150 psi except when a higher pressure rating, up to 1380 kPa 200 psi is necessary.**

**AWWA recommends a minimum of 1.8 m 6 feet of earth cover above raw water transmission mains for ordinary conditions. Delete this information when depth is indicated on the drawings.**

**********

2.1.1.4.1 Piping, Fittings, Joints and Jointing Material

[Prestressed concrete pressure pipe (PCCP), AWWA C301.][Reinforced Concrete Cylinder Pipe (RCCP), steel-cylinder type AWWA C300.][Concrete pressure pipe, reinforced with a steel cylinder that is helically wrapped with mild steel bar reinforcement AWWA C303.]

**********
**NOTE: AWWA C301 pipe must be designed in accordance with ANSI/AWWA C304. AWWA C300 and AWWA 303 pipe must be designed in accordance with AWWA M9.**
**********

[ Pipe has been designed for the following minimum conditions:

a. Pressure rating - [_____] kPa psi

b. Earth cover - [_____] m feet

c. Water hammer - [_____] percent of pressure rating

d. Live load - [AASHTO H 20 truck loading] [_____]
]

**********
**NOTE: In those parts of the United States where concrete pipe will be carrying sulfate-bearing waters or where concrete pipe will be buried in soils containing sulfates specify concrete pipe manufactured using sulfate-resisting cement. Specify Type II (moderate sulfate resisting) cement when water-soluble sulfates (as SO4) in the soil are in the range of 0.1 and 0.2 percent and, for water, are in the range of 150 to 1000 parts per million. Specify Type V (sulfate resisting) cement when soils contain in excess of 0.2 percent water-soluble sulfate and water samples contain in excess of 1000 parts per million sulfate. The availability of pipe made using Type V cement should be verified. In areas where reactive aggregates are known to occur, specify low alkali cement.**
**********

Provide fittings that match the same specification as that used for the pipe and are designed as specified for the pipe. [Utilize [Type II] [Type V] [low alkali cement] pipe and fittings that match the requirements of ASTM C150/C150M.] Include factory inscribed pressure rating identification markings for pipe and fittings.

Jointing Material: Provide rubber-gasket joints compatible with the type using a bell and spigot joint design of steel.

2.1.1.5 Steel Piping

**********
**NOTE: AWWA C200 includes steel water pipe, 150 mm 6 inch in nominal diameter and larger.**

**Verify availability of pipe sizes required. In the**

**Pacific Coast, Rocky Mountain, and Southwest States, steel pipe is available in 125 mm 5 inch diameter and larger. In other parts of the country, steel pipe may not be available in sizes less than 600 mm 24 inch diameter since the major producer in those areas has discontinued production of steel water pipe.**

**Delete coatings not allowed for the project. AWWA M11 in the chapter on protective coatings contains information on the relative merits of cement-mortar and coal-tar enamel coatings. See Foreword to AWWA C210 for information on coal-tar epoxy coating.**

**Delete requirements for lining of aboveground piping when aboveground piping is not included in project. When included, pipe and fittings for aboveground lines will be furnished with lining only. Exterior protection for aboveground piping should be specified in Section 09 90 00 PAINTS AND COATINGS.**

**Use of steel pipe is restricted to water supply lines only where future tapping is not anticipated. Use for sizes 80 mm 3 inches in diameter and larger.**

**********

2.1.1.5.1 Pipe and Fittings

Pipe, AWWA C200. Fittings, AWWA C208 and AWWA C200, with reference to the requirements specified therein for "Special Sections." Provide cement-mortar lining and [cement-mortar] [coal-tar enamel] [coal-tar epoxy] coating on pipe and fittings [for underground lines] in accordance with applicable AWWA standard. Provide cement-mortar lining on [pipe and fittings for aboveground lines.] Utilize pipe ends and fittings compatible for the joints and jointing materials used.

a. Utilize welded or seamless pipe with plain, or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Provide bell-and-spigot ends for sizes less than 150 mm 6 inches diameter in accordance with AWWA C200.

b. Provide fittings and specials made of the same material as the pipe. Use specials and fittings made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Match the thickness rating of pipe fittings and specials to the thickness specified and the pressure rating calculated for the pipe with which they are used. Provide identical protective materials for fittings and specials as specified for the pipe. Hand wrap, line, or coat specials and fittings that cannot be mechanically wrapped, lined, or coated using the same material used for the pipe with the same number of applications of each material, smoothly applied.

**********

**NOTE: Use 1000 kPa 150 psi except when a higher pressure rating, up to 1400 kPa 200 psi is necessary.**

**A minimum earth cover of 1.5 m 5 feet is recommended**

**for ordinary conditions. Delete this information when depth is indicated on the drawings.**
**********

2.1.1.5.2 Wall Thickness for Pipe and Fittings

**********
**NOTE: Insert minimum acceptable thickness and yield strength in the blanks.**
**********

The minimum metal thickness for steel pipe wall is [_____] mm inches, based on steel having a yield strength of [_____] kPa psi. Pipe has been designed for the following minimum conditions:

| | |
|---|---|
| Pressure rating | [_____] kPa psi |
| [Earth cover] | [[_____] m feet] |
| Water hammer | 40 percent of pressure rating |
| Live load | AASHTO H 20 truck loading |
| Allowable deflection | 2 percent of nominal pipe diameter |

**********
**NOTE: In the calculation of wall thickness for steel water main pipe, base the value of E' (modulus of soil reaction) on realistic expectations of sidefill compaction rather than theoretical ones.**

**Calculate pipe wall thickness on the basis of an allowable fiber stress in the steel equal to 50 percent of the minimum yield strength of the steel used in the manufacture of the pipe. Design procedure in accordance with the methods given in AWWA M11, Chapter 4, "Determination of Pipe Wall Thickness," Chapter 5, "Water Hammer and Pressure Surge," and Chapter 6, "External Loads."**
**********

Ensure that the wall thickness of fittings is equal to or greater than that required for the pipe. Reinforce fittings in accordance with methods given in AWWA M11, Chapter 13, "Supplementary Design Data and Details" when necessary to meet the pressure test requirements.

2.1.1.5.3 Joints and Jointing Material

**********
**NOTE: AWWA M11, Chapter 8, "Pipe Joints," contains detailed information on the various field jointing methods for steel piping.**

**Delete requirements for and references to welded joints when not allowed for the project. Welded joints should not be allowed for piping less than 600 mm 24 inches in diameter, except when pipeline**

**is cement-mortar lined in place after installation.**
**********

Provide rubber-gasketed pipe and fitting bell-and-spigot joints[, welded joints,] or the mechanically coupled type using a sleeve-type mechanical coupling[, unless otherwise specified].[ Provide flanged joints where indicated.][ Provide mechanically coupled type joints using a sleeve type mechanical coupling where indicated.][ Provide [grooved][ or ][shouldered] type where indicated.][ Provide insulating joints where indicated.][ It is acceptable to use [grooved][ or ][shouldered] type joints in lieu of flanged joints.]

a. Rubber-Gasketed Bell-and-Spigot Joints: Provide joints and pipe ends in accordance with the pipe manufacturer's standard for this type of joint, except that the joint is to also meet the requirements specified for rubber-gasketed joints and rubber gaskets in AWWA C200.

**********
**NOTE: Delete requirements for and references to welded joints when not allowed for the project. Welded joints should not be allowed for piping less than 600 mm 24 inches in diameter, except when pipeline is cement mortar lined in place after installation.**
**********

b. Welded Joints: Provide electrodes of the quality specified in AWWA C206.

c. Sleeve-Type Mechanical Coupled Joints: As specified in paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

d. [Grooved] [and] [Shouldered] Type Joints: [Provide pipe ends grooved by roll grooving or with welded-on adapters and cut grooves. Provide grooves made by roll grooving with dimensions as recommended by the coupling manufacturer. Match dimensions for cut grooves in adapters to AWWA C606. ]Couplings [and shouldered pipe ends], AWWA C606. Match the joint dimensions as specified in AWWA C606 for rigid joint[ , joint dimensions as specified in AWWA C606 for flexible joints].

**********
**NOTE: Use Class D flanges when maximum working pressure is 1200 kPa 175 psi or less in lines 300 mm 12 inches in diameter and smaller, or 1000 kPa 150 psi or less in lines larger than 300 mm 12 inches in diameter. For higher working pressures, use Class E flanges.**
**********

e. Flanged Joints: Provide pipe ends with steel flanges, AWWA C207; [Class D] [Class E]. Bolts and nuts for flanged connections, AWWA C207. Rubber gaskets, AWWA C207; asbestos gaskets are not allowed.

f. Insulating Joints: Designed to prevent metal-to-metal contact at the joint between adjacent sections of piping. Provide flange type joints with insulating gasket, insulating bolt sleeves, and

insulating washers. Provide dielectric type gaskets, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts as recommended in the Appendix to AWWA C115/A21.15.

2.1.1.5.4 Lining [and Coating]:

**********
**NOTE: Under ordinary conditions, steel water pipe and fittings in the sizes included in water systems covered by this specification are furnished with factory applied cement-mortar lining. In-place cement-mortar lining for new construction is required only under unusual conditions.**

**Delete bracketed text when lining is factory applied.**
**********

a. Cement-Mortar Lining: AWWA C205, shop-applied. Materials for cement mortar lining in place as specified in AWWA C602.

b. Cement-Mortar Coating: AWWA C205, shop-applied.

**********
**NOTE: Use coal-tar enamel coating with double felt wraps instead of single layer of felt wrap where trench soil is classified as Group IV, Unusually Corrosive (as defined in AWWA M11, Chapter 10, "Principles of Corrosion and Corrosion Control"); or where electrical resistivity of soil has been measured at less than 2,000 ohms/cc.**
**********

c. Coal-Tar Enamel Coating: Except as otherwise specified, prepare, prime, and coat piping with hot-applied coal-tar enamel and a bonded [single layer of felt wrap in accordance with AWWA C203] [double felt wraps in accordance with AWWA C203]. Provide shop applied coating of fibrous-glass mat felt material as specified in Section 10 of AWWA C203. Do not use asbestos felt.

d. Coal-Tar Epoxy Coating: Clean, prime, and topcoat piping with coal-tar epoxy coating system in accordance with AWWA C210. Shop-apply coating.

[2.1.1.5.5 Steel Piping for Service Lines

Pipe, ASTM A53/A53M, Standard Weight, zinc-coated. Fittings, ASME B16.4, Class 125, zinc coated; or ASME B16.3, Class 150, zinc coated, threaded.
[
**********
**NOTE: Protective materials for galvanized pipe less than 80 mm 3 inches in diameter will be required only where the pipe is within the zone of influence of adjacent buried cathodic protection systems.**
**********

Mechanically apply, in a factory or plant especially equipped for the purpose, the protective materials for steel pipe. Unless otherwise indicated, the materials consist of [one of the following] [the following]

for the indicated pipe material and size:

Clean pipe and fittings less than 80 mm 3 inches in diameter of foreign material by wire brushing and solvent cleaning, and apply one coat of coal-tar primer and two coats of coal-tar enamel matching the requirements of AWWA C203; protect threaded ends of pipe and fittings prior to coating.

]]2.1.1.6 Copper Pipe For Service Lines

2.1.1.6.1 Copper Tubing and Associated Fittings

Provide ASTM B88M ASTM B88, Type K copper tubing. Provide AWWA C800 fittings. AWWA C800 includes ASME B1.20.3, ASME B1.20.1, ASME B16.18 solder-type joint fittings.

[2.1.1.7 Trenchless Piping

**********

**NOTE: Evaluate site specific conditions along with material properties, material availability, installation procedures, cost and a variety of other factors to determine if trenchless piping is suitable for a particular job and choose the best procedure for a particular job.**

**Where only one piping option is available to the contractor a justification and approval must be approved prior to project advertisement in accordance with FAR 6.3 Other Than Full and Open Competition.**

**Butt fused pipe is subject to rapid crack propagation (RCP) by many variables including pipe damage during construction and air in the water line. When RCP occurs in bell & spigot (B&S) pipe, the length of the failure is limited to the length of the pipe. Once pipes are fused together RCP can pass through the fused joints and may result in lengthy pipe failures. Ensuring air release valves are used where air may be trapped and pipe is adequately protected from damage during construction are two ways to help avoid RCP.**

**When butt fusion is used as a jointing method, require properly qualified fusion technicians.**

**********

2.1.1.7.1 PVC Pipe

AWWA C900 plain end meeting or exceeding ASTM D1784 cell class 12454, plastic formulated for fusing with a minimum Pressure Class [235 (DR18)] [305 (DR 14)] with ductile iron outside diameter (DIOD).

2.1.1.7.1.1 Butt Fusion

Use butt fusion jointing method for plain-end PVC pipe. Comply with AWWA C900 and AWWA C605 for butt fusion joints. No offset in alignment between adjacent pipe joints of fittings is permitted. The fusion technician must be qualified by the fusion equipment manufacturer to

thermally butt-fuse the size of pipe used at the time of fusion performance. Each joint must be datalogged, recorded and submitted for review and meet the requirements of ASTM F1674.

2.1.1.7.2 PE Pipe

Provide in accordance with AWWA C906, ASTM D3035, ASTM F1962, PE4710, with material designation code [CC2] [CC3] with a minimum Pressure Class of [250 (DR 9)] [335 (DR 7)]with ductile iron outside diameter (DIOD).

2.1.1.7.2.1 Butt Fusion Fittings

Use AWWA C906, AWWA M55, ASTM D3261 ANSI Class 250 or as necessary to provide minimum pressure rating.

2.1.1.7.2.2 Butt Fusion

Use butt fusion jointing method for plain-end PE pipe. Comply with AWWA C906 and ASTM F2620 for Butt Fusion joints. No offset in alignment between adjacent pipe joints of fittings is permitted. The fusion technician must be qualified by the fusion equipment manufacturer to thermally butt-fuse the size of pipe used at the time of fusion performance. Each joint must be datalogged, recorded and submitted for review.

2.1.1.7.3 Ductile Iron Ball and Socket Joint

Use centrifugally cast ductile iron pipe meeting the applicable requirements of AWWA C151/A21.51 [Pressure Class [_____]] [Thickness Class [_____]] and in accordance with pipe manufacturer's instructions. The separately cast Ductile-Iron ball, bell and retainer ring conforms with the requirements of ASTM A536, Grade 70-50-05. Critical surfaces of the ball, bell socket and retainer ring are machined.

2.1.1.7.3.1 Fittings

Ductile iron bell, ball and retainer ring meeting the applicable requirements of AWWA C110/A21.10and in accordance with pipe manufacturer's instructions for ball and socket joint pipe.

][2.1.1.8 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad is to conform to the specifications for pipelines conveying nonflammable substances in AREMA Eng Man. Provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron railroad crossing casing pipe is to conform to and have strength computed in accordance with ASTM A746.

]2.1.2 Valves

**********

**NOTE: Select the following requirement when a protective interior coating is considered necessary for corrosion protection. A protective interior coating is required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion for water having a pH range from 4 to 9.**

**********

[ Provide a protective interior coating in accordance with AWWA C550.

]2.1.2.1 Gate Valves 80 mm 3 Inch Size and Larger [on Buried Piping]

**********

**NOTE: AWWA C500 includes nonrising-stem (NRS) gate valves, 80 mm through 1200 mm 3 in through 48 in, and outside screw and yoke (OS&Y) rising-stem gate valves, 80 mm through 600 mm 3 in through 24 in. AWWA C509 includes sizes 75 mm through 900 mm 3 in through 36 in. AWWA C515 includes NRS gate valves, 75 mm through 1350 mm 3 in through 54 in, and OS&Y gate valves, 75 mm through 400 mm 3 in through 16 in.**

**For UL 262 gate valves in systems on which pipe is pressure rated at 1000 kPa 150 psi, use a working pressure of 1200 kPa 175 psi for valve sizes 300 mm 12 inches and smaller, and 1000 kPa 150 psi for valves larger than 300 mm 12 inches.**

**Indicator should be required for geared gate valves where valve is in location where gate position cannot readily be seen.**

**********

AWWA C500, AWWA C509, AWWA C515, or UL 262 and:

a. AWWA C500: nonrising stem type with double-disc gate and mechanical-joint ends or push-on joint ends compatible for the adjoining pipe

b. AWWA C509 or AWWA C515: nonrising stem type with mechanical-joint ends[ or resilient-seated gate valves 80 to 300 mm 3 to 12 inches in size]

c. UL 262: inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 1200[_____] kPa 175[_____] psi, and have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined.

Match materials for UL 262 gate valves to the reference standards specified in AWWA C500. Gate valves open by counterclockwise rotation of the valve stem. Stuffing boxes have 0-ring stem seals[, except for those valves for which gearing is specified, in which case use conventional packing in place of 0-ring seal]. Stuffing boxes are bolted and constructed so as to permit easy removal of parts for repair.[ Use gate valves with special ends for connection to[ cement piping or] sleeve-type mechanical coupling in lieu of mechanical-joint ends and push-on joint ends.] Provide valve ends and gaskets for connection to[ cement piping or to] sleeve-type mechanical couplings that conform to the requirements specified [respectively ]for the [joint or ]coupling. [Provide AWWA C500 [_____] mm inch gate valves with gearing[ and indicator]. ][Where an indicator post are shown, provide an indicator post flange for AWWA C500, AWWA C509, or AWWA C515 gate valves conforming to the requirements of UL 262. ][Provide AWWA C500 [_____] mm inch gate valves with bypasses.] [Provide gate valves [on [_____] mm inch service lines] with threaded ends. ][Gate valves[ on [_____] mm inch service lines] have ends

compatible with joining to the pipe used;[ push-on joint ends or mechanical-joint ends for joining to ductile-iron pipe][ or ][ push-on joint ends or mechanical-joint ends for joining to PVC water main pipe]; with AWWA C111/A21.11 gaskets and pipe ends.] Provide all valves from one manufacturer.

2.1.2.2 Gate Valves 75 mm 3 Inch Size and Larger [in Valve Pit(s)] [and] [Aboveground Locations]

**********

**NOTE: For ordinary conditions, outside-screw-and-yoke rising-stem type is preferred to nonrising stem/inside-screw type.**

**For ordinary conditions, the double-disc or split-wedge type gate is preferred to the solid-wedge/solid or one-piece gate.**

**For UL 262 gate valves in system on which pipe is pressure rated at 1000 kPa 150 psi, use a working pressure of 1200 kPa 175 psi for valve sizes 300 mm 12 inches and smaller, and 1000 kPa 150 psi for gate valves larger than 300 mm 12 inches.**

**Indicator is required for geared valves where valve is in location where gate position cannot readily be seen.**

**********

AWWA C500, AWWA C509, AWWA C515, or UL 262 and:

a. AWWA C500: [outside-screw-and-yoke rising-stem][nonrising stem] type with [double-disc][solid-wedge] gates and flanged ends

b. AWWA C509 or AWWA C515: [outside-screw-and-yoke rising-stem][nonrising stem] type with flanged ends

c. UL 262: [outside-screw-and-yoke][inside-screw] type, with [double-disc or split-wedge][solid or one-piece] type gate and flanged ends, and designed for a hydraulic working pressure of 1200[_____] kPa 175[_____] psi

Match materials for UL 262 gate valves to the reference standards specified in AWWA C500. [[[_____] mm inch ]Gate valves are nonrising stem type or inside-screw type [where indicated]. ] [[[_____] mm inch size ]Gate valves are solid-wedge gates or solid or one-piece type gates[ where indicated]. ]Provide gate valves with handwheels that open by counterclockwise rotation of the valve stem. Bolt and construct stuffing boxes so as to permit easy removal of parts for repair. In lieu of flanged ends, provide valves with [grooved][ or ][shouldered] ends compatible with [grooved][ or ][shouldered] type joints, as specified in the paragraph DUCTILE-IRON PIPING.[ Provide valves [_____] mm inch size with gearing[ and indicator], AWWA C500 or AWWA C509.][ Provide [_____] mm inch size valve with bypasses, AWWA C500.] Provide all valves from one manufacturer.

2.1.2.3 Check Valves

**********

**NOTE: Select the following requirement when a protective interior coating is considered necessary for corrosion protection. A protective interior coating is required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion for water having a pH range from 4 to 9.**

**********

[Provide a protective interior coating in accordance with AWWA C550. ]Swing-check type, AWWA C508 or UL 312 and:

a. AWWA C508: Iron or steel body and cover and flanged ends

b. UL 312: Cast iron or steel body and cover, flanged ends, and designed for a minimum working pressure of [1000][_____] kPa [150] [_____] psi.

Materials for UL 312 check valves are to match the reference standards specified in AWWA C508. Provide check valves with a clear port opening.[ Provide [spring-loaded][weight-loaded] check valves[ where indicated].][ Class 125 flanges are to match ASME B16.1.] Provide [grooved][ or ][shouldered] ends [grooved][ or ][shouldered] type joints, as specified in the paragraph DUCTILE-IRON PIPING in lieu of flanged ends. Provide all check valves from one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

**********

**NOTE: Although butterfly valves are acceptable for use in 75 mm through 1,800 mm 3 in through 72 in sizes, they are typically used in sizes greater than 300 mm 12 inches.**

**********

Provide rubber-seated butterfly valves and wafer type valves that match the performance requirements of AWWA C504. Wafer type valves not meeting laying length requirements are acceptable if supplied and installed with a spacer, providing the specified laying length. Meet all tests required by AWWA C504. Flanged-end valves are required in a pit. Provide a union or sleeve-type coupling in the pit to permit removal. Direct-bury mechanical-end valves 80 through 250 mm 3 through 10 inches in diameter. Provide a valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Provide valve operators that restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Maintain a constant downstream pressure regardless of fluctuations in demand. Using pressure reducing valves capable of providing [_____] kPa psi operating pressure on the inlet side, with outlet pressure set for [_____] kPa psi. Provide hydraulically-operated, pilot controlled, globe or angle type valves that are capable of being actuated either by diaphragm or piston. Provide diaphragm-operated, adjustable, spring-loaded type pilot controls made of lead-free bronze with stainless steel working parts, designed to permit flow when controlling pressure exceeds the spring setting. Construct the bodies of bronze, cast iron or cast steel with lead-free bronze trim; the valve stem of stainless steel;

the seat of lead-free bronze; and the valve discs and diaphragms of synthetic rubber. Provide [threaded][flanged] ends.

2.1.2.6 Air Release, Air/Vacuum, and Combination Air Valves

Provide AWWA C512 air release [, air vacuum] and combination air valves that release air and prevent the formation of a vacuum. Provide valves with an iron body, lead-free bronze trim and stainless steel float that automatically releases air when the lines are being filled with water and admits air into the line when water is being withdrawn in excess of the inflow.

2.1.2.7 Water Service Valves

2.1.2.7.1 Gate Valves Smaller than 75 mm 3 Inch in Size [on Buried Piping]

Gate valves smaller than 75 mm 3 inch size [on Buried Piping] MSS SP-80, Class 150, solid wedge, nonrising stem, with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.7.2 Gate Valves Smaller Than 75 mm 3 Inch Size in Valve Pits

MSS SP-80, Class 150, solid wedge, inside screw, rising stem. Provide valves with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.7.3 Check Valves Smaller than 50 mm 2 Inch in Size

Provide check valves with a minimum working pressure of 1000 kPa 150 psi or as indicated with a clear waterway equal to the full nominal diameter of the valve. Valves open to permit flow when inlet pressure is greater than the discharge pressure, and close tightly to prevent return flow when discharge pressure exceeds inlet pressure. Cast the size of the valve, working pressure, manufacturer's name, initials, or trademark on the body of each valve.

Provide valves for screwed fittings, made of lead-free bronze and in conformance with MSS SP-80, Class 150, Types 3 and 4 compatible for the application.

2.1.2.8 Valve Boxes

Provide a valve box for each gate valve[ on buried piping][, except where indicator post is shown]. Construct adjustable valve boxes manufactured from [cast iron][ or ][precast concrete] of a size compatible for the valve on which it is used.[ Provide cast iron valve boxes with a minimum cover and wall thickness of 5 mm 3/16 inch and conforming to ASTM A48/A48M, Class 35B. Coat the cast-iron box with a heavy coat of bituminous paint.][ Provide a round head.] Cast the word "WATER" on the lid. The minimum diameter of the shaft of the box is [135 mm5 1/4 inches][as indicated]. Provide [ASTM C1433] precast concrete valve box.[ Provide precast concrete boxes installed in locations subjected to vehicular traffic[ to withstand AASHTO load designation as outlined in AASHTO HB-17 ][_____].] [Manufacture precast concrete boxes in accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.]

2.1.2.9 Valve Pits

Construct the valve pits at locations indicated or as required above and in accordance with the details shown.

2.1.3 Blowoff Valve Assemblies

**********
**NOTE: Show locations of blowoff valve assemblies on drawings and details.**
**********

Provide blowoff valve assemblies complete with all pipe, fittings, valve, valve box, riser box and lid, riser extension, discharge fitting and other materials required to connect to the water main. Provide blow off valve assemblies 100 mm 4 inches or larger with AWWA C110/A21.10 or AWWA C153/A21.53 fittings.[ Provide a blowoff valve assembly with a removable riser.]

2.1.4 Fire Hydrants And Hose Houses

2.1.4.1 Fire Hydrants

**********
**NOTE: For projects in all parts of the United States except California and Hawaii, delete requirements for and references to wet-barrel type fire hydrants. For projects in areas not subject to freezing temperatures ascertain from the local fire department serving the base or station (1) whether wet-barrel type fire hydrants are desired exclusively, (2) whether dry-barrel type fire hydrants are necessary (in areas having freezing temperatures), or (3) whether either type fire hydrant is acceptable. Only dry-barrel type fire hydrants have fire hydrant stem. For hose gate valves in dry-barrel fire hydrants, use UL 246 as the standard reference.**
**********

Provide fire hydrants where indicated. Paint fire hydrants with at least one coat of primer and two coats of enamel paint. Paint barrel and bonnet colors in accordance with UFC 3-600-01. Stencil fire hydrant number and main size on the fire hydrant barrel using black stencil paint.

**********
**NOTE: When a protective interior coating is considered necessary for corrosion protection include the bracketed option below.**
**********

[ Provide a protective epoxy interior coating conforming to AWWA C550 on those portions of the fire hydrant continuously in contact with sea water or salt water.
]

**********
**NOTE: Use "as specified" wording under the following circumstances: (1) project at existing station where fire hydrants with standard threads and nuts**

**are in use; (2) project at existing station where conversion to fire hydrants with standard threads and nuts is in progress; (3) project at new location where local fire department connects to fire hydrants with standard threads and nuts.**

**Indicate appropriate standard under the following circumstances: (1) project at existing station where fire hydrants with nonstandard threads and nuts are in use; (2) project at new location where local fire department connects to fire hydrants with nonstandard threads and nuts.**

**********

2.1.4.1.1 [Dry-Barrel Type] [and] [Wet-Barrel Type] Fire Hydrants

Provide [Dry-barrel type fire hydrants, AWWA C502 or UL 246, "Base Valve" with 150 mm 6 inch inlet, 135 mm 5 1/4 inch valve opening, one [115] [_____] mm [4 1/2] [_____] inch pumper connection, and two 65 mm 2 1/2 inch hose connections.] Provide [Wet-barrel type fire hydrants, AWWA C503 or UL 246, "Wet Barrel" with 150 mm 6 inch inlet, one [115][_____] mm [4 1/2] [_____] inch pumper connection, and two 65 mm 2 1/2 inch hose connections. Individually valve pumper connection and hose connections with independent nozzle gate valves.]

Provide [mechanical-joint or push-on joint end] [mechanical-joint end only] inlet [, except where flanged end is indicated]; with end matching requirements [as specified in [AWWA C502] [or] [AWWA C503] or UL 246] [_____] for size and shape of operating nut, cap nuts, and threads on hose and pumper connections. Provide fire hydrants with [frangible sections as mentioned in AWWA C502] [breakable features as mentioned in AWWA C503]. Provide fire hydrant with special couplings joining [upper and lower sections of fire hydrant barrel] [and upper and lower sections of fire hydrant stem] that break from a force imposed by a moving vehicle.

2.1.4.1.2 Flush-Type Fire Hydrants

**********

**NOTE: Use "as specified" wording under the following circumstances: (1) project at existing station where fire hydrants with standard threads and nuts are in use; (2) project at existing station where conversion to fire hydrants with standard threads and nuts is in progress; (3) project at new location where local fire department connects to fire hydrants with standard threads and nuts.**

**Indicate appropriate standard under the following circumstances: (1) project at existing station where fire hydrants with nonstandard threads and nuts are in use; (2) project at new location where local fire department connects to fire hydrants with nonstandard threads and nuts.**

**********

Provide flush-type fire hydrants that conform to the applicable requirements of AWWA C502, except that they are designed to permit placement of fire hydrant below surface of pavement. Provide 150 mm 6 inch inlet, 108 mm 4 1/4 inch minimum valve opening, one [115] [_____] mm [4

1/2] [_____] inch pumper connection, and one 65 mm 2 1/2 inch hose connection that have readily accessible hose and pumper connections and operating nuts enclosed in a cast iron box with a cast-iron cover set flush with the pavement. Provide flush lifting cover handle. Inlet has either mechanical-joint or push-on joint end [, except where flanged end is indicated]. Size and shape of operating nut and cap nuts and threads on hose and pumper connections as [specified in AWWA C502] [indicated].

2.1.4.2 Fire Hydrant Hose Houses

**********

**NOTE: The fire hydrant hose house equipment listed is standard for areas such as family housing where mobile fire department response within approximately 15 minutes is unlikely. In other types of installations where lack of prompt fire department response necessitates fully equipped fire hydrant hose houses for use by station personnel, the type and amount of equipment needed for individual hose houses will be adjusted depending on the needs of the immediate area. Do not specify metal-hose houses, in salt water areas or other locations where there is a corrosive atmosphere.**

**********

Provide hose houses matching the requirements of NFPA 24 at each fire hydrant indicated on the drawings to have a fire hydrant hose house.

2.1.4.2.1 Additional Equipment

Provide the following equipment, in addition to that listed in NFPA 24, Hose Houses and Equipment, with each hose house:

a. 60 m 200 feet of 65 mm 2-1/2 inch woven jacketed, rubber lined hose matching the requirements of NFPA 1961 with a minimum service test pressure of 2.06 MPa 300 psi; 30 m 100 feet of 40 mm 1-1/2 inch woven jacketed, rubber lined hose matching the requirements of NFPA 1961 with a minimum service test pressure of 2.06 MPa 300 psi;

b. One gated 65 by 40 by 40 mm 2-1/2 by 1-1/2 by 1-1/2 inch wye;

c. One playpipe for 65 mm 2-1/2 inch hose with 25 mm 1 inch shutoff nozzle tip;

d. One playpipe for 40 mm 1-1/2 inch hose with 13 mm 1/2 inch shutoff nozzle or combination nozzle;

e. Two adapter fittings, 65 to 40 mm 2-1/2 to 1-1/2 inch;

f. Two spanners for 40 mm 1-1/2 inch hose.

2.1.5 Meters

**********

**NOTE: Water meters are required to be installed for most facilities. Refer to UFC 1-200-02 High Performance and Sustainable Building Requirements for criteria and guidance. In some situations, sub-metering may be required.**

**This specification is primarily written for outside meter settings used for measuring water consumption from potable water systems delivered to facilities such as those meters for buildings, structures, piers, and ships.**

**This specification is for meters with working pressures of 150 psi or less.**

**This specification is for cold water meters. Refer to the appropriate AWWA Standard for water temperature limitations.**

**This specification is not intended to cover other types of dedicated operational meters such as those used in booster pump stations or production sources.**

**Select meters according to AWWA M6.**

**Size meters according to AWWA M22. It is common that the needed meter size is smaller than the service line pipe size, to avoid over sizing.**

**Coordinate with the Installation's Public Works Department to determine Installation specific meter requirements. In some cases the Government may provide a water meter to be installed by the Contractor.**

**Meters used for residential fire sprinkler applications meeting the requirements of NFPA 13D, sizes 3/4 in. (20 mm) through 2 in. (50 mm), are found in AWWA C714.**

**Many utility operators or regions use different terms. Review the available features, options and compatibility and consult with manufacturers to ensure the registers will work as intended.**

**********

Submit certificates certifying all required and recommended tests set forth in the referenced standard and AWWA M6 have been performed and comply with all applicable requirements of the referenced standard and AWWA M6 within the past three years. Include certification that each meter has been tested for accuracy of registration and that each meter complies with the accuracy and capacity requirements of the referenced standard when tested in accordance with AWWA M6.

Include a register with all meters whether they are or are not connected to a remote reading system.

[2.1.5.1 Turbine Type Meters

**********

**NOTE: AWWA C701 covers cold water turbine meters sizes 20 mm 3/4 inch to 500 mm 20 inch for Customer Service.**

**Class I meters are those meters previously covered by AWWA C701-70, 1970. Class II meters are in-line high velocity with lower head loss, greater flow sensitivity, tighter accuracy tolerances over a wider range of flow.**

**If large capacity is of primary importance, flows are usually above 10 percent of maximum rating, and low.flow accuracy is secondary, the turbine meter should be used.**

**********

Provide AWWA C701 [Class I] [Class II] [Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible] meter with a strainer screen. Main casing constructed of [copper alloy containing not less than 75 percent copper] [[cast iron] [fabricated steel] with protective coating in accordance with AWWA C213 or AWWA C550].

][2.1.5.2 Propeller Type Meters

**********

**NOTE: AWWA C704 covers various types and classes of propeller meters sizes 50 mm 2 inches to 1,800 mm 72 inches for waterworks applications.**

**********

Provide AWWA C704 [Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible] meter. Flow tubes or main cases constructed of [cast iron] [fabricated steel] [with protective coating in accordance with AWWA C153/A21.53, AWWA C210 or AWWA C213].

][2.1.5.3 Displacement Type Meters

**********

**NOTE: Displacement meters 2 inch (50 mm) and smaller. There are two variations of displacement meters, the nutating piston (disc) and the oscillating piston. Both are essentially equal in performance. These meters have a combination of accuracy, long life, simple design, moderate cost, and easy maintenance.**

**The meters described in AWWA C700 are not designed to be used in water service piping intended for extinguish fire.**

**Where highly aggressive water is encountered, the manufacturers should be consulted for recommendations concerning the use of materials that are more resistant to corrosive attack.**

**Refer to AWWA C700 for information on breakable and non-breakable covers.**

**********

Provide AWWA C700[ Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible] meter with [nutating disk][oscillating piston]. Pressure casings constructed of copper alloy containing not less than 75 percent copper.[ Provide registers with

[breakable][non-breakable] covers and straight-reading [permanently sealed][replaceable change gear] registers.][ Provide non-breakable covers of copper alloy containing not less than 75 percent copper] copper alloy conforming to ASTM B584. For meter sizes 13mm 1/2 inch through 25 mm 1 inch provide [split-case] [frost-protection-type design].

][2.1.5.4 Compound Type Meters

**********
**NOTE: AWWA C702 covers various types and classes of cold-water compound type meters in sizes 2 in. (50 mm) through 8 in. (200 mm).**
**********

Provide AWWA C702 [Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible] meter [with strainers]. Main casing constructed of [copper alloy containing not less than 75 percent copper] [[cast iron] [fabricated steel] [with protective coating in accordance with AWWA C213 or AWWA C550]]. Equip with tapped bosses near the outlet for field testing purposes.

][2.1.5.5 Fire Service Type Meters

**********
**NOTE: AWWA C703 covers various types and classes of cold-water fire service–type meters in sizes 75 mm through 250 mm 3 inches through 10 inches.**

**NSF/ANSI 61 is not required for non potable uses.**

**Strainers should be part of the meter assembly and not be interchangeable with other strainers that may be offered by the meter manufacturer.**
**********

Provide AWWA C703[ Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible][ turbine type] meter[ with strainers]. Main casing constructed of[ copper alloy containing not less than 75 percent copper][ cast iron with protective coating in accordance with AWWA C550]. Equip with a[ mechanical display-type][ electronic display-type] straight-reading register.

]2.1.5.6 Register

**********
**NOTE: Meter registers installed below grade, regardless of optional mechanical pumping features, must be suitable for submerged/pit environments. Such registers generally have a negligible increase in the metering cost. Also use a submergible type where exposure to wet environments is possible. The most common water meter register is a 6-wheel type mechanical display.**
**********

Provide [AWWA C700] [AWWA C701] [AWWA C702] [AWWA C703] [open] [sealed] [permanently sealed] straight-reading register [for use in a submerged environment] supplied by the meter manufacturer. Equip register with cubic meters [U.S. gallons][cubic feet] readings.[ Use [a direct reading

remote register designed in accordance with AWWA C706][an encoder type remote register designed in accordance with AWWA C707]].

[2.1.5.7 Strainers

Provide [AWWA C701][AWWA C702][AWWA C703] strainer recommended and supplied by the meter manufacturer. Provide strainer of the same material as the meter body (i.e., bronze, ductile, or stainless).

]2.1.5.8 Meter Connections

**********

**NOTE: This paragraph is written for meters located outside of the building. Inside meter settings as well as those used outside above ground or in hot-boxes, would follow the same principles.**

**********

[Provide [flanged] [female screw threads] [_____] main case connection fittings.][Provide connections compatible with the type of pipe and conditions encountered.]

[2.1.5.9 Advanced Metering Infrastructure

**********

**NOTE: Advanced Metering Infrastructure (AMI) Water Meters are required per the Utility Meter Policy Memo dated 16 April 2013 from the Office of Under Secretary of Defense. Coordinate advance metering with the Installation AMI manager.**

**********

[The Government will supply][Provide] an Advanced Metering Infrastructure (AMI) compatible water meter(s) [for the Contractor to install] and connect to the existing AMI Data Acquisition System (DAS). Use the existing Government laptop computers to configure the meter using existing software loaded on the computer. Modifications to existing software on the computer or the addition of software to the computer is not allowed. The Contractor must ensure that the meter(s) transmit the metered data to the DAS. The current meters being used by [_____] are: [_____]. [The Government will configure the meter(s), which must be compatible with the existing system, using existing software. Contractor is to ensure that the meter(s) transmit the specified data to the DAS. The current meters being used by [_____] are: [_____].]

][2.1.5.10 Direct Digital Control System Interface

Provide all meters with the capability of providing pulse output to the DDC system provided in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

][2.1.5.11 Meter Setter

**********

**NOTE: Meter setters are intended to allow the meter to be placed or removed in a meter box or vault. Meter setters may bought or assembled of separate components. Assembled meter setters usually increase construction costs and decrease uniformity**

**among meter settings.**

**Three basic styles of setters include yokes, copper setters, and yoke meter boxes. Variations could also include the meter setter being pre-assembled and piped into a plastic meter box.**

**********

[ Provide AWWA C800 [manufactured] meter setter with [a bypass, ]inlet and outlet valves.
]

**********

**NOTE: By-passes should be provided for any meter greater than 2-inch to allow for meter testing and maintenance. In many instances, the size of the by-pass can be less than the size of the service line or meter.**

**********

[ Provide a [_____] mm [_____] inch by-pass assembly[ as shown on drawings] with the valve located[ inside][ outside] the vault.[ Provide valve box for valve located outside of vault.]

]]2.1.5.12 Meter [Boxes] [Vaults]

**********

**NOTE: Indicate traffic rated and non traffic rated meter boxes on the drawings.**

**Use cast iron and concrete meter boxes in traffic areas.**

**Meter Vaults are intended for large meters (i.e., 75 mm 3 inch and above). Meter boxes are intended for less than 75 mm 3 inch diameter pipes.**

**When meter vaults are used provide construction details of meter setting on the drawings.**

**Ensure meter boxes and vaults provide adequate clearance for meter removal, access for valve operation or maintenance.**

**Use rounds lids when possible. Round lids provide an advantage over other shapes since they do not fall down into the meter pit damaging the metering equipment below. When used in areas with foot traffic, a round lid can also reduce the risk for someone falling into the pit and causing an injury. The oval or rectangular meter box can sometimes provide an advantage since they can be used in a more narrow space while providing the needed length.**

**********

Provide meter [boxes] [vaults] of sufficient size to completely enclose the meter and shutoff valve or service stop and in accordance with the details shown on the drawings. Provide a meter boxes or vaults with a height equal to the distance from invert of the service line to finished grade at the meter location.

2.1.5.12.1 Cast Iron

Provide ASTM A48/A48M, Class 25 cast iron meter box and lid. Provide a [round] lid [with precast holes for remote electronic meter reading modules] having the word "WATER" cast on the top surface.

[2.1.5.12.2 Precast Concrete Meter [Boxes] [Vaults]

Provide [ASTM C1433] [precast concrete meter boxes in accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.] precast concrete meter [boxes] [vaults] with ASTM A48/A48M, Class 25 cast iron lid. Provide a ASTM A48/A48M, Class 25 cast iron [with precast holes for remote electronic meter reading modules] [round] lid having the word "WATER" cast on it. Provide meter [boxes] [vaults] of sufficient size to completely enclose the meter and shutoff valve or service stop and in accordance with the details shown on the drawings.

[2.1.5.12.2.1 Vault Access Door

Provide a [single-leaf][ double-leaf] cast-in [aluminum][painted steel] diamond-plate access door with the following dimensions:

Width: [_____] mm feet

Length: [_____] mm feet

Include [stainless steel spring][pneumatic] lift assist, type 316 stainless steel slam locking latch, automatic hold-open arm with a red release handle, and flush mounted retractable lifting handle. Door must have a minimum load rating for[ AASHTO HS-20] [6,800 kg15,000 lbs] load.[ Center door[ over meter assembly][ over ladder and aligned with interior wall].]

]2.1.5.12.2.2 Fittings

Provide flanged fittings for pipe 75 mm 3 inches and larger.

2.1.5.12.2.3 Vault Valves

**********

**NOTE: Use indicating type valves inside the vault (i.e., OS&Y, ball, butterfly) so that the valve's position can be observed without entering the confined space.**

**********

Provide [ball] [outside screw and yoke (OS&Y)] [butterfly] valves in meter vault.

][2.1.5.12.3 Plastic Meter Boxes

**********

**NOTE: Plastic boxes and lids are acceptable for use in unpaved areas or grass areas not subject to vehicular traffic.**

**Medium duty ratings include occasional vehicle traffic such as a stray vehicle or tractor use for**

**mowing. Do not use medium duty ratings in areas where vehicle traffic is expected.**
**********

Provide manufactured plastic boxes [and lids] meeting the following requirements:

a. One-piece molded construction

b. Vertical load rating for medium duty use of [6,800 kg15,000 lbs][_____]

c. Ultraviolet (UV) exterior surface protection

d. White interior surface

[ Provide a ASTM A48/A48M, Class 25 cast iron ring and [round] lid.

]]2.1.6 Backflow Preventers

**********
**NOTE: This specification covers backflow preventers installed used to protect the potable water system in outside applications.**

**AWWA C511 requires a minimum working pressure of 1000 kPa 150 psi.**

**Backflow preventers (i.e., the double check valve assembly (DC) and the reduced pressure principle assembly (RP)) must be installed above ground to prevent cross contamination.**

**Locate backflow preventers assemblies in areas with adequate drainage. Double check valves may get the surrounding area wet when testing is being performed. RPs can discharge large quantities of water. A 25 mm 1 inch RP may discharge up to 125 gallons per minute of water, so having adequate drainage is crucial.**
**********

Provide a [bronze] [cast iron] [ductile iron] AWWA C511 reduced pressure principle type backflow preventer meeting the following requirements:

a. Size: [_____]

[ b. Maximum Rated Flow: [_____]

][c. Allowable Pressure Loss: [_____]

] d. Flanged [cast iron], [bronze] [brass] mounted gate valve

[ e. Strainer of the same material as the backflow preventer

][f. Stainless steel alloys in accordance with ASTM A276/A276M, Type [304] [_____]

] [The particular make, model, and size of backflow preventers to be installed must be included in the latest edition of the List of Approved

Backflow Prevention Assemblies issued by the FCCCHR List and be accompanied by a backflow certificate of full approval from FCCCHR List. ]Select materials for piping, strainers, and valves used in assembly installation that are galvanically compatible. Materials joined, connected, or otherwise in contact are to have no greater than 0.25 V difference on the Anodic Index, unless separated by a dielectric type union or fitting.

2.1.6.1 Backflow Preventer Enclosure

**********
**NOTE: Where freezing temperatures are possible include requirements for an enclosure to prevent freezing.**
**********

Provide an [insulated] enclosure[ with heat].

2.1.7 Disinfection

Chlorinating materials are to conform to: Chlorine, Liquid: AWWA B301; Hypochlorite, Calcium and Sodium: AWWA B300.

2.2 ACCESSORIES

2.2.1 Pipe Restraint

**********
**NOTE: Design pipe anchorage for a minimum working pressure of 2.4 MPa 350 psi and in accordance with AWWA C600, AWWA C605, AWWA M9, AWWA M11 Chapter 13, "Supplementary Design Data and Details", NFPA 24, Chapter 10 and ASTM F1674.**

**Use thrust blocks, joint restraint or a combination of thrust blocks and joint restraint as indicated by design analysis.**
**********

[2.2.1.1 Thrust Blocks

Use ASTM C94/C94M concrete having a minimum compressive strength of [15 MPa 2,500 psi] [_____] at 28 days[ or use concrete of a mix not leaner than one part cement, two and one half parts sand, and five parts gravel, having the same minimum compressive strength].

][2.2.1.2 Precast Thrust Blocks

Provide precast concrete thrust blocks.

][2.2.1.3 Joint Restraint

**********
**NOTE: Provide restrained joints in accordance with and in accordance with ASTM F1674**
**********

Provide restrained joints in accordance with NFPA 24, Chapter 10[ and in accordance with ASTM F1674].

Provide [mechanical joint restraint] [restraint devices with gripper wedges incorporated into a follower gland and specifically designed for the pipe material[ and meeting the requirements of AWWA C110/A21.10 ]] [or metal harness fabricated by the pipe manufacturer].

]2.2.2 Protective Enclosures

Provide Freeze-Protection Enclosures that are insulated and designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of [_____] degrees C F when external temperatures reach as low as [_____] degree C F.

**********

**NOTE: Consider the enclosure materials and ensure that the material is compatible with the environment. Aluminum enclosures are acceptable in most environments and are recommended for harsh environments and areas subject to vandalism.**

**********

2.2.2.1 Housing

Reinforced and insulated [aluminum] [or] [fiberglass] construction; with anchoring devices for attaching housing to concrete base, access doors with locking devices, sized to allow access and service of the protected unit, drain openings, and an electric heating cable or heater with self-limiting temperature control.

[2.2.3 Tapping Sleeves

**********

**NOTE: Tapping sleeves are not allowed in many locations. Coordinate with the Installations utility department to see if this paragraph should be deleted.**

**Show size of tapping sleeve on drawings.**

**********

Provide cast gray, ductile, malleable iron or stainless steel, split-sleeve type tapping sleeves of the sizes indicated for connection to existing main with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Utilize similar metals for bolts, nuts, and washers to minimize the possibility of galvanic corrosion. Provide dielectric gaskets where dissimilar metals adjoin. Provide a tapping sleeve assembly with a maximum working pressure of [1000] [_____] kPa [150] [_____] psi. Provide bolts with square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, utilize 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-pound.

]2.2.4 Sleeve-Type Mechanical Couplings

**********

**NOTE: Delete "or steel" when middle ring of cast iron only is considered necessary due to anticipated corrosion problems.**

**Minimum numbers of bolts for each pipe size should be as follows: 80 mm 3 inch, 3; 100 mm 4 inch, 4; 150 mm 6 inch, 5; 200 mm 8 inch, 6; 250 mm 10 inch, 7; 300 mm 12 inch and 350 mm 14 inch, 8; 400 mm 16 inch, 9; 450 mm 18 inch, 10; 500 mm 20 inch, 12; 550 mm 22 inch, 13; 600 mm 24 inch, 14.**

**********

Use couplings to join plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling consists 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. Provide true circular middle ring and the follower rings sections free from irregularities, flat spots, and surface defects; provide for confinement and compression of the gaskets.[ For [ductile iron] [and] [PVC] pipe, the middle ring is cast-iron [or steel; and the follower rings are malleable or ductile iron].][ For steel piping, the middle ring is steel and the follower rings are steel or malleable iron.][ Cast iron, ASTM A48/A48M not less than Class 25.] Malleable and ductile iron are to meet the requirements of ASTM A47/A47M and ASTM A536, respectively.[ Steel is to have a strength not less than that of the pipe.] Use gaskets for resistance to set after installation and to meet the requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Provide track-head type bolts ASTM A307, Grade A, with nuts, ASTM A563M ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Provide 16 mm 5/8 inch diameter bolts; minimum number of bolts for each coupling is [_____] [for [_____] mm inch pipe], [_____] [for [_____] mm inch pipe,] [and] [_____] [for [_____] mm inch pipe]. Shape bolt holes in follower rings to hold fast to the necks of the bolts used. Do not use mechanically coupled joints using a sleeve-type mechanical coupling as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Provide a tight flexible joint with mechanical couplings under reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Match coupling strength to that of the adjoining pipeline.

2.2.5 Insulating Joints

Provide a rubber-gasketed insulating joint or dielectric coupling between pipe of dissimilar metals which will effectively prevent metal-to-metal contact between adjacent sections of piping.

[2.2.6 Bonded Joints

**********

**NOTE: Use bonded joints to maintain electrical continuity in metallic pipeline where cathodic protection is provided during construction or where it is anticipated that cathodic protection will be**

**provided in the future.**

**Coordinate bonded joints with nearby existing cathodic protection systems.**

**********

[Where indicated][For all ferrous pipe], provide a metallic bond at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. Provide Size 1/0 copper conductor thermal weld type bond wire designed for direct burial and shaped to stand clear of the joint.

]2.2.7 Dielectric Fittings

Install dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains to prevent metal-to-metal contact of dissimilar metallic piping elements and compatible with the indicated working pressure.

2.2.8 Tracer Wire for Nonmetallic Piping

**********

**NOTE: As an option, warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL may be used. Specify non-metallic color coded 'warning tape' when used in conjunction with tracer wire.**

**********

Provide a continuous bare copper or aluminum wire not less than 2.5 mm 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

2.2.9 Water Service Line Appurtenances

2.2.9.1 Corporation Stops

**********

**NOTE: Delete the paragraph when there is no water service piping of 50 mm 2 inch diameter or less included in the project.**

**********

Ground key type; lead-free bronze, ASTM B61 or ASTM B62; compatible with the working pressure of the system and 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.

2.2.9.2 Curb or Service Stops

**********

**NOTE: Delete this paragraph when there is no water service piping of 40 mm 1 1/2 inch diameter or less included in the project.**

**********

Ground key, round way, inverted key type; made of lead-free bronze, ASTM B61or ASTM B62; and compatible with the working pressure of the system. Provide compatible ends for connection to the service piping.

Cast an arrow into body of the curb or service stop indicating direction of flow.

[2.2.9.3 Service Clamps

Provide single or double flattened strap type service clamps used for repairing damaged cast-iron, steel or PVC pipe with a pressure rating not less than that of the pipe being repaired. Provide clamps with a galvanized malleable-iron body with cadmium plated straps and nuts and a rubber gasket cemented to the body.

]2.2.9.4 Goosenecks

Manufacture goosenecks from Type K copper tubing; provide joint ends for goosenecks compatible with connecting to corporation stop and service line. [Where multiple gooseneck connections are required for an individual service, connect goosenecks to the service line through a compatible lead-free brass or bronze branch connection; the total clear area of the branches to be at least equal to the clear area of the service line.]

2.2.9.5 Curb Boxes

Provide a curb box for each curb or service stop manufactured from cast iron, size capable of containing the stop where it is used. Provide a round head. Cast the word "WATER" on the lid. Factory coat the box with a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Connections to Existing System

Perform all connections to the existing water system in the presence of the Contracting Officer.

3.1.2 Operation of Existing Valves

Do not operate valves within or directly connected to the existing water system unless expressly directed to do so by the Contracting Officer.

3.1.3 Earthwork

**********

**NOTE: Earthwork requirements for pipe trenches, including bedding, are covered in Section 31 00 00 EARTHWORK. The applicable requirements for exterior water system which are set forth in Section 31 00 00 EARTHWORK must be incorporated into the project specification. The specifier should verify the current appropriate specification and revise as necessary if different.**
**NOTE: For Navy, earthwork requirements for pipe trenches, including bedding, are covered in Section 31 23 00.00 20 EXCAVATION AND FILL. The applicable requirements for exterior water system which are set forth in Section 31 23 00.00 20 EXCAVATION AND FILL must be incorporated into the project**

**specification. The specifier should verify the current appropriate specification and revise as necessary if different.**
**********

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL.

## 3.2 INSTALLATION

Install all materials in accordance with the applicable reference standard, manufacturers instructions and as indicated herein.

### 3.2.1 Piping

#### 3.2.1.1 General Requirements

Install pipe, fittings, joints and couplings in accordance with the applicable referenced standard, the manufacturer's instructions and as specified herein.

##### 3.2.1.1.1 Termination of Water Lines

Terminate the work covered by this section at a point approximately 1.5 m 5 feet from the building, unless otherwise indicated.

Do not lay water lines in the same trench with gas lines, fuel lines, electric wiring, or any other utility. Do not install copper tubing in the same trench with ferrous piping materials. Where nonferrous metallic pipe (i.e., copper tubing) crosses any ferrous piping, provide a minimum vertical separation of 300 mm 12 inches between pipes.

##### 3.2.1.1.2 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. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Blocking or wedging between bells and spigots is not permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. 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.[ Provide a minimum of 760 mm 2 1/2 feet depth of cover over top of pipe.]

3.2.1.1.3 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.

3.2.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after coordination with the facility 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 and as indicated, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

**********
**NOTE: Use the following paragraph for PWC PEARL'S projects.**
**********

All connections to NAVFAC Hawaii's potable water lines 300 mm 12 inches in diameter and smaller using corporation stops or tapping sleeves and tapping valves are only to be made by NAVFAC Hawaii's forces. Coordinate this work, via the Contracting Officer, with NAVFAC Hawaii's and provide NAVFAC Hawaii, Utilities Department, PW65, telephone 473-2557, 14 calendar days advance notification of the date of connection. The Government will furnish, install and operate the tapping machine. Equipment necessary for the installation and operation of the tapping machine as well as necessary cutting blades will be provided by the Government. Disinfection of the tapping machine will be done by the Government. Provide [corporation stops,] [tapping sleeves and tapping valves,] and all other material, labor, and equipment necessary for the connection. Perform all earthwork and disinfection work at the connection prior to installation of the tapping machine by the Government. Perform the disinfection work in the presence of the PWC PEARL Utilities Department personnel. Provide all other connections, including wet tapping mains larger than 300 mm 12 inches in diameter and installation of new pipe fittings in existing mains. Make connections to existing water lines in the presence of the NAVFAC Hawaii Utilities Department personnel. Provide NAVFAC Hawaii, Utilities Department, PW65, telephone 473-2557, 14 calendar days advance notification of the date of connection.

3.2.1.1.5 Sewer Manholes

No water piping is to pass through or come in contact with any part of a sewer manhole.

3.2.1.1.6 Water Piping Parallel With Sewer Piping

[ Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer than 3.0 m 10 feet, horizontally, from any sewer line.
]

a. Normal Conditions: Lay water piping at least 3.0 m 10 feet horizontally from sewer or sewer manhole whenever possible. Measure the distance from outside edge to outside edge of pipe or outside edge of manhole. When local conditions prevent horizontal separation install water piping in a separate trench with the bottom of the water piping at least 450 mm 18 inches above the top of the sewer piping.

b. Unusual Conditions: When local conditions prevent vertical separation, construct sewer piping of AWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. When local conditions prevent vertical separation, test the sewer manhole in place to ensure watertight construction.

3.2.1.1.7 Water Piping Crossing Sewer Piping

**********
**NOTE: Choose one of the following options.**
**********

[Provide at least 450 mm 18 inches above the top (crown) of the sewer piping and the bottom (invert) of the water piping whenever possible. Measure the distance edge-to-edge. Where water lines cross under gravity sewer lines, construct sewer line of AWWA compliant ductile iron water piping with rubber-gasketed joints and no joint located within 3 m 10 feet, horizontally, of the crossing.][ Lay water lines which cross sewer force mains and inverted siphons at least 600 mm 2 feet above these sewer lines; when joints in the sewer line are closer than 900 mm 3 feet horizontally from the water line relay the sewer line to ensure no joint closer than 900 mm 3 feet.]

a. Normal Conditions: Provide a separation of at least 450 mm 18 inches between the bottom of the water piping and the top of the sewer piping in cases where water piping crosses above sewer piping.

b. Unusual Conditions: When local conditions prevent a vertical separation described above, construct sewer piping passing over or under water piping of AWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. Construct sewer crossing with a minimum 6.1 m 20 feet length of the AWWA compliant ductile iron water piping, centered at the point of the crossing so that joints are equidistant and as far as possible from the water piping. Protect water piping passing under sewer piping by providing a vertical separation of at least 450 mm 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 or damage to the water piping.

3.2.1.1.8 Penetrations

Provide ductile-iron or Schedule 40 steel wall sleeves for pipe passing through walls of valve pits and structures. Fill annular space between walls and sleeves with rich cement mortar. Fill annular space between pipe and sleeves with mastic.

3.2.1.1.9 Flanged Pipe

Only install flanged pipe aboveground or with the flanges in valve pits.

3.2.1.2 Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS 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 and AWWA M41 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 and AWWA M41 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[ equipment and] accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts 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. When flanged pipe or fitting has dimensions that do not allow the making of a flanged joint as specified, replace it. [Use set screw flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the set screw flange manufacturer. During installation of set screw gasket provide for confinement and compression of gasket when joint to adjoining flange is made.]] [Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. ] Make [grooved] [and] [shouldered] type joints with the couplings previously specified for this type joint connecting pipe with the [grooved] [or] [shouldered] ends specified for this type joint; assemble in accordance with the recommendations of the coupling manufacturer.[ Groove pipe in the field only with groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.][ Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves are to be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.]

b. Allowable Deflection: Follow AWWA C600 and AWWA M41 for the maximum allowable deflection. If the alignment requires deflection in excess of the above limitations, provide special bends or a sufficient number of shorter lengths of pipe to achieve angular deflections within the limit set forth.

**********

**NOTE: Delete the following paragraph except when required. See the AWWA M41 for ductile iron pipe and fittings for guidance.**

**Method A and B require polyethylene tubing and should be used as the default selection. Method C requires polyethylene sheeting.**

**********

[ c. Exterior Protection: Completely encase buried ductile iron pipelines using [Method A or B] [Method C], with polyethylene film, in accordance with AWWA C105/A21.5.
]

3.2.1.3 PVC and PVCO Water Main Pipe

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, setting of fire hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use a lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Joint Offset: Construct joint offset in accordance AWWA C605. Do not exceed the minimum longitudinal bending as indicated by AWWA C605.

c. Fittings: Install in accordance with AWWA C605.

3.2.1.4 Polyethylene (PE) Piping

Install PE pipes in accordance with AWWA M55 and ASTM D2774.

3.2.1.5 Fiberglass Piping

Install fiberglass piping in accordance with AWWA M45, ASTM D3839 and the manufacturer's installation instructions.

3.2.1.5.1 RTRP I Jointing

Assemble the pipe in conformance with the manufacturer's written instruction and installation procedures. Prepare field bonding and curing of joints as specified by the pipe manufacturer (several pipe joints having interference-fit type couplings may be bonded and cured simultaneously. The pipe is not to be moved and additional joints are not to be made until the previously bonded joints are completely cured. Joints not having interference-fit type coupling are to be fitted with a

clamp that will hold the joint rigidly in place until the joint cement has completely cured.

Provide a protective material on the inner surface of the clamp to prevent damage to the plastic pipe when the clamp is tightened in place. Provide a manufacturer recommended device or method to determine when the joint is pulled against the pipe stop. Provide a gauge from the pipe manufacturer to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. Gauge all pipe ends. At any ambient temperatures, cure field bonded epoxy-cemented joints with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the size and type of joint, or by an alternate heating method recommended by the manufacturer. Do not move the joint sections during heating, or until the joint has cooled to ambient temperature.

3.2.1.5.2 RTRP II Jointing

Utilize a reinforced overlay joint to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric saturated with compatible catalyzed resin.

3.2.1.5.3 RPMP Jointing

Utilize bell and spigot gasket-sealing couplings to connect pipes. Lubricate the spigot prior to push-together assembly.

3.2.1.5.4 Fittings and Specials for RTRP and RPMP Pipe

Assemble metal to RTRP and RPMP pipe connections by bolting steel flanges to RTRP and RPMP pipe flanges. Utilize cast-iron fittings with gasket bell or mechanical joint with RTRP if pipe has cast iron outside diameter. Steel flanges are to be flat-faced type. Use spacer rings to provide a flat-face seat for RTRP and RPMP pipe flanges where raised-face steel flanges are used. Provide a full-face Buna "N" gasket 3 mm 1/8 inch thick with a shore hardness of 50-60 between all flanged connections. The RTRP and RPMP pipe flange are to have raised sealing rings. Use flat washers under all nuts and bolts on RTRP and RPMP pipe flanges. Torque non-corrosive bolts and nuts to not more than 135 Newton meters 100 foot pounds. Do not direct bury flanges. Provide a concrete pit for all flanged connections.

3.2.1.5.5 Allowable Offsets

a. RTRP: Comply with manufacturer's recommendations for the maximum offset in alignment between adjacent pipe joints but do not exceed 5 degrees.

b. RPMP: Comply with manufacturer's recommendations for pipe with bell and spigot rubber gasket joints. Maximum allowable deflections from a straight line or grade is 4 degrees and determined by the diameter, unless a lesser amount is recommended by the manufacturer. Form short-radius curves and closures with short lengths of pipe or fabricated specials specified.

3.2.1.6 [Concrete Pressure Pipe] [PCCP] [RCCP] Piping

Except as otherwise specified in the following subparagraphs, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS, the

laying and joining requirements specified in AWWA M9; and with the recommendations given in AWWA M9 "Design of Thrust Restraints for Buried Pipe".

**********

**NOTE: Some pipe joints eliminate the need for additional pipe anchorage, such as full exterior joint welds, skip welds, clamp type harness, bell bolt harness and snap ring harnesses.**

**********

a. Jointing: Make joints with the gaskets specified for concrete pipe joints, using a lubricant recommended by the manufacturer. Assemble joints in accordance with the joining requirements specified in AWWA M9 and with the recommendations given for laying the pipe in AWWA M9, chapter entitled "Installation by Trenching or Tunneling--Methods and Equipment." Acceptable joint types are bell and spigot, structural welded, skip welded, clamp type harness, bell bolt harness and snap ring harnesses. Prior to backfilling, wrap joints with a joint wrapper and fill with grout as recommended by the manufacturer. For pipe large enough to accommodate a worker, point the interior joint space with a stiff mixture of portland cement and smooth finish with a hand trowel.

b. Allowable Offsets: To the extent possible, follow the manufacturer's laying schedule, which will indicate the use and location of joint gaps, spacers, beveled joints, short pipe lengths, fabricated specials and beveled adapters. Unless a lesser amount is recommended by the manufacturer, the maximum allowable offset in a joint is 5 degrees.

3.2.1.7 Steel Piping

Unless otherwise specified, install pipe and fittings in accordance with AWWA C604 and AWWA M11, Chapter 12, "Transportation, Installation, and Testing." [Apply protective coating for aboveground piping as specified in Section [_____].]

a. Jointing: Make rubber-gasketed bell-and-spigot joints with the gaskets previously specified for this type joint, using a lubricant recommended by the pipe manufacturer; assemble in accordance with the recommendations of the pipe manufacturer.[ Make welded joints in accordance with AWWA C206 and with the recommendations given for installation of pipe in AWWA M11, Chapter 12, "Transportation, Installation, and Testing."] Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.[ 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 [equipment and] accessories. Align bolt holes for each flanged joint. Use full-size bolts for the bolt holes; use of undersized bolts is not permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without straining the flange. Replace flanged pipe or fittings with dimensions that do not allow the making of a flanged joint as specified.][[ Make grooved type joints with the couplings specified for this type joint connecting pipe with roll-grooved ends or pipe with welded-on cut-grooved adapters, each with dimensions as previously specified for this type joint. Groove pipe ends in the field only with manufacturer recommended groove rolling equipment and

manufacturer recommended groove adapters in the field only with manufacturer recommended groove cutting equipment; use groove rolling and groove cutting equipment especially for the purpose and produced by a manufacturer of grooved joint couplings. Obtain approval for field-cut grooves before assembling the joint.][ Make shouldered type joints with the couplings specified for this type joint connecting pipe with the shouldered ends specified for this type joint.] Assemble [grooved] [and] [shouldered] type joints in accordance with the recommendations of the coupling manufacturer.][ Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves are to be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.] Finish joints on piping with cement-mortar lining[ and on piping with cement-mortar coating] as specified in Appendix on Field Joints in AWWA C205.[ Finish joints on piping with [coal-tar enamel] [or] [coal-tar epoxy] coating by cleaning, priming, coating, and wrapping with a cold-applied tape coating matching the requirements of, and applied in accordance with AWWA C209.]

b. Allowable Offsets: For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets is 5 degrees unless a lesser amount is recommended by the manufacturer. Form short-radius curves and closures with short lengths of pipe or fabricated specials specified.

**********

**NOTE: Under ordinary conditions, steel water pipe and fittings in the sizes included in water systems covered by this specification are furnished with factory-applied cement-mortar lining.**

**Under unusual circumstances add cement mortar lining after installation. Add the following note: "Provide cement mortar lining after installation in accordance with AWWA C602".**

**********

c. Cement Mortar Lining: AWWA C205, shop applied.

3.2.1.8 Metallic Piping for Service Lines

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

3.2.1.8.1 Screwed Joints

Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only or with PTFE Tape, for use with threaded pipe. Threads are to be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

3.2.1.8.2 Joints for Copper Tubing

Cut copper tubing with square ends; remove fins and burrs. Replace

dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Use solder and flux containing less than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

3.2.1.8.3 Flanged Joints

Make flanged joints up tight, avoid undue strain on flanges, valves, fittings, and accessories.

3.2.1.8.4 Protection of Buried Steel Service Line Piping

**********
**NOTE: Use coal-tar enamel coating with double felt wraps instead of single layer of felt wrap where soil is classified as Group IV, Unusually Corrosive (as defined in AWWA M11, Chapter 10, "Principles of Corrosion and Corrosion Control"); or where electrical resistivity of soil has been measured at less than 2,000 ohms/cc.**
**********

[Unless otherwise specified,] prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded[ single layer of felt wrap in accordance with AWWA C203][ double felt wraps in accordance with AWWA C203 ]. For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.2.1.9 Plastic Service Piping

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of ASTM D2774 [and ASTM D2855], unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F402.

3.2.1.9.1 Jointing

[Make solvent-cemented joints for PVC piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D2855.] Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.9.2 Plastic Pipe Connections to Appurtenances

Connect plastic service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.10 Trenchless Piping

3.2.1.10.1 Butt Fusion

Fusible pipe will be fused by qualified fusion technicians, as required by

manufacturer of the fusion equipment. Record and log each fusion joint by an electronic monitoring device (data logger) connected to the fusion machine. Log fusion data and create Post-Construction Fusion Report with software specifically developed for the pipe material being fused. Software must record the parameters required by the fusion equipment manufacturer and these specifications. Manual log data not logged by the data logger and be included in the Post-Construction Fusion Report. Assemble fusible PVC and PE pipe lengths in the field with butt-fused joints. Follow the manufacturer's fusion equipment procedures.

a. Install butt fused PE Pipe in accordance with ASTM F1962.

b. For butt fused PVC Pipe provide joints meeting the requirements of ASTM F1674.

3.2.1.10.2 Post-Construction Fusion Report

Include the following data for each fusible connection in the report:

a. Pipe Size and Thickness
b. Machine Size
c. Fusion Technician Identification
d. Job Identification
e. Fusion Joint Number
f. Fusion, Heating, and Drag Pressure Settings
g. Heat Plate Temperature
h. Time Stamp
i. Heating and Cool Down Time of Fusion
j. Ambient Temperature

3.2.1.10.3 Installation Ductile Iron Ball and Socket Joint

Install pipe and fittings in accordance with AWWA C600 and AWWA M41 for pipe installation, joint assembly, and thrust restraint.

a. Allowable Deflection: Meet the applicable requirements of AWWA C600, AWWA M41 and in accordance with pipe manufacturer's instructions for the maximum allowable deflection.

**********
**NOTE: Delete the following paragraph except when required. See the AWWA M41 for ductile iron pipe and fittings for guidance.**
**********

[ b. Exterior Protection: Completely encase buried ductile iron pipelines using Method A or B, with polyethylene film, in accordance with AWWA C105/A21.5.

]3.2.1.11 Fire Protection Service Lines for Sprinkler Supplies

Connect water service lines used to supply building sprinkler systems for fire protection to the water main in accordance with NFPA 24.

3.2.1.12 Water Service Piping

3.2.1.12.1 Location

Connect water service piping to the building service where the building

service has been installed. Where building service has not been installed, terminate water service lines approximately 1.5 m 5 feet from the building line at the points indicated; close such water service lines with plugs or caps.

3.2.1.12.2 Water Service Line Connections to Water Mains

**********
**NOTE: Use first optional sentence for service line piping less than 80 mm 3 inches in diameter. Use third optional sentence for service line piping 80 mm 3 inches in diameter or larger. Delete references to size except when more than one size range is present.**
**********

[Connect [[_____] mm inch] water service lines to the main [by a corporation stop and gooseneck and install a service stop below the frostline][as indicated]. ][Connect water service lines 50 mm 2 inch size to the main[ with a rigid connection or a corporation stop and gooseneck and install a gate valve on service line below the frostline][as indicated]. ][ Connect [[_____] mm inch] water service lines to the main [with a rigid connection and install a gate valve on service line below the frostline][as indicated]. ][Connect water service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. ][Connect water service lines to PVC water mains in accordance with UBPPA UNI-PUB-08 and the recommendations of AWWA M23, Chapter 9, "Service Connections." ][Connect water service lines to concrete water mains in accordance with the recommendations of AWWA M9, "Tapping Concrete Pressure Pipe." ]Connect water service lines to steel water mains in accordance with the recommendations of the steel water main pipe manufacturer and with the recommendations for special and valve connections and other appurtenances in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

[3.2.2 Railroad Right-of-Way

Install piping passing under the right-of-way of a commercial railroad in accordance with the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5, of the AREMA Eng Man.[ For PVC water main pipe, also install in accordance with the recommendations of AWWA M23 for installation of casings.]

]3.2.3 Meters

Install meters and meter [boxes] [vaults] at the locations shown on the drawings. Center meters in the [boxes] [vaults] to allow for reading and ease of removal or maintenance. Set top of box or vault at finished grade.

3.2.4 Backflow Preventers

Install backflow preventers of type, size, and capacity indicated a minimum of 300 mm 12 inch and a maximum of 900 mm 36 inch above concrete base. Include valves and test cocks. Install according to the manufacturers requirements and the requirements of plumbing and health department and authorities having jurisdiction. Support NPS 63 mm 2 1/2 inch and larger backflow preventers, valves, and piping near floor with 300 mm 12 inch minimum air gap, and on concrete piers or steel pipe supports. Do not install backflow preventers that have a relief drain in

vault or in other spaces subject to flooding. Do not install by-pass piping around backflow preventers.

3.2.4.1 Backflow Preventer Enclosure

Install a level concrete base with top of concrete surface approximately [ 50 mm2 inches] [[_____] mm inches] above grade. Install protective enclosure over valve and equipment. Anchor protective enclosure to concrete base.

3.2.5 Disinfection

[ Disinfection of systems supplying non-potable water is not required.
]

**********

**NOTE: The continuous-feed method of chlorination is recommended for disinfecting new water systems. Other methods may be selected in accordance with AWWA C651. Keep the bracketed text when using the continuous-feed method of chlorination.**

**********

Prior to disinfection, provide disinfection procedures, proposed neutralization and disposal methods of waste water from disinfection as part of the disinfection submittal. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Disinfect new water piping using the AWWA C651 [continuous-feed method of chlorination][_____].[ Ensure a free chlorine residual of not less than 10 mg/L 10 parts per million after 24 hour holding period and prior to performing bacteriological tests.]

3.2.6 Flushing

Perform bacteriological tests prior to flushing. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 mg/L 0.2 to 0.5 parts per million, the residual chlorine content of the distribution system, or acceptable for domestic use. Use AWWA C655 neutralizing chemicals.

3.2.7 Pipe Restraint

3.2.7.1 Concrete Thrust Blocks

Install concrete thrust blocks where indicated.

3.2.7.2 Restrained Joints

Install restrained joints in accordance with [the manufacturer's instructions] [NFPA 24] [_____] where indicated. [For metal harness use tie rods and clamps as shown in NFPA 24.] [Provide structural welded, skip welded, clamp type harness, bell bolt harness, snap ring harness for pipe anchorage.] [Provide metal harness fabricated by the pipe manufacturer and furnished with the pipe.]

3.2.8 Valves

3.2.8.1 Gate 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 or AWWA C515, 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 or AWWA C515. Install gate valves on PVC and PVCO water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

#### 3.2.8.2 Check Valves

Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation [, except as otherwise indicated]. Make and assemble joints to check valves as specified for making and assembling the same type joints between pipe and fittings.

#### 3.2.8.3 Air Release, Air/Vacuum, and Combination Air Valves

Install pressure vacuum assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to the requirements of plumbing and health department and authorities having jurisdiction. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

### 3.2.9 Blowoff Valve Assemblies

Install blowoff valve assemblies as indicated on the drawings or in accordance with the manufactures recommendations. Install discharge fitting on the end of riser pipe to direct the flow of water so as to minimize damage to surrounding areas.

### 3.2.10 Fire Hydrants

Install fire hydrants[, except for metal harness,] in accordance with AWWA C600 for fire hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings.[ Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which fire hydrant is attached.] Install fire hydrants with the 115 mm 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, install fire hydrants with the 115 mm 4 1/2 inch connection facing the paved surface where the connecting main is located.

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Tests

Notify the Contracting Officer a minimum of five days in advance of hydrostatic testing. Coordinate the proposed method for disposal of waste water from hydrostatic testing. Perform field tests, and provide labor, equipment, and incidentals required for testing[, except that water needed for field tests will be furnished as set forth in paragraph AVAILABILITY AND USE OF UTILITY SERVICES in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS]. Provide documentation that all items of work have been constructed in accordance with the Contract documents.

3.3.1.1 Hydrostatic Test

**********

**NOTE: NFPA 24 requires a minimum test pressure of 1,400 kPa 200 psi or 375 kPa 50 psi in excess of the system working pressure. Several of the AWWA standards do not meet the requirements of NFPA 24. Where water mains or water service lines provide fire service or water and fire service, they must be tested in accordance with NFPA 24.**

**If water mains or water service lines do not provide fire service delete the first bracketed option below.**

**********

Test the water system in accordance with the applicable AWWA standard specified below. [Where water mains provide fire service, test in accordance with the special testing requirements given in the paragraph SPECIAL TESTING REQUIREMENTS FOR FIRE SERVICE. ]Test ductile-iron water mains 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] is not to exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other methods. Test PVC and PVCO plastic water systems made with PVC pipe in accordance with the requirements of AWWA C605 for pressure and leakage tests. The amount of leakage on pipelines made of PVC water main pipe is not to exceed the amounts given in AWWA C605, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test concrete water mains in accordance with the recommendations in AWWA M9, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines is not to exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints is not to exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. To stop leakage, repair welded joints only by welding. Test water service lines in accordance with requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints, [and ]screwed joints. Do not backfill utility trench or begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least [7][_____] days after placing of the concrete.

3.3.1.2 Hydrostatic Sewer Test

**********

**NOTE: Refer to state standard for minimum test pressure or if state standards are not applicable use a minimum test pressure of200 kPa 30 psi.**

**********

The hydrostatic pressure sewer test will be performed in accordance with the applicable AWWA standard for the piping material or AWWA C600[ with a minimum test pressure of [_____]].

3.3.1.3 Leakage Test

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.

For PE perform leak testing in accordance with ASTM F2164.

3.3.1.4 Bacteriological Testing

**********
**NOTE: Option A is recommended for bacteriological tests. Delete Option A requirements and provide applicable requirements if Option B is preferred.**
**********

Perform bacteriological tests in accordance with AWWA C651 [Option A][Option B].[ For new water mains use Option A and obtain two sets of samples for coliform analysis, each sample being collected at least 16 hours apart. Take samples every 370 m 1,200 ft plus one set from the end of the line and at least one from each branch greater than one pipe length.] Analyze samples by a certified laboratory, and submit the results of the bacteriological samples.

3.3.1.5 Backflow Preventer Tests

After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

3.3.1.6 Special Testing Requirements for Fire Service

**********
**NOTE: NFPA 24 requires a minimum test pressure of 1400 kPa 200 psi or 375 kPa 50 psi in excess of the system working pressure. Where water mains or water service lines provide fire service or water and fire service, they must be tested in accordance with NFPA 24.**
**********

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24

3.3.1.7 Tracer Wire Continuity Test

**********
**NOTE: To ensure future ability to locate non-metallic mains, require tracer wire continuity verification. Delete this requirement for metallic mains, including concrete mains with steel cylinders.**
**********

Test tracer wire for continuity after service connections have been completed and prior to final pavement or restoration. Verify that tracer wire is locatable with electronic utility locating equipment. Repair breaks or separations and re-test for continuity.

## 3.4 SYSTEM STARTUP

Water mains and appurtenances must be completely installed, disinfected, flushed, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Obtain approval by the Contracting Officer prior to the new water piping being placed into service.

## 3.5 CLEANUP

Upon completion of the installation of water lines and appurtenances, remove all debris and surplus materials resulting from the work.

-- End of Section --