SECTION 33 11 00

*** WATER UTILITY DISTRIBUTION PIPING

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 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

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 WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2010; Addenda 2011) 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	(2010) 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	(2011) 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	(2011) 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	(2012) 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	(2013) 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	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2014) Dry-Barrel Fire Hydrants
AWWA C503	(2014) 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	(2015) Cold-Water Meters - Compound Type
AWWA C703	(2015) Cold-Water Meters - Fire Service Type
AWWA C704	(2015) 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	(2013) Fiberglass Pressure Pipe
AWWA M11	(2016) Steel Pipe: A Guide for Design and Installation
AWWA M23	(2002; 2nd Ed) Manual: PVC Pipe - Design and Installation
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
AWWA M6	(2012) Water Meters - Selection, Installation, Testing, and Maintenance
AWWA M9	(2008; Errata 2013) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

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

ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2013) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
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

ASTM INTERNATIONAL (ASTM)

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 A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2014) 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	(2009; R 2014) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal

ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
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	(2016) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2018) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C1433	(2016b) Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C94/C94M	(2017a) Standard Specification for Ready-Mixed Concrete
ASTM D1599	(2014; E 2015) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D1784	(2011) 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	(1998; R 2011) 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) 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 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	(2013) Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
ASTM F2620	(2013) Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
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) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

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	(2013) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1961	(2013) Standard on Fire Hose
NFPA 1963	(2014) Standard for Fire Hose Connections
NFPA 24	(2016; ERTA 2016) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NSF INTERNATIONAL (NSF)

NSF 372	(2011) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2017b) Plastics Piping System Components and Related Materials
NSF/ANSI 61	(2017) Drinking Water System Components - Health Effects

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2016; with Change 1) Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 246	(2011; Reprint Feb 2013) Hydrants for Fire-Protection Service
UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
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 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 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 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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. 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

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

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

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

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

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

2.1.1.1.1 Pipe and Fittings

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

[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

2.1.1.2.1 PVC and PVCO Piping

2.1.1.2.1.1 PVC Piping

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

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.

[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

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 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

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

AWWA C950, Type [I] [II], Pressure Class 150 with a minimum pipe stiffness of 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 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)]

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.]

[Pipe has been designed for the following minimum conditions:

a. Pressure rating - [_____] psi

b. Earth cover - [_____] feet

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

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

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

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 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.

2.1.1.5.2 Wall Thickness for Pipe and Fittings

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

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

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

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.

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].

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]:

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.

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.
[
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 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 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

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

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

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

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 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 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 [_____] 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 [_____] inch gate valves with bypasses.] [Provide gate valves [on [_____] inch service lines] with threaded ends.][Gate valves[on [_____] 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 3 Inch Size and Larger [in Valve Pit(s)] [and] [Aboveground Locations]

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 175[_____] psi

Match materials for UL 262 gate valves to the reference standards specified in AWWA C500. [[[_____] inch]Gate valves are nonrising stem type or inside-screw type [where indicated].] [[[_____] 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 [_____] inch size with gearing[and indicator], AWWA C500 or AWWA C509.][Provide [_____] inch size valve with bypasses, AWWA C500.] Provide all valves from one manufacturer.

2.1.2.3 Check Valves

[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 [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

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 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 [_____] psi operating pressure on the inlet side, with outlet pressure set for [_____] 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 3 Inch in Size [on Buried Piping]

Gate valves smaller than 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 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 2 Inch in Size

Provide check valves with a minimum working pressure of 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 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 [5 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][_____].]

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

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 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

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.

[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.
]

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 6 inch inlet, 5 1/4 inch valve opening, one [4 1/2] [_____] inch pumper connection, and two 2 1/2 inch hose connections with national standard fire hose threads in accordance with NFPA 1963.] Provide [Wet-barrel type fire hydrants, AWWA C503 or UL 246, "Wet Barrel" with 6 inch inlet, one [4 1/2] [_____] inch pumper connection, and two 2 1/2 inch

hose connections with national standard fire hose threads in accordance with NFPA 1963. 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

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 6 inch inlet, 4 1/4 inch minimum valve opening, one [4 1/2] [_____] inch pumper connection, and one 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

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. 200 feet of 2-1/2 inch woven jacketed, rubber lined hose matching the requirements of NFPA 1961 with a minimum service test pressure of 300 psi; 100 feet of 1-1/2 inch woven jacketed, rubber lined hose matching the requirements of NFPA 1961 with a minimum service test pressure of 300 psi;

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

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

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

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

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

2.1.5 Meters

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

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

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

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 1/2 inch through 1 inch provide [split-case] [frost-protection-type design].

][2.1.5.4 Compound Type Meters

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

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

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

[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

[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

[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

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

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] [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: [_____] feet

Length: [_____] 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] [15,000 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 3 inches and larger.

2.1.5.12.2.3 Vault Valves

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

][2.1.5.12.3 Plastic Meter Boxes

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

a. One-piece molded construction

b. Vertical load rating for medium duty use of [15,000 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

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

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

[2.2.1.1 Thrust Blocks

Use ASTM C94/C94M concrete having a minimum compressive strength of [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

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 F when external temperatures reach as low as [_____] degree

F.

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

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 [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 50 foot-pound.

]2.2.4 Sleeve-Type Mechanical Couplings

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 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 5/8 inch diameter bolts; minimum number of bolts for each coupling is [_____] [for [_____] inch pipe], [_____] [for [_____] inch pipe,] [and] [_____] [for [_____] 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

[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

Provide a continuous bare copper or aluminum wire not less than 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

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

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

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

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 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 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 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.

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 10 feet, horizontally, from any sewer line.
]

3.2.1.1.7 Water Piping Crossing Sewer Piping

[Provide at least 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 10 feet, horizontally, of the crossing.][Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line relay the sewer line to ensure no joint closer than 3 feet.]

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.

[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 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 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".

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.

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

[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.

[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 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

[Connect [[_____] 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 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 [[_____] 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 12 inch and a maximum of 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 2 1/2 inch and larger backflow preventers, valves, and piping near floor with 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 [2 inches] [[_____] 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.
]
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 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 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 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, install fire hydrants with the 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

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 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 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 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.

3.3.1.3 Bacteriological Testing

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 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.

3.3.1.4 Backflow Preventer Tests

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

3.3.1.5 Special Testing Requirements for Fire Service

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

3.3.1.6 Tracer Wire Continuity Test

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 --