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Preparing Activity: NAVFAC Replacing without revision
NFGS of same number and date

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

SECTION 02510N

WATER DISTRIBUTION

09/00

NOTE: This guide specification covers the requirements for potable and nonpotable (raw water and sea or salt water) systems.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: For both potable and nonpotable (raw water and sea or salt water) systems, the largest size pipe is 600 mm 24 inches in diameter and the maximum working pressure does not exceed 1400 kPa 200 psi for pipelines 300 mm 12 inch size and smaller and 1000 kPa 150 psi for pipelines larger than 300 mm 12 inch size. This section covers exterior water distribution systems only.

1. Cathodic protection should be considered where the anticipated degree of corrosion is so great that coating systems, including polyethylene encasement, are not adequate to protect the piping for the desired life of the system.

2. When piping beneath open piers and other exposed locations is subject to freezing temperatures, include requirements for insulation and protective coverings in the project specification. Information on this subject related to open piers may be found in Technical Report R593, September 1968, "Freeze

Protection for Freshwater and Sanitary Piping Under
Open Piers," by the Naval Facilities Engineering
Services Center, 560 Center Drive, Port Hueneme,
California 93043-4328.

NOTE: The following information shall be shown on
the project drawings:

1. Plan and location of all new pipelines,
including size of pipe.
2. Maximum working pressure of the system.
3. Location, size, and type of service of existing
connecting, intersecting, and adjacent pipelines and
other utilities.
4. Paved areas and railroads which pass over new
pipelines.
5. Profile, where necessary to show unusual
conditions.
6. Class or thickness of pipe, including material
identification, and limits for same where class or
thickness will be different for different sections
of pipeline.
7. Bedding conditions.
8. Location of flanged joints, joints made with
sleeve-type mechanical couplings, grooved and
shouldered type joints, and insulating joints.
9. Location of valves, hydrants (showing which are
traffic type hydrants), and indicator posts; and
details concerning valves, where necessary.
10. Size and shape of hydrant operating nut and cap
nuts if nonstandard nuts are required; dimensions of
threads (major diameter, minor diameter, pitch
diameter, thread form, and number of threads per
inch) on hydrant hose and pumper connections if
nonstandard threads are required.
11. Connection of service line to water main, if
different from that specified.
12. Location or size of thrust blocks, including
type; or location of and details of metal harness,
when necessary (metal harness, when necessary, must
be shown for PVC plastic water main pipe).
13. Design details of concrete thrust blocks.
14. Design details for fire hydrant installation.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts

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

AREMA Manual	(2003) Manual for Railway Engineering
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AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(2002; A C203a-99) Coal-Tar Protective

Coatings and Linings for Steel Water
Pipelines - Enamel and Tape - Hot-Applied

AWWA C205	(2000) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied
AWWA C206	(1997) Field Welding of Steel Water Pipe
AWWA C207	(2001) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
AWWA C208	(2001) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	(2000) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipe
AWWA C210	(2003) Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C301	(1999) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C303	(2002) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
AWWA C500	(2002; A C500a-95) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C503	(1997) Wet-Barrel Fire Hydrants
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C800	(2001) Underground Service Line Valves and Fittings
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In.

Through 12 In. (100 mm Through 300 mm),
for Water Distribution

AWWA C906 (1999) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission

AWWA M11 (1989) Manual: Steel Pipe: A Guide for Design and Installation

AWWA M23 (2002) Manual: PVC Pipe - Design and Installation

AWWA M9 (1995) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.22 (2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.4 (1998) Gray Iron Threaded Fittings

ASME B18.2.2 (1987; R 1999) Square and Hex Nuts

ASME B18.5.2.2M (1982; R 2000) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A 307 (2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 47 (1999) Ferritic Malleable Iron Castings

ASTM A 47M (1990; R 1996) Ferritic Malleable Iron Castings (Metric)

ASTM A 48 (1994ae1) Gray Iron Castings

ASTM A 48M (1994e1) Gray Iron Castings (Metric)

ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 536 (1984; R 1999e1) Ductile Iron Castings

ASTM A 563 (2000) Carbon and Alloy Steel Nuts

ASTM A 563M (2001) Carbon and Alloy Steel Nuts (Metric)

ASTM A 746	(1999) Ductile Iron Gravity Sewer Pipe
ASTM B 32	(2003) Solder Metal
ASTM B 42	(2002) Seamless Copper Pipe, Standard Sizes
ASTM B 61	(2002) Steam or Valve Bronze Castings
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 150	(2002ae1) Portland Cement
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM D 1527	(1999) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(2001) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2282	(1999) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)
ASTM D 2466	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2468	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(2001) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for

Joining Plastic Pipe

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

MSS SP-80 (2003) Bronze Gate, Globe, Angle and Check
Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (2002) Installation of Private Fire
Service Mains and Their Appurtenances

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS WW-P-460 (Rev D) Pipe Fittings; Brass or Bronze
(Threaded) Classes 125 and 250 Pound

UNDERWRITERS LABORATORIES (UL)

UL 246 (1993; Rev thru Dec 1998) Hydrants for
Fire-Protection Service

UL 262 (2004) Gate Valves for Fire-Protection
Service

UL 312 (2004) Check Valves for Fire-Protection
Service

UL 789 (2004) Indicator Posts for Fire-Protection
Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3 (1992) Recommended Practice for the
Installation of Polyvinyl Chloride (PVC)
Pressure Pipe (Nominal Diameters 4-36 Inch)

UBPPA UNI-B-8 (2000) Recommended Practice for the Direct
Tapping of Polyvinyl Chloride (PVC)
Pressure Water Pipe (Nominal Diameters
6-12 Inch)

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

**NOTE: Provide only those pipe sizes and materials
applicable to the project requirements.**

NOTE: Choose one of the following options.

[Provide water distribution mains indicated as [_____] mm [_____] inch
lines of [ductile-iron] [polyvinyl chloride (PVC) plastic] [concrete]
[steel] or [_____] pipe. Provide water main accessories, gate valves [and

check valves] as specified and where indicated. Submit design calculations of water piping.]

NOTE: Choose the option below for LANTNAVFACENGCOM projects.

[Provide water distribution mains indicated as 100 through 300 mm 4 through 12 inch diameter pipe sizes of [ductile-iron] [or] [polyvinyl chloride (PVC) plastic] pipe. Provide [ductile iron] [or] [concrete] pipe for 300 mm 12 inch diameter or larger pipe sizes. Also provide water main accessories, gate valves [and check valves] as specified and where indicated.]

1.2.2 Water Service Lines

NOTE: Provide only those pipe sizes and materials applicable to the project requirements.

NOTE: Delete the sentence allowing water main pipe to be used for water service lines except when there is water service pipe of 80 mm 3 inch size or larger included in the project. Ductile-iron piping is available in 80 mm 3 inch size, but 100 mm 4 inch size is smallest for PVC plastic water main pipe.

NOTE: Choose one of the following options.

[Provide water service lines indicated as [_____] mm [_____] inch lines from water distribution main to building service at [a point approximately 1.5 m 5 feet from building] [the point[s] indicated]. Water service lines shall be [copper pipe] [copper tubing] [polyvinyl chloride (PVC) plastic pipe] [acrylonitrile-butadiene-styrene (ABS) plastic pipe] [or] [steel pipe]. [[Ductile-iron] [or] [polyvinyl chloride (PVC) plastic] pipe appurtenances, and valves as specified for water mains may also be used for service lines.] Provide water service line appurtenances as specified [and where indicated]. Submit design calculations of water piping.]

NOTE: Choose the option below for LANTNAVFACENGCOM projects.

[Provide water service lines indicated as less than 100 mm 4 inch lines from water distribution main to building service at [a point approximately 1.5 m 5 feet from building] [the point[s] indicated]. Water service lines shall be [copper tubing] [polyvinyl chloride (PVC) plastic pipe] [or] [acrylonitrile-butadiene-styrene (ABS) plastic pipe]. Provide water service line appurtenances as specified [and where indicated].]

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

NOTE: Delete bracketed wording in the first sentence when steel pipe is not allowed.

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

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.

SD-05 Design Data

design calculations of water piping

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining [and coating]

lining

Fire hydrants

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Installation procedures for water piping

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store [plastic piping, 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] [and] [hydrants] free of dirt and debris.

1.4.2 Handling

**NOTE: Delete coatings not allowed for the project.
AWWA M11 in the chapter on protective coatings
contains information on the relative merits of**

cement mortar and coal-tar enamel coatings. See Foreword to AWWA C210 for information on coal-tar epoxy coating.

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store [plastic piping, jointing materials and] rubber gaskets that are not to be installed immediately, under cover out of direct sunlight. [Handle steel pipe with [coal-tar enamel] [coal-tar epoxy] coating in accordance with the provisions for handling coal-tar-enamel coated pipe in AWWA C203.]

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

NOTE: Allowable Piping Materials:

1. The project specification should allow all piping materials for water mains and for water service lines which are suitable for the project, each to be permitted as a Contractor's option.

2. Refer to the appropriate NAVFAC Design Manual on water supply systems for general information on piping materials suitable for use on water mains and on water service lines for water distribution systems.

3. Pipe materials which are known to be unsuitable for particular local conditions (i.e., corrosion, deterioration, etc.) should not be permitted for the project. However, consider use of more effective protective coatings, etc., where economically feasible.

4. Approval of polyethylene water service line piping, previously allowed by this guide specification, was withdrawn by Amendment 2 (September 1982) to TS-02713 (January 1981) because of widespread problems with the pipe. This withdrawal of approval remains in force until further notice.

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

NOTE: Insert the necessary Pressure Class/Thickness Class to meet project conditions, as determined from AWWA C151, Table 51.1, for Pressure Class, and Tables 51.6 and 51.7 for Thickness Class.

- a. Pipe and Fittings: Pipe, [except flanged pipe,] AWWA C151, [Pressure Class [____]] [Thickness Class [____]]. [Flanged pipe, AWWA C115.] Fittings, AWWA C110 or AWWA C153 [; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint]. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104, standard thickness.

- b. Joints and Jointing Material:

NOTE: Push-on joint or mechanical joint may be used except when the greater deflection afforded by the mechanical joint (as compared to the push-on joint) is considered necessary for all joints in the distribution system. See AWWA C600 for allowable deflection on each type of joint. When mechanical joints, flanged joints, mechanically coupled type joints using sleeve-type mechanical couplings, grooved or shouldered type joints, and insulating joints are specified as exceptions to the basic jointing method, their location(s) should be either indicated on the project drawings or specified using terminology consistent with that on the project drawings.

NOTE: Do not locate flanged joints, grooved joints, and shouldered joints on buried pipelines unless they are in valve pits or chambers.

(1) Joints: Joints for pipe and fittings shall be [push-on joints] [or] [mechanical joints] [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.] [Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings."] [[Grooved] [or] [shouldered] type joints may be used in lieu of [flanged joint or] push-on joint, except where joint is buried.]

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade

65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

(5) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115. Bolts and nuts, as recommended in the Appendix to AWWA C115.

(6) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

NOTE: At the text below, do not use grooved and shouldered type joints for LANTNAVFACENGCOM projects.

(7) [Grooved] [and] [Shouldered] Type Joints: [Grooved] [and] [shouldered] pipe ends and couplings, AWWA C606. Joint dimension shall be as specified in AWWA C606 for rigid joints [, except that where joints are indicated to be flexible, joint dimensions shall be as specified for flexible joints].

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

NOTE: Use Pressure Class 150 (DR 18) except when Pressure Class 200 (DR 14) is necessary. See Appendix A to AWWA C900. Molecular Oriented (MO) PVC pipe can only be specified for Pressure Class 150 and with cast-iron-pipe-equivalent OD. When due to external loading, pipe of greater strength than Class 200 is required, do not include PVC plastic water main pipe.

- a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class [150 (DR 18)] [200 (DR 14)] with cast-iron-pipe-equivalent OD. [Molecular Oriented (MO) PVC pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 with cast-iron-pipe-equivalent OD.] Fittings shall be gray iron or ductile iron, AWWA C110 or AWWA C153, and have cement-mortar lining, AWWA C104, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph.
- b. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA

C111. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. 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, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.1.3 Polyethylene (PE) Plastic Piping

Pipe and heat-fusion fittings shall conform to AWWA C906.

2.1.1.4 Concrete Piping

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

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

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

NOTE: AWWA recommends a minimum of 1.8 m 6 feet of earth cover for ordinary conditions. Delete this information when depth is indicated on the drawings.

- a. Piping and Fittings: [Prestressed steel cylinder type reinforced concrete pipe, AWWA C301. Steel cylinder type reinforced concrete pipe, not prestressed, AWWA C300.] Pretensioned steel cylinder type reinforced concrete pipe, AWWA C303. Pipe shall be designed for the following minimum conditions:

Pressure rating - [_____] kPa psi

[Earth cover - [_____] mm feet.]

Water hammer - 40 percent of pressure rating

Live load - AASHTO H 20 truck loading

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

Do not order pipe until design calculations have been approved. Fittings shall conform to the same specification as that used for the pipe and shall be designed as specified for the pipe. [Cement used in the manufacture of the pipe and fittings shall be [Type II] [Type V] [low alkali cement] conforming to ASTM C 150.] Identification marking for pipe and fittings shall include the pressure rating.

- b. Jointing Material: Gaskets shall be as specified in the referenced specification for the pipe.

2.1.1.5 Steel Piping

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

NOTE: Delete "for underground lines" except when aboveground water distribution mains are included in the project.

NOTE: Delete coatings not allowed for the project. AWWA M11 in the chapter on protective coatings contains information on the relative merits of cement-mortar and coal-tar enamel coatings. See

Foreword to AWWA C210 for information on coal-tar epoxy coating.

NOTE: Delete requirements for lining of aboveground piping when aboveground piping is not included in project. When included, pipe and fittings for aboveground lines will be furnished with lining only. Exterior protection for aboveground piping should be specified in Section 09900, "Paints and Coatings."

NOTE: Delete requirements for and references to steel pipe and associated fittings for LANTNAVFACENGCOM projects.

- a. Pipe and Fittings: Pipe, AWWA C200. Fittings, AWWA C208 and to AWWA C200, with reference to the requirements specified therein for "Special Sections." Pipe and fittings [for underground lines] shall have cement-mortar lining and [cement-mortar] [coal-tar enamel] [coal-tar epoxy] coating. [Pipe and fittings for aboveground lines shall have cement-mortar lining.] Ends of pipe and fittings shall be suitable for the joints and jointing materials used.

NOTE: In the text below, use the first bracketed wording when the project designer calculates the wall thickness for steel pipe and fittings. Use the second bracketed wording when the wall thickness determination is required to be made by the manufacturer of the pipe. Wall thickness determination of steel pipe, when calculated by the project designer, should be performed in the same manner as specified when it is to be done by the manufacturer of the pipe.

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

NOTE: A minimum earth cover of 1.5 m 5 feet is recommended for ordinary conditions. Delete this information when depth is indicated on the drawings.

- b. Wall Thickness for Pipe and Fittings: [The minimum metal thickness for steel pipe wall shall be [_____] mm inch, based on steel having a yield strength of [_____] kPa psi.] [Wall thickness of steel pipe and fittings shall be determined by the manufacturer of the pipe and calculated in the following manner. Design for the following minimum conditions:

Pressure rating.....[_____] kPa psi

[Earth cover.....[_____] mm feet]

Water hammer.....40 percent of pressure rating

Live load.....AASHTO H 20 truck loading

Allowable deflection.....2 percent of nominal pipe diameter

NOTE: At the text below, see AWWA M11, Chapter 6, "External Load" for values of E'. In the calculation of wall thickness for steel water main pipe, the value of E' (modulus of soil reaction) should be based on realistic expectations of sidefill compaction rather than theoretical ones.

Calculate pipe wall thickness on the basis of an allowable fiber stress in the steel equal to 50 percent of the minimum yield strength of the steel used in the manufacture of the pipe. Design procedure shall be in accordance with the methods given in AWWA M11, Chapter 4, "Determination of Pipe Wall Thickness," Chapter 5, "Water Hammer and Pressure Surge," and Chapter 6, "External Load." The value of E', modulus of soil reaction, shall be [_____] . Do not order the pipe until calculations have been approved.] Wall thickness of fittings shall be not less than that required for the pipe. Fittings shall be designed to withstand the hydrostatic pressure test specified herein in paragraphs entitled "Testing Procedure," and "Special Testing Requirements." When necessary to meet the pressure test requirements, fittings shall be reinforced in accordance with methods given in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

c. Joints and Jointing Materials

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

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

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

construction would be required only under unusual conditions. If required, specify as follows:

1. Substitute the following paragraph for d(1) of paragraph entitled "Steel Piping."

"(1) Cement-Mortar Lining: Materials for in-place cement-mortar lining shall be as specified in AWWA C602."

2. Insert the following new paragraph in its appropriate place at paragraph entitled "Installation of Steel Piping."

"c. Cement-mortar Lining of Pipeline in Place: Pipeline shall be cement-mortar lined after installation. Procedure shall be in accordance with AWWA C602."

3. Insert the latest publication of AWWA C602 in paragraph entitled "References."

(1) Joints: Joints for pipe and fittings shall be rubber-gasketed 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.] [Joints shall be [grooved] [or] [shouldered] type where indicated.] [Provide insulating joints where indicated.] [[Grooved] [or] [shouldered] type joints may be used in lieu of flanged joints.]

(2) Rubber-Gasketed Bell-and-Spigot Joints: Design of joints and pipe ends shall be in accordance with the pipe manufacturer's standard for this type of joint, as approved, except that the joint shall also meet the requirements specified for rubber-gasketed joints and rubber gaskets in AWWA C200.

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

(3) Welded Joints: Electrodes shall be of the quality specified in AWWA C206.

(4) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

(5) [Grooved] [and] [Shouldered] Type Joints: [Pipe ends shall be grooved by roll grooving or shall have welded-on adapters with cut grooves. Grooves made by roll grooving shall have dimensions as recommended by the coupling manufacturer. Cut grooves in adapters shall have dimensions conforming to AWWA C606.]

Couplings [and shouldered pipe ends], AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joint [, except that where joints are indicated to be flexible, joint dimensions shall be as specified for flexible joints].

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

(6) 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 will not be allowed.

(7) Insulating Joints: Design to prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115. Bolts and nuts shall be as recommended in the Appendix to AWWA C115.

d. Lining [and Coating]:

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

1. Substitute the following paragraph for d(1) of paragraph entitled "Steel Piping."

"(1) Cement-Mortar Lining: Materials for in-place cement-mortar lining shall be as specified in AWWA C602."

2. Insert the following new paragraph in its appropriate place at paragraph entitled "Installation of Steel Piping."

"c. Cement-mortar Lining of Pipeline in Place: Pipeline shall be cement-mortar lined after installation. Procedure shall be in accordance with AWWA C602."

3. Insert the latest publication of AWWA C602 in paragraph entitled "References."

(1) Cement-Mortar Lining: AWWA C205, shop-applied.

(2) Cement-Mortar Coating: AWWA C205, shop-applied.

NOTE: Use coal-tar enamel coating with double felt wraps instead of single layer of felt wrap where soil in which pipe is to be buried as classified as Group IV, Unusually Corrosive (as defined in AWWA M11, Chapter 10, "Principles of Corrosion and Corrosion Control") or as Class 4, Extreme (as defined in NAVFAC Design Manual on water supply systems; or where electrical resistivity of soil has been measured at less than 2,000 ohms/cc.

(3) 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]. Asbestos felt shall not be used; felt material shall be fibrous-glass mat as specified in Section 10 of AWWA C203. Shop-apply coating.

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

2.1.1.6 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of AREMA Manual, except for casing pipe, provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves [on Buried Piping]

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

NOTE: Delete all requirements involving gearing when no valves 400 mm 16 inch size and larger as specified in this paragraph are included in the project. Indicator should be required for geared valves where valve is in location where gate position cannot readily be seen.

NOTE: Delete requirements for bypasses when no valves 400 mm 16 inch size and larger as specified in this paragraph are included in the project. Fill

in blank with each valve size 400 mm 16 inches and larger included in the project.

NOTE: Add the following requirement in areas where it is known that the local water promotes galvanic corrosion in the form of dezincification or dealuminumization: "Bronze used in valves shall be Grade A, Grade D, or Grade E as specified in" (for Water Main Gate Valves) "AWWA C500 or AWWA C509"; (for Water Main Check Valves) "AWWA C508"; (for Water Service Line Gate Valves 80 mm 3 Inch Size and Larger) "AWWA C500."

Add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Valves shall have a protective epoxy interior coating conforming to AWWA C550." Insert the latest publication of AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants" in paragraph entitled "References." Protective coating should be required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion.

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of [_____] kPa psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals [, except for those valves for which gearing is specified, in which case use conventional packing in place of O-ring seal].

Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to [cement piping or to] sleeve-type mechanical coupling. Valve ends and gaskets for connection to [cement piping or to] sleeve-type mechanical coupling shall conform to the applicable requirements specified [respectively] for the [joint or] coupling. [Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262.] [Provide [_____] mm inch size valves with gearing [and indicators], AWWA C500.] [Provide [_____] mm inch size valves with bypasses, AWWA C500.] Valves shall be of one manufacturer.

2.1.2.2 Gate Valves [in Valve Pit(s)] [and] [Aboveground Location]

NOTE: For ordinary conditions, outside-screw-and-yoke rising-stem type is preferred

to nonrising stem/inside-screw type.

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

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

NOTE: Delete all requirements involving gearing when no valves 400 mm 16 inch size and larger as specified in this paragraph are included in the project. Indicator should be required for geared valves where valve is in location where gate position cannot readily be seen.

NOTE: Delete requirements for bypasses when no valves 400 mm 16 inch size and larger as specified in this paragraph are included in the project. Fill in blank with each valve size 400 mm 16 inches and larger included in the project.

NOTE: Add the following requirement in areas where it is known that the local water promotes galvanic corrosion in the form of dezincification or dealuminumization: "Bronze used in valves shall be Grade A, Grade D, or Grade E as specified in" (for Water Main Gate Valves) "AWWA C500 or AWWA C509"; (for Water Main Check Valves) "AWWA C508"; (for Water Service Line Gate Valves 80 mm 3 Inch Size and Larger) "AWWA C500."

Add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Valves shall have a protective epoxy interior coating conforming to AWWA C550." Insert the latest publication of AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants" in paragraph entitled "References." Protective coating should be required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion.

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves

conforming to: (1) AWWA C500 shall be [outside-screw-and-yoke rising-stem] [nonrising stem] type with [double-disc] [solid-wedge] gates and flanged ends, (2) AWWA C509 shall be [outside-screw-and-yoke rising-stem] [nonrising stem] type with flanged ends, and (3) UL 262 shall be [outside-screw-and-yoke] [inside-screw] type, shall have [double-disc or split-wedge] [solid or one-piece] type gate and flanged ends, and shall be designed for a hydraulic working pressure of [_____] kPa psi. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. [Valves [[_____] mm inch size] shall be nonrising stem type or inside-screw type [where indicated].] [Valves [[_____] mm inch size] shall have solid-wedge gates or solid or one-piece type gates [where indicated].] Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of flanged ends, valves may have [grooved] [or] [shouldered] ends suitable for [grooved] [or] [shouldered] type joints, as specified in paragraph entitled "Ductile-Iron Piping." [Valves [_____] mm inch size shall have gearing [and indicator], AWWA C500.] [Provide [_____] mm inch size valve with bypasses, AWWA C500.] Valves shall be of one manufacturer.

2.1.2.3 Check Valves

NOTE: Add the following requirement in areas where it is known that the local water promotes galvanic corrosion in the form of dezincification or dealuminumization: "Bronze used in valves shall be Grade A, Grade D, or Grade E as specified in" (for Water Main Gate Valves) "AWWA C500 or AWWA C509"; (for Water Main Check Valves) "AWWA C508"; (for Water Service Line Gate Valves 80 mm 3 Inch Size and Larger) "AWWA C500."

Add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Valves shall have a protective epoxy interior coating conforming to AWWA C550." Insert the latest publication of AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants" in paragraph entitled "References." Protective coating should be required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion.

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of [_____] kPa psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. [Valves shall be [spring-loaded] [weight-loaded] [where indicated].] In lieu of flanged ends, valves may have [grooved] [or] [shouldered] ends suitable for [grooved] [or] [shouldered] type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.4 Fire Hydrants

NOTE: For projects in all parts of the United States except California and Hawaii, delete requirements for and references to wet-barrel type hydrants. For projects in California and Hawaii, ascertain from the local fire department serving the base or station (1) whether wet-barrel type hydrants are desired exclusively, (2) whether dry-barrel type hydrants are necessary (in areas having freezing temperatures), or (3) whether either type hydrant is acceptable. Only dry-barrel type hydrants have hydrant stem. For hose gate valves in dry-barrel fire hydrants, use UL 246 as the standard reference.

The fire hydrant in most prevalent use in the U.S. is the one conforming to AWWA C502 or UL 246. Standard for this hydrant are National Standard pipe threads on hose and pumper connections and operating nut and cap nuts of pentagonal shape measuring 40 mm 1 1/2 inches from point to opposite flat at base. These threads and nuts are also standard for Factory Mutual approved hydrants. For the purposes of this guide specification, these threads and nuts will be defined as standard threads and nuts. Thread dimensions other than National Standard and operating nut and cap nuts differing in size and shape from that described above will be defined as nonstandard threads and nuts.

[Dry-barrel type] [or] [wet-barrel type] [, except that flush-type hydrants shall be provided where indicated]. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

NOTE: At the text below, add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Hydrants shall have a protective epoxy interior coating conforming to AWWA C550 on those portions continuously in contact with sea water or salt water." See Note H located at rear of text for guidance.

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

existing station where hydrants with nonstandard threads and nuts are in use; (2) project at new location where local fire department connects to hydrants with nonstandard threads and nuts.

- a. [Dry-Barrel Type] [and] [Wet-Barrel Type] Fire Hydrants: [Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 150 mm 6 inch inlet, 135 mm 5 1/4 inch valve opening, one [115] [] mm [4 1/2] [] inch pumper connection, and two 65 mm 2 1/2 inch hose connections. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves.] [Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 150 mm 6 inch inlet, one [115] [] mm [4 1/2] [] inch pumper connection, and two 65 mm 2 1/2 inch hose connections.] Inlet shall have [mechanical-joint or push-on joint end] [mechanical-joint end only] [, except where flanged end is indicated]; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as [specified in [AWWA C502] [or] [AWWA C503] or UL 246] [indicated]. [Hydrants indicated as "traffic type," shall have [frangible sections as mentioned in AWWA C502] [breakable features as mentioned in AWWA C503]. The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel [and upper and lower sections of hydrant stem] and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.]

NOTE: At the text below, add the following requirement when a protective interior coating is considered necessary for corrosion protection:
"Hydrants shall have a protective epoxy interior coating conforming to AWWA C550 on those portions continuously in contact with sea water or salt water." See Note H located at rear of text for guidance.

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

- b. Flush-Type Fire Hydrants: Hydrants shall conform to the

applicable requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have 150 mm 6 inch inlet, 108 mm 4 1/4 inch minimum valve opening, one [115] [] mm [4 1/2] [] inch pumper connection, and one 65 mm 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have 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 shall be as [specified in AWWA C502] [indicated].

2.1.2.5 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.6 Valve Boxes

Provide a valve box for each gate valve [on buried piping] [, except where indicator post is shown]. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 135 mm 5 1/4 inches. [as indicated]. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.7 Sleeve-Type Mechanical Couplings

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

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

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. [For [ductile iron] [and] [PVC plastic] pipe, the middle ring shall be of cast-iron [or steel; and the follower rings shall be of malleable or ductile iron].] [For steel piping, the middle ring shall be of steel and the follower rings shall be of steel or malleable iron.] [Cast iron, ASTM A 48M ASTM A 48, not less than Class 25.] Malleable and ductile iron shall, conform to ASTM A 47M ASTM A 47 and ASTM A 536, respectively. [Steel shall have a strength not less than that of the pipe.] Gaskets

shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563M ASTM A 563, Grade A; or round-head square-neck type bolts, ANSI B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 16 mm 5/8 inch in diameter; minimum number of bolts for each coupling shall be [_____] [for [_____] mm inch pipe [, [_____] for [_____] mm inch pipe,] [and] [_____] for [_____] mm inch pipe]. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.2.8 Tracer Wire for Nonmetallic Piping

NOTE: As an option, warning tape as specified in Section 02302, "Excavation, Backfilling, and Compacting for Utilities," may be used.

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

2.2 WATER SERVICE LINE MATERIALS

NOTE: This specification does not contemplate maximum working pressures in service lines which would require piping and valves of pressure rating exceeding 1000 kPa 150 psi. However, should the need arise for small-diameter pipelines to operate at working pressures exceeding 1000 kPa 150 psi, consult the various pipe, fitting, and valve specifications used herein to determine the proper pressure rating designation for the given material at the higher pressure, and modify the appropriate paragraphs to the extent necessary.

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, FS WW-P-460, 825 kPa 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88M ASTM B 88, Type K. Fittings for solder-type joint, ANSI B16.18 or ASME B16.22; fittings for compression-type joint, ASME B16.26, flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

NOTE: In the text below, delete bracketed wording
where piping is to be installed at or exposed to
temperatures below 4.5 degrees C 40 degrees F.

- a. Polyvinyl Chloride (PVC) Plastic Piping: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 1000 kPa 150 psi minimum pressure rating. Fittings, ASTM D 2466. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: [PVC 1120/PVC I; PVC 1220/PVC 12;] PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564.
- b. Acrylonitrile-butadiene-styrene (ABS) Plastic Piping: ASTM D 1527 or ASTM D 2282, with pipe schedule or SDR as necessary to provide 1000 kPa 150 psi minimum pressure rating. Fittings, ASTM D 2468, as required to provide barrel wall thickness not less than that of the pipe. Solvent cement for jointing, ASTM D 2235.

2.2.1.4 Steel Pipe and Associated Fittings

NOTE: Delete requirements for and references to
steel pipe and associated fittings for
LANTNAVFACENGCOM projects.

Pipe, ASTM A 53, Standard Weight, zinc-coated. Fittings, ASME B16.4, Class 125, zinc coated; or ASME B16.3, Class 150, zinc coated, threaded.

2.2.1.5 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

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

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

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

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. [Where multiple gooseneck connections are required for an individual service, goosenecks shall be connected to the service line through a suitable approved brass or bronze branch connection; the total clear area of the branches shall be at least equal to the clear area of the service line.] Length of goosenecks shall be in accordance with standard practice.

2.2.2.4 Gate Valves [on Buried Piping]

NOTE: Add the following requirement in areas where it is known that the local water promotes galvanic corrosion in the form of dezincification or dealuminumization: "Bronze used in valves shall be Grade A, Grade D, or Grade E as specified in" (for Water Main Gate Valves) "AWWA C500 or AWWA C509"; (for Water Main Check Valves) "AWWA C508"; (for Water Service Line Gate Valves 80 mm 3 Inch Size and Larger) "AWWA C500."

Add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Valves shall have a protective epoxy interior coating conforming to AWWA C550." Insert the latest publication of AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants" in paragraph entitled "References." Protective coating should be required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion.

Gate valves 80 mm 3 inch size and larger [on buried piping] AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 1200 kPa 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. [Valves [on [] mm inch service lines] shall have threaded ends.] [Valves [on [] mm inch service lines] shall have ends suitable for 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 plastic water main

pipe]; gaskets and pipe ends, AWWA C111.]

2.2.2.5 Gate Valves [on Buried Piping]

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

2.2.2.6 Gate Valve 80 mm 3 Inch Size and Larger

NOTE: Add the following requirement in areas where it is known that the local water promotes galvanic corrosion in the form of dezincification or dealuminization: "Bronze used in valves shall be Grade A, Grade D, or Grade E as specified in" (for Water Main Gate Valves) "AWWA C500 or AWWA C509"; (for Water Main Check Valves) "AWWA C508"; (for Water Service Line Gate Valves 80 mm 3 Inch Size and Larger) "AWWA C500."

Add the following requirement when a protective interior coating is considered necessary for corrosion protection: "Valves shall have a protective epoxy interior coating conforming to AWWA C550." Insert the latest publication of AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants" in paragraph entitled "References." Protective coating should be required on all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion.

The three optional bracketed wordings concerning gate type (double-disc or solid-wedge/one-piece) in the second and the third sentences (referring, respectively, to AWWA C500 and UL 262) should be used as follows: first optional wording only, second optional wording only, or first and third optional wordings together, depending on the gate type(s) needed for the project (each third optional wording runs from "except" to end of sentence). When a gate valve is installed in an upside down position, the solid wedge type gate should be specified, since the double-disc type does not seat properly in this position.

Gate valves 80 mm 3 inch size and larger in [valve chambers] [valve pits] [and] [aboveground locations], AWWA C500 or UL 262 and of one make. Valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem type with flanged ends and [double-disc] [solid-wedge] gates [, except that valves [_____] mm inch size] shall have solid-wedge gates [where indicated], and (2) UL 262 shall be outside-screw-and-yoke type, shall be designed for a hydraulic working pressure of 1200 kPa 175 psi, and shall have flanged ends and [double-disc or split-wedge] [solid or one-piece] type gate [, except that valves [_____] mm inch size] shall have solid or one-piece type gate [where indicated]. Materials for UL 262 valves shall

conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by a counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.7 Gate Valves Smaller Than 80 mm 3 Inch Size in Valve Pits

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

2.2.2.8 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

2.2.2.9 Valve Boxes

Provide a valve box for each gate valve [on buried piping]. Valve boxes shall be of [cast iron] [or] [precast concrete] [as indicated] of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 135 mm 5 1/4 inches [as indicated]. [Cast-iron box shall have a heavy coat of bituminous paint.]

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

NOTE: Choose one of the following options.

[Terminate the work covered by this section at a point approximately 1.5 m 5 feet from the building [, unless otherwise indicated]. [Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 3.0 m 10 feet from any sewer line.] [Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 3.0 m 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 900 mm 3 feet horizontally of the crossing.] [Lay water lines which cross sewer force mains and inverted siphons at least 600 mm 2 feet above these sewer lines; when joints in the sewer line are closer than 900 mm 3 feet horizontally from the water line, encase these joints in concrete.] [Do not lay water lines in the same trench with [gas lines] [fuel lines] [or] [electric wiring].]]

NOTE: Choose the option below for LANTNAVFACENGCOM

projects.

[Terminate the work covered by this section at a point approximately 1.5 m 5 feet from the building [, unless otherwise indicated]. [Do not lay water lines in the same trench with [gas lines] [fuel lines] [or] [electric wiring].]]

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 3.0 m 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 3.0 m 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 450 mm 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 450 mm 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 450 mm 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 6.1 m 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

NOTE: Earthwork requirements for pipe trenches,

including bedding, are covered in Section 02300 EARTHWORK. The applicable requirements for exterior water distribution system which are set forth in Section 02300 must be incorporated into the project specification, whether in Section 02300 or in an all-inclusive earthwork section. The above referenced section number and title is subject to change. The specifier should verify the current appropriate specification and revise as necessary if different.

Insert the appropriate Section number and title in the blank below using proper format per UFC 1-300-02.

Perform earthwork operations in accordance with [_____.]

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be 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 proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports [where indicated and] where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. [Depth of cover over top of pipe shall not be less than 760 mm 2 1/2 feet.]

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

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

[Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure [in accordance with the

recommended procedures of the manufacturer of the pipe being tapped] [as indicated] [, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe].]

[All connections to PWC PEARL'S potable water lines 300 mm 12 inches in diameter and smaller using corporation stops or tapping sleeves and tapping valves shall only be made by PWC PEARL'S forces. Coordinate this work, via the Contracting Officer, with PWC PEARL'S and provide PWC PEARL, Utilities Department, Code 652, telephone 471-0542, 14 calendar days advance notification of the date of connection. The Government will furnish, install and operate the tapping machine. Equipment necessary for the installation and operation of the tapping machine as well as necessary cutting blades will be provided by the Government. Disinfection of the tapping machine will be done by the Government. Provide [corporation stops,] [tapping sleeves and tapping valves,] and all other material, labor, and equipment necessary for the connection. Perform all earthwork and disinfection work at the connection prior to installation of the tapping machine by the Government. Perform the disinfection work in the presence of the PWC PEARL Utilities Department personnel. All other connections, including wet tapping mains larger than 300 mm 12 inches in diameter and installation of new pipe fittings in existing mains, shall be performed by the Contractor. Make connections to existing water lines in the presence of the PWC PEARL Utilities Department personnel. Provide PWC PEARL, Utilities Department, Code 652, telephone 471-0542, 14 calendar days advance notification of the date of connection.]

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

**NOTE: At the text below, do not use grooved and
shouldered type joints for LANTNAVFACENGCOM projects.**

- a. Jointing: [Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.] [Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111.] [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 to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent

the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer.] [Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.] [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 approved 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 shall 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. Pipe Anchorage: Provide [concrete thrust blocks (reaction backing)] [metal harness] for pipe anchorage [, except where metal harness is indicated]. [Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.] [Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24 [, except as otherwise indicated].]

NOTE: Delete the following paragraph except when required. See the NAVFAC Design Manual on water supply systems for guidance.

NOTE: At the text below, see Foreword to AWWA C105 for guidance on selecting Class of polyethylene film.

- c. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using [Class A] [Class C] polyethylene film, in accordance with AWWA C105.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of 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 an approved 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 UBPPA UNI-B-3 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 UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable 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 UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111. 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. Pipe Anchorage: Provide [concrete thrust blocks (reaction backing)] [metal harness] for pipe anchorage [, except where metal harness is indicated]. [Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.] [Metal harness shall be as indicated.]

3.1.2.3 Installation of Polyethylene (PE) Plastic Piping

PE pipes shall be installed in accordance with ASTM D 2774.

3.1.2.4 Installation of Concrete Piping

Except as otherwise specified in the following subparagraphs, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines;" with the laying and joining requirements specified in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe"; and with the recommendations given in AWWA M9, Chapter 7, "Thrust Restraining Methods."

- a. Jointing: Make joints with the gaskets specified for concrete pipe joints, using an approved lubricant recommended by the manufacturer. Assemble joints in accordance with the joining requirements specified in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying the pipe in AWWA M9, Chapter 6, "Installation by Trenching or Tunneling--Methods and Equipment."

- b. Pipe Anchorage: Provide [concrete thrust blocks (reaction backing)] [metal harness] for pipe anchorage [, except where metal harness is indicated]. [Thrust blocks shall be in accordance with the recommendations of AWWA M9, Chapter 7, "Thrust Restraining Methods," except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.] [Metal harness shall be in accordance with the recommendations for tied joints in AWWA M9, Chapter 7, "Thrust Restraining Methods."]

3.1.2.5 Installation of Steel Piping

NOTE: Delete requirements for and references to steel pipe and associated fittings for LANTNAVFACENGCOM projects.

Insert the appropriate Section number and title in the blank below using format per UFC 1-300-02.

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

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

Under ordinary conditions, steel water pipe and fittings in the sizes included in water distribution systems covered by this specification are furnished with factory-applied cement-mortar lining. In-place cement-mortar lining for new construction would be required only under unusual conditions. If required, specify as follows:

1. Substitute the following paragraph for d(1) of paragraph entitled "Steel Piping."

"(1) Cement-Mortar Lining: Materials for in-place cement-mortar lining shall be as specified in AWWA C602."

2. Insert the following new paragraph in its appropriate place at paragraph entitled "Installation of Steel Piping."

"c. Cement-mortar Lining of Pipeline in Place: Pipeline shall be cement-mortar lined after installation. Procedure shall be in accordance with AWWA C602."

3. Insert the latest publication of AWWA C602 in paragraph entitled "References."

- a. Jointing: Make rubber-gasketed bell-and-spigot joints with the gaskets previously specified for this type joint, using an approved 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 to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without straining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions.] [[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 approved groove rolling equipment and groove adapters in the field only with approved groove cutting equipment; groove rolling and groove cutting equipment shall be designed 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 shall 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 conforming to and applied in accordance with AWWA C209.]
- b. Pipe Anchorage: Provide [concrete thrust blocks (reaction backing)] [metal harness] for pipe anchorage [, except where metal harness is indicated]. [Thrust blocks shall be in accordance with the recommendations for thrust restraint in AWWA M11, Chapter 13, "Supplementary Design Data and Details," except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 15 MPa 2500 psi

at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.] [Metal harness shall be in accordance with the recommendations for joint harnesses in AWWA M11, Chapter 13, "Supplementary Design Data and Details" [, except as otherwise indicated]. Metal harness shall be fabricated by the pipe manufacturer and furnished with the pipe.]

3.1.2.6 Installation of Valves and Hydrants

- a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. [Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation."] [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 gate valves [and check valves] as specified for making and assembling the same type joints between pipe and fittings.

- b. Installation of Hydrants: Install hydrants [, except for metal harness,] in accordance with AWWA C600 for 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 hydrant is attached.] Install hydrants with the 115 mm 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.2.7 Installation Beneath 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 AREMA Manual. [For PVC plastic water main pipe, also install in accordance with the recommendations of AWWA M23 for installation of casings.]

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 1.5 m 5 feet from the building line at [a point directed by the Contracting Officer] [the point[s] indicated]; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

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

NOTE: Delete requirements for and references to steel pipe and associated fittings for LANTNAVFACENGCOM projects.

[Connect service lines [[_____] mm inch size] to the main [by a corporation stop and gooseneck and install a service stop below the frostline] [as indicated].] [Connect service lines 50 mm 2 inch size to the main [with a rigid connection or a corporation stop and gooseneck and install a gate valve on service line below the frostline] [as indicated].] [Connect service lines [[_____] mm inch size] to the main [with a rigid connection and install a gate valve on service line below the frostline] [as indicated].] [Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.] [Connect service lines to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."] [Connect service lines to concrete water mains in accordance with the recommendations of AWWA M9, Chapter 12, "Tapping Concrete Pressure Pipe."] [Connect 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."]

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

NOTE: Delete requirements for and references to steel pipe and associated fittings for LANTNAVFACENGCOM projects.

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

(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. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

(2) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more 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) Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

NOTE: At the text below, use coal-tar enamel coating with double felt wraps instead of single layer of felt wrap where soil in which pipe is to be buried is classified as Group IV, Unusually Corrosive (as defined in AWWA M11, Chapter 10, "Principles of Corrosion and Corrosion Control") or as Class 4, Extreme (as defined in NAVFAC Design Manual on water supply systems); or where electrical resistivity of soil has been measured at less than 2,000 ohms/cc.

- b. 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.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 [and ASTM D 2855], unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

- a. Jointing: [Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855.] [Make solvent-cemented joints for ABS plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with the recommendations of the pipe manufacturer, as approved.] Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.5 Disinfection

Disinfect new water piping and existing water piping affected by

Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.1.6 [Optional Disinfection Method

NOTE: For Iceland projects, include the following option.

Disinfect new potable water lines and affected portions of existing potable water lines with geothermal water. Geothermal water shall be not less than 90 degrees Celsius and contact time shall be not less than 30 minutes. After disinfection, thoroughly flush new potable water lines and affected portions of existing potable water lines with the chlorinated base water supply for a minimum of two hours.]

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

NOTE: Insert the appropriate Section number and title in the blank below using proper format per UFC 1-300-02.

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing [, except that water and electric power needed for field tests will be furnished as set forth in [_____]]. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. [Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.]

3.2.2 Testing Procedure

NOTE: Delete references to water service lines of these materials except when there is water service pipe of 80 mm 3 inch size or larger included in the project. Ductile-iron piping is available in 80 mm 3 inch size, but 100 mm 4 inch size is smallest for PVC plastic water main pipe.

NOTE: Delete requirements for and references to steel pipe and associated fittings for

LANTNAVFACENGCOM projects.

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." [Test ductile-iron water mains [and water service lines] in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints [or push-on joints] shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method.] [Test PVC plastic water mains [and water service lines made with PVC plastic water main pipe] in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, 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, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines shall not exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline.] [Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints shall not exceed 1.8 liters per 24 hours per millimeter 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. Repair of welded joints to stop leakage shall be done by welding only.] Test water service lines in accordance with applicable 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].

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 375 kPa 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 50 mm 2 inches in diameter, hydrostatic test pressure shall be not less than 1400 kPa 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --