STANDARD SPECIFICATIONS

FOR WATER MAIN INSTALLATION

ALAMEDA COUNTY WATER DISTRICT
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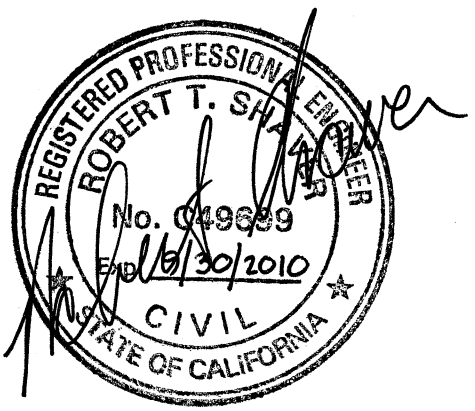
DECEMBER 2008

SPECIFICATIONS

REGISTERED ENGINEER'S STAMP

STANDARD SPECIFICATIONS FOR WATER MAIN INSTALLATION
DATED
DECEMBER 2008

The technical information of the specifications (Part F) has been prepared by or under the direction of the following registered engineer.



REVISIONS

Users of the District's Standard Specifications for Water Main Installation, standard drawings, and Approved Materials list shall be responsible to confirm they are using the most recent versions. To confirm the most recent versions of the Standard Specifications for Water Main Installation, standard drawings and Approved Materials list, please contact the District Engineering Department at (510) 668-4499 or visit the District website at *www.acwd.org*.

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PART F

ACWD STANDARD SPECIFICATIONS

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APPROVED MATERIALS – See inside of back cover or contact the Alameda County Water District Engineering Department for the current list.

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F.1 GENERAL REQUIREMENTS

F.1.1 General

Whenever in these Standard Specifications the following abbreviations and terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Abbreviations:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	ASTM International (formerly American Society for Testing Materials)
AWS	American Welding Society
AWWA	American Water Works Association
Cal/OSHA	California Occupational Safety and Health Administration
NACE	NACE International (formerly National Association of Corrosion Engineers)
NEMA	National Electrical Manufacturers Association
NSF	NSF International (formerly National Sanitation Foundation)

Whenever the above abbreviations are used in reference to specifications, codes or standards published by the society, association or organization for which the abbreviation is given, the current edition of the specification, code or standard shall apply, unless otherwise expressly stated. If referenced, tentative standards shall be construed as current unless otherwise noted.

If obsolete specifications have been referenced, they shall be replaced by a current specification from the same source covering the same subject matter.

F.1.2 Definitions

Where the words "as shown," "as detailed," "as indicated" or words of like import are used, reference is to the project drawings unless the context clearly indicates a different meaning. Where the words "required," "approved," "satisfactory," "suitable," "determined," "acceptable" or words of like import are used in the project drawings or project specifications, action by the District is indicated unless the context clearly indicates otherwise. Such action, or failure to act, shall not relieve the Contractor of its responsibilities to perform the work in accordance with the requirements of the project.

Abandon	All work necessary to physically disconnect, preserve and protect a water facility or portion thereof for potential future use.
Air Valve	Any combination air valve which includes the properties of both a pressure air release valve and an air and vacuum release valve.

Approved Materials	The current edition of the Alameda County Water District's list of Approved Materials.
Backfill	That portion of the trench backfill which is above the bedding of the water main (above a point 6 inches over the top of the water main).
Bedding, or Pipe Envelope	That portion of the trench backfill which is under, around and to 6 inches over the water main.
Board of Directors	The governing body of the District.
Caltrans	See definition of "Department of Transportation."
City	The word "City" when used herein shall mean the cities of Fremont, Newark and Union City, Alameda County, California, unless otherwise specifically stated.
Contractor	The individual or individuals, firm, partnership, corporation, joint venture or combination thereof, acting as an independent Contractor in performing work. The Contractor shall have a valid State of California "A" or "C34" license.
County	Alameda County, State of California.
Cut Sheets	Cut sheets are sheets of tabulated data, indicating stationings, structures, fittings, angle points, slopes, offsets, elevations and water main depths. District standard cut sheets shall be used on all water main extensions.
Days	Calendar days, unless otherwise designated.
Department of Transportation	State of California, Business, Transportation and Housing Agency, Department of Transportation.
District	The Alameda County Water District.
District Engineer	The Engineering Manager of the Alameda County Water District, acting either directly or through properly authorized employees or agents, such employees or agents acting within the scope of the particular duties entrusted to them.
Drawings	See definition of "Plans."
Easements	Easements are areas dedicated to the general public or the District in which District's facilities may be located.

Engineer — See definition of "District Engineer."

Highway Specifications — The Standard Specifications of the State of California, Business, Transportation and Housing Agency, Department of Transportation, current issue.

Inspector — The Inspector is a field representative of the District, acting within the scope of the particular duties entrusted to him/her.

Manufacturer — Any individual, partnership, corporation, association or other legal relationship which fabricates or assembles materials by hand, machine or other means, into a product suitable for use within a public water system and approved for use by the District.

Overtime Work — Overtime work is all work performed on Saturdays, Sundays, District holidays, or on weekdays before 7:30 a.m. or after 4:00 p.m.

District Holidays

a. New Year's Day	January 1
b. Martin Luther King's Birthday	3rd Monday in January
c. Washington's Birthday	3rd Monday of February
d. Memorial Day	Last Monday in May
e. Independence Day	July 4
f. Labor Day	1st Monday in September
g. Veterans' Day	November 11
h. Thanksgiving Day	4th Thursday in November
i. Day After Thanksgiving Day	4th Friday in November
j. Christmas Eve Day	December 24
k. Christmas Day	December 25

When a District Holiday falls on Sunday, the following Monday will be observed. When a District Holiday falls on Saturday, the preceding Friday will be observed.

Owner — See definition of "District."

Paved Surface — Any form of pavement used on street, sidewalk or other areas composed of concrete, asphalt, oil, brick or treated crushed rock or any combination of above forms of pavement having a dense, cohesive, stable surface.

Permits or Licenses — Clearances from other agencies to perform specific work under specific conditions at specific locations.

Plans (Drawings) — Those parts of the Project Plans, containing the District's drawings, which show the locations, character, dimensions, and details of the work to be done.

Pipe Types

ACP	Asbestos Cement Pipe
CMP	Corrugated Metal Pipe
DIP	Ductile Iron Pipe
GIP	Galvanized Iron Pipe
HDPE	High Density Polyethylene Pipe
ML & CT	Mortar Lined and Coal Tar Coated Steel Pipe
ML & DC	Mortar Lined and Dielectric Coated Steel Pipe
ML & MC	Mortar Lined and Mortar Coated Steel Pipe
PVC	Polyvinyl Chloride Pipe

Project — See definition of "Work."

Right-of-Way — All land or interest therein which by deed, conveyance, agreement, easement, implication, dedication, usage or process of law is reserved for or dedicated to the use of the general public, or the District within which the District has the right to install, maintain and operate its facilities.

Roadway — All of a right-of-way dedicated, granted, used or to be used, for vehicle movement.

Section or Subsection — Any reference to a section or subsection which is not accompanied by further reference other than a letter and numbers (e.g., F.2.3.1) refers to a section or subsection of the Standard Specifications.

Service Connection — The pipeline used to convey water from the main to the meter.

Shop Drawings — Drawings produced by the steel fabricator for the purpose of showing details, dimensions, sizes of material, joints and all information and data necessary for the fabrication of the metal work.

Standard Drawings — District Standard Drawings which will be considered a part of these specifications.

State — The State of California.

Subcontractor	The individual or individuals, firm, partnership, corporation, or combination thereof, who will perform work for the Contractor. The Subcontractor shall have a valid State of California license pertaining to its field of operations.
Superintendent	The executive representative of Contractor, present on work at all times during performance of work, authorized to receive and fulfill instructions of the District.
Work	The required work of physical improvement shown and defined by the Project, including all written changes thereto. The work is "public works" as defined by statute.
Uniform Plumbing Code	The Uniform Plumbing Code adopted by International Association of Plumbing and Mechanical Officials (formerly known as Western Plumbing Officials Association), current edition as of the time of construction.

F.1.3 Contractor Requirements

The Contractor shall have a valid State of California "A" or "C34" license.

It is the Contractor's responsibility to prosecute the work in accordance with all applicable federal, state and local laws, these specifications and the approved plans.

F.1.4 Inspection by District

Contractor shall notify District 48-hours prior to the day the work is to begin at the start of water main construction. In addition, prior to installation or backfill of any water system components or prior to resuming work after any work stoppage lasting longer than 24 hours, Contractor shall notify District's Engineering Department not less than twenty-four (24) hours in advance of the time of such installations or resumption of work so that arrangements for inspection of the work can be made.

District may not furnish continuous inspection of the work. However, District will, with proper notification; endeavor to furnish the necessary inspection to ensure that the work is in compliance with the District's Specifications and the approved plans.

However, notwithstanding the above, no pipe, valve, and/or appurtenance will be backfilled until the installation of the pipe, valve and/or appurtenance has been inspected and approved by the District. Where backfilling is made prior to inspection and approval, reexcavation and exposure of the pipe, valve and/or appurtenance for examination will, at the option of the District, be required before approval of the installation is obtained.

When overtime work is to be requested, Contractor shall notify District not later than 12:00 noon on the workday prior to the day the overtime is to be performed. The District has no obligation

to provide, and may refuse, inspection for Contractor overtime work. If overtime work is approved, District inspection of overtime work will only be provided upon receipt of a written request by the Contractor and/or Developer (as applicable) specifying the dates and time of the requested overtime inspection and agreeing to pay all District costs associated with the overtime inspection, including, but not limited to, all base labor, fringe and overhead, overtime labor premium, equipment and materials.

F.2 PIPE MATERIALS AND REQUIREMENTS

F.2.1 Polyvinyl Chloride Pressure (PVC) Pipe and Fittings

F.2.1.1 General

This section applies to the materials, manufacture, fabrication and testing of polyvinyl chloride (PVC) pressure pipe and PVC pipe-related fittings used within the District. See Approved Materials for specific PVC pipe materials and PVC pipe-related fittings approved for use within the District.

F.2.1.2 PVC Pipe Fabrication

PVC pipe shall have cast iron outside diameter (CIOD) dimensions.

PVC pipe 6-inch through 12-inch shall be DR 18, unless otherwise shown as DR 14 on the Approved Plans, and shall conform to AWWA C900 except where herein modified. If part of the project requires DR 14 PVC pipe, all the PVC pipe used in that project shall be DR 14.

All PVC pipe shall be 20 foot laying lengths, unless otherwise shown on the Approved Plans. On curved alignments, the District may require 10-foot laying lengths to be installed.

Marking on pipe shall include the following and shall be applied at intervals of not more than 5 feet:

- Nominal size in inches and OD base (e.g., 12 CI)
- PVC
- Dimension Ratio (e.g., DR 18)
- AWWA Pressure Class (e.g., PC 235)
- Test pressure for hydrotested pipe (e.g., T470)
- AWWA Designation Number (e.g., ANSI/AWWA C900-07)
- Manufacturer's Name or Trademark and Production run record or lot code
- Seal (mark) of the testing agency verifying the suitability of the pipe material for potable-water service (e.g., NSF 61)

PVC pipe used to convey reclaimed water shall be purple in color and be stamped, "CAUTION: RECLAIMED WATER – DO NOT DRINK" and "PELIGRO: AGUA IMPURA – NO BEBER" or similar wording approved by the District.

F.2.1.3 PVC Pipe Joints

Joining of PVC pipe shall be with either elastomeric-gasket bell ends or couplings. All elastomeric-gasket bell ends or couplings used for PVC pipe joints shall conform to AWWA C900 for PVC pipe 6-inch through 12-inch except where herein modified.

Elastomeric-Gasket Bell Ends: The bell ends shall be an integral thickened bell end (IB). When measured in accordance with ASTM D2122, the dimensions of the integral bell wall thickness at any point shall conform to the dimension ratio of the pipe except in the annular gasket ring groove and bell entry portions where the wall shall be at least the thickness of the pipe barrel. All elastomeric gaskets shall be furnished by the PVC pipe manufacturer.

PVC Pipe Couplings: PVC pipe couplings shall be compatible with the PVC pipe. Couplings shall be furnished together with 2 elastomeric gaskets. All elastomeric gaskets shall be furnished by the coupling manufacturer.

Marking on pipe couplings shall include the following:

- Nominal size OD Base (e.g., 12-in.)
- PVC
- AWWA Pressure Class (e.g., PC 235)
- AWWA Designation Number (e.g., ANSI/AWWA C900-07)
- Manufacturer's Name or Trademark
- Seal (mark) of the testing agency verifying the suitability of the coupling or fitting for potable-water service (e.g., NSF 61)

Lubricants: Joint lubricants shall be compatible with the pipe and elastomeric gaskets materials.

Lubricants shall be non-toxic and shall not support the growth of bacteria, impart a taste or odor to the pipe or adversely affect in any way the quality of water transported by the pipe when used in accordance with AWWA C605 and when the pipe has been installed in accordance with Section F.5. Lubricants shall be certified to NSF 61 for use with potable water.

Lubricant containers shall be labeled with the following:

- Trade name of the lubricant
- Lubricant manufacturer's name
- NSF 61 Certification mark

F.2.1.4 Push-On and Flange-Joint Fittings for PVC Pipe

All fittings for use with PVC pipe (except tees and crosses) shall use push-on joints which are designed to accept CIOD PVC pipe. Fabricated PVC, injection-molded PVC, ductile-iron or gray-iron may be used. The rubber rings shall be furnished by the manufacturer of the fitting.

All tees and crosses used with PVC pipe shall have all flanged ends except tees used for fire hydrants, blowoffs, firelines, and service lines 4-inch and larger, which may have push-on ends at connections to PVC pipe. Reducers and elbows shall have flanged ends at connections to another fitting or to a valve and shall have push-on ends at connections to PVC pipe. Flanged ends shall be flat-faced and shall conform to AWWA C110.

All fittings with flanged ends shall be made of either gray iron or ductile iron. No PVC fittings with flanged ends shall be allowed.

PVC Fittings: PVC fittings shall be injection molded conforming to AWWA C907 for PVC pipe 6-inch and 8-inch, and shall be fabricated conforming to AWWA C900 for PVC pipe 12-inch.

PVC pipe fittings shall be manufactured from PVC compound meeting ASTM cell classification 12454 with a Hydrostatic Design Basis (HDB) of 4000 psi (ASTM D2837). Fittings shall be certified to NSF 61 for usage in potable water.

PVC fittings shall have a minimum wall thickness of 125 percent the wall thickness of the adjoining AWWA C900 PVC pipe of the same nominal diameter. The minimum wall thickness at any point in the bell groove shall be at least that of the wall thickness of the adjoining AWWA C900 PVC pipe of equivalent pipe size. All fittings are to be made for usage on PVC pipe with CIOD pipe diameter.

PVC fittings for use on AWWA C900 PVC pipe shall have push-on joints only; no flanged joints shall be permitted on PVC fittings for PVC pipe.

Marking on fabricated and injection-molded PVC fittings shall include the following:

- Nominal size OD Base and deflection angle if applicable (e.g., 12-in.x 8 in. or 12-in. 45°)
- PVC
- AWWA Pressure Class (e.g., PC 235) for AWWA C900 fittings or (e.g., PC 150) for C907 fittings
- AWWA Designation Number (e.g., AWWA C900-07 or AWWA C907-04)
- Manufacturer's Name or Trademark
- Production-record code for AWWA C907 fittings
- Seal (mark) of the testing agency verifying the suitability of the pipe material for potable-water service (e.g., NSF 61)

Ductile-Iron Fittings: Ductile-iron fittings for PVC pipe shall conform to either AWWA C110 (standard-style) or AWWA C153 (compact-style) except as herein modified.

Ductile-iron fittings shall be either:
1) cement mortar lined in accordance with AWWA C104 and asphaltic coated in accordance with AWWA C153, or
2) fusion-bonded epoxy lined and coated in accordance with AWWA C116 and Section F.10.4 of these Specifications.

Ductile-iron fittings with push-on-joint ends shall be rated for 350 psi working pressure.
Ductile-iron fittings with flange-joint ends shall be rated for 250 psi working pressure, minimum.

Cast markings on ductile-iron fittings shall include the following:

- AWWA Designation Number (e.g., for compact fittings, ANSI/AWWA C153/A21.53)
- Pressure rating
- Nominal diameters of openings
- Manufacturer's identification
- Country where cast
- The letters "DI" or "Ductile"
- Number of degrees or fraction of the circle on all bends

Gray-Iron Fittings: Gray-iron fittings for PVC pipe shall conform to AWWA C110 except where herein modified.

Gray-iron fittings shall be either:
1) cement mortar lined in accordance with AWWA C104 and asphaltic coated in accordance with C110, or
2) fusion-bonded epoxy lined and coated in accordance with AWWA C116 and Section F.10.4 of these Specifications.

Gray-iron fittings with push-on or flange-joint ends shall be rated for 250 psi working pressure.

Cast markings on gray-iron fittings shall include the following:

- Pressure rating
- Nominal diameters of openings
- Manufacturer's identification
- Country where cast
- Number of degrees or fraction of the circle on all bends

Steel Fittings: Steel fittings shall not be used with PVC pipe. To transition from PVC pipe to steel pipe, ductile-iron or gray-iron push-on to flange-joint adapters shall be used.

F.2.1.5 Inspection and Testing

District at its discretion may inspect the plant facilities, materials, manufacture and testing of the pipe and fittings to be furnished by Contractor in order to insure that all products comply with this specification.

The manufacturer shall conform to all specified provisions for Quality-Control and Qualification Test Requirements stipulated in AWWA C900, AWWA C907, AWWA C110, AWWA C111 and AWWA C153, as appropriate. All costs incurred by District for witnessing the manufacturing and/or testing of the pipe and fittings shall be borne by the Contractor furnishing the pipe and fittings.

F.2.1.6 Affidavit of Compliance

District may elect to waive any of the above testing and inspection requirements. The District may require the manufacturer to submit records of all quality-control tests and an affidavit stating that all pipe and fittings have been manufactured and tested in accordance with this Specification.

F.2.2 Lined and Dielectric Coated Steel Pipe and Fittings

F.2.2.1 General

This section of the specifications applies to the materials, manufacture, fabrication and testing of shop-fabricated steel cylinder pipe and fittings. See Approved Materials for approved steel pipe-related fittings. The requirements for steel pipe for 4-inch and larger service connections, firelines, field fabricated pipeline offsets and fire hydrant laterals are specified in Section F.2.3.7.

F.2.2.2 Fabrication of Steel Pipe

Steel pipe 6-inches and larger in diameter shall be manufactured in accordance with AWWA C200 unless otherwise shown on the Approved Plans or where herein modified.

Steel cylinder pipe may be fabricated in accordance with one of the following ASTM Standards:

- A53, Type E or S
- A134, Grade 30, 33 or 36
- A135, all grades
- A139, all grades

Pipe fabricated to one of the above ASTM standards shall comply with all Charpy and quality-control procedures stipulated in AWWA C200.

Steel plate, sheet or coils for cylinders and fittings shall be in accordance with one of the following ASTM Standards:

- A36
- A283, Grade C or D
- A1011, Grade 30, 33 or 36
- A1018, Grade 30, 33 or 36

Pipe sections may be seamless or made from one or more steel sheets either spirally or longitudinally butt welded.

Pipe cylinders shall be fabricated into standard nominal laying lengths of not less than 20 feet, nor more than 40 feet unless approved by the District. Shorter lengths may be used where required to provide for proper location of curves, offsets, fittings, valves and closures.

For projects with 20 or more linear feet of steel pipeline, complete steel cylinder pipe manufacturing shall be performed at a single pipe producing facility. Partial steel cylinder pipe production at one facility and the completion at another will not be acceptable.

F.2.2.3 Fabrication of Fittings for Steel Pipe

Fittings and specials for steel cylinder pipe shall be manufactured in accordance with AWWA C200 and AWWA C208 unless otherwise shown on the Approved Plans or where herein modified.

Steel used for the fabrication of fittings or specials shall conform to the material specification for the manufacture of steel cylinder pipe as specified in Section F.2.2.2 and shall be compatible in all respects to the steel used for the adjoining steel pipe.

Tees, reducers, nozzles, branches, crosses and other special fittings shall be manufactured from bare steel pipe of equal thickness of the adjacent pipe or a minimum thickness of not less than ¼-inch whichever is greater. Outlets, fittings, etc., shall be reinforced with collars or wrapper plates per AWWA Design Manual M-11. Crotch plates shall not be used unless approved or required by the District. Mitres on bends or elbows shall conform to AWWA C208.

Fabricated fittings shall be assembled with complete joint penetration welds in accordance with AWS D1.1. Adjacent edges shall be beveled as required.

When attaching blowoffs, outlets, nozzles and similar appurtenances to coated steel cylinder pipe, the coating on the pipe shall be removed not less than 3-inches from the line of the outside weld, using care to avoid damage beyond the area removed. Any portion of the coating that has been damaged shall be removed and replaced. Openings of the correct size and shape shall be cut through the pipe plate, and the fittings shall be welded to the pipe, as shown on the Approved Plans and required by AWWA C200, and reinforced with collars or wrapper plates per AWWA Design Manual M-11, if required.

All fittings and specials shall be lined and coated with the same material as the pipe to which they are to be attached unless otherwise approved by the District. Cement mortar lining shall comply with AWWA C205, Section 4.4.5, “Lining of Specials,” and the wire reinforcement of the cement mortal lining for fittings or specials larger than 24-inches nominal diameter shall be with 2-inch by 4-inch No. 13 gauge self-furring welded wire fabric tack welded to the inside of the fitting or special.

Bolt holes for flanges shall straddle the center lines. Steel flanges used on fittings and specials are specified in F.3.9.

F.2.2.4 Pipe Wall Thickness

Pipe wall thickness for steel cylinder pipe shall be in accordance with the following table except where greater thicknesses are indicated on the Approved Plans or specified elsewhere herein.

PIPE WALL THICKNESS FOR CEMENT MORTAR LINED STEEL MAINS*					
Nominal Pipe Size [inches]	Minimum Outside Diameter of Steel Cylinder [inches]**	Minimum Steel Cylinder Wall Thickness [inches]**	Cement Mortar Lining Thickness [inches]	Cement Mortar Lining Tolerances [inches]	Minimum Inside Diameter of Pipe (Waterway) [inches]
6	6.625	0.280 (Schedule 40)	1/4	-1/16, +1/8	5.315
8	8.625	0.250 (Schedule 20)	1/4	-1/16, +1/8	7.375
10	10.750	0.250 (Schedule 20)	1/4	-1/16, +1/8	9.375
12	13.250	3/16	5/16	-1/16, +1/8	12.000
14	15.250	3/16	5/16	-1/16, +1/8	14.000
16	17.375	1/4	5/16	-1/16, +1/8	16.000
18	19.375	1/4	5/16	-1/16, +1/8	18.000
20	21.375	1/4	5/16	-1/16, +1/8	20.000
24	25.500	1/4	3/8	-1/16, +1/8	24.000
30	31.500	1/4	3/8	-1/16, +1/8	30.000
36	37.500	1/4	3/8	-1/16, +1/8	36.000

* Requirements indicated within the above table are applicable only to the installation of new continuous steel water mains. Requirements for steel offsets in existing PVC, asbestos cement or steel water mains or for steel service connections, firelines or fire hydrant laterals are specified in Section F.2.3.7.

** Depending on the application, the District may require steel cylinder wall thickness to be greater than indicated. In such circumstances, the outside diameter shall be increased to provide the required minimum inside diameter indicated. Minimum steel cylinder thickness for pipes larger than 36-inches shall be determined by the District on a case by case basis.

F.2.2.5 Pipe Joints

Pipeline shall be fabricated so that all field welded joints are fully welded bell and spigot joints, butt weld joints or butt strap joints unless otherwise specified or required by the District. Reference is made to Section F.2.2.5.3, Flexible Joints. In special cases, the District may require flanges, flexible couplings, victaulic-type couplings or other types of joints be used.

Flanged joints shall be used for all valve connections to steel pipe.

F.2.2.5.1 Welded Joints

Pipe ends for welded joints shall be as indicated on District Standard Drawing WSP-1-08.

Welded joints may be bell and spigot joints, butt weld joints or butt strap joints in accordance with District Standard Drawing WSP-1-08. The steel pipe fabrication shop drawings shall indicate the type of welded joint.

In general, bell and spigot joints may be used in straight pipe sections on either side of a valve or fitting, through encasements or where indicated on the plans. Butt strap joints may be used for making field closures, at points of field modification in the water main caused by field conditions or where shown on the plans. Butt weld joints shall only be used when shown on the plans or when approved by the District.

F.2.2.5.2 Flanged Joints

Pipe ends to be fitted with flanges shall have the longitudinal or spiral welds of the pipe cylinder ground to plate surface for a distance sufficient to receive flanges. The flanges after welding shall be perpendicular to the axis of the pipe, free of warp with faces smooth and true.

Bolt holes for flanges shall straddle the center lines.

Flanges, flange gaskets, nuts and bolts shall be as specified in Sections F.3.9, F.3.10 and F.3.11, respectively.

F.2.2.5.3 Flexible Joints

Pipe ends for flexible joints shall be plain and cut perpendicular to the axis of the pipe and shall have the longitudinal or spiral welds of the pipe cylinder ground to plate surface for a distance sufficient to receive the flexible coupling.

The coating on the pipe shall be held back a sufficient length to allow the joint to be assembled.

Flexible coupling shall be as specified in Section F.3.12.

F.2.2.6 Coatings for Steel Cylinder Pipe

All steel pipe shall be coated with a machine-applied spiral tape coating system in accordance with AWWA C214 and all special sections, connections and fabricated fittings shall be coated in compliance with AWWA C209, unless otherwise specified herein, shown on the Approved Plans or required by the District. The District shall be notified not less than 48 hours in advance of the coating operation in order that the operation may be inspected at District's option.

F.2.2.6.1 Shop-Applied Spiral Tape Wrap Coating for Straight Pipe

A. Materials: straight pipe shall be furnished with machine-applied spiral tape wrap in accordance with AWWA C214, except where modified herein.

- Primer: Shall be supplied by the tape manufacturer.
- Compatibility: Primer, tape, and outer wrap shall be supplied by the same manufacturer.
- Approved products: See Approved Materials for approved tape coatings.

- Machine-applied spiral tape wrap shall be of the following thickness:

	Coating Thickness in Mils			
Nominal Pipe Diameter [inches]	**Inner Wrap Thickness [mils]**	**Outer Wrap Thickness [mils]**	**Additional Outer Wrap Thickness [mils]**	**Total Minimum Coating System Thickness [mils]**
6 – 23	20	30	0	50
24 and over	20	30	30	80

B. Application: Machine-Applied Spiral-Wrapped Tape Coating System shall be applied as follows:

- Surface preparation: Prepare surface in accordance with the coating manufacturer's specifications, but not less than that required in AWWA C214.

- Primer: Mix and apply in accordance AWWA C214 and the manufacturer's recommendations.

- Inner and Outer Tape Wrap: Apply in accordance with AWWA C214 and the manufacturer's recommendations for temperature and application tensions.

- Cutbacks: Cutbacks shall be determined by the type of joint and shall be approved by the District. Where mechanical couplings are used, the cutback shall be as recommended by the mechanical joint manufacturer so that the tape coating will not interfere with the joint seal. Cutbacks shall be a straight edge for the total thickness of the coating.

C. Repairs: All holidays (visually or electrically discovered) of machine-applied spiral-wrapped tape coating system at the coating plant or in the field shall be repaired with compatible materials for primer, inner and outer tape wraps as recommended by the pipe coating manufacturer and listed in Approved Materials for use within the District.

F.2.2.6.2 Shop-Applied Spiral Tape Wrap Coating for Special Sections, Connections and Fabricated Fittings

A. Materials: All shop-applied spiral tape wrap for special sections, connections and fabricated fittings shall be in accordance with AWWA C209 and as modified herein.

- Primer: Shall be supplied by the tape manufacturer.

- Compatibility: Primer, tape, and outer wrap shall be supplied by the same manufacturer.

- Approved products: See Approved Materials for approved tape coatings.

- Shop-applied spiral tape wrap shall be of the following thickness:

	Coating Thickness in Mils			
Nominal Pipe Diameter [inches]	**Inner Wrap Thickness [mils]**	**Outer Wrap Thickness [mils]**	**Additional Outer Wrap Thickness [mils]**	**Total Minimum Coating System Thickness [mils]**
6 – 23	20	30	0	50
24 and over	20	30	30	80

B. Application: Shop-Applied Spiral-Wrapped Tape Coating System shall be applied as follows:

- Surface preparation: Prepare surface in accordance with the coating manufacturer's specifications, but not less than that required in AWWA C209.

- Primer: Mix and apply in accordance AWWA C209 and the manufacturer's recommendations.

- Inner and Outer Tape Wrap: Apply in accordance with AWWA C209 and the manufacturer's recommendations for temperature, overlap width and application tensions.

- Cutbacks: Cutbacks shall be determined by the type of joint and shall be approved by the District. Where mechanical couplings are used, the cutback shall be as recommended by the mechanical joint manufacturer so that the tape coating will not interfere with the joint seal. Cutbacks shall be a straight edge for the total thickness of the coating.

C. Repairs: All holidays (visually or electrically discovered) of tape coating system at the coating plant or in the field shall be repaired with compatible materials for primer, inner and outer tape wraps as recommended by the pipe coating manufacturer and as listed in Approved Materials for use within the District.

F.2.2.6.3 Special Coatings

When shown on the Approved Plans or required by the District in order to properly protect pipeline surfaces due to above-grade or other unique installation requirements, special pipe coatings shall be used. These special coating systems may consist of special tape coatings, fusion-bonded epoxy coatings or other coating systems as required by the District and/or specified in Section F.10.

Steel pipe used to convey reclaimed water shall be wrapped such that the outermost wrap is purple in color. Reclaimed water pipelines shall be identified as such either by warning tape or by stenciling on the pipe. Warning tape or stenciling shall state "CAUTION: RECLAIMED WATER – DO NOT DRINK" and "PELIGRO: AGUA IMPURA – NO BEBER" or similar wording approved by the District.

F.2.2.7 Linings for Steel Cylinder Pipe

The interior surface of the pipe shall be lined in accordance with one of the following specifications. The District shall be notified not less than 48 hours in advance of the lining operation in order that the operation may be inspected.

F.2.2.7.1 Cement Mortar Lining

Cement mortar lining shall be in accordance with AWWA C205 and shall be of the thickness required by F.2.2.4.

Immediately after application of the lining, the pipe ends shall be tightly capped with a waterproof cover to prevent the escape of moisture from the interior of the pipe. If additional moisture is required to maintain a moist condition, water shall be introduced inside the pipe, after the mortar has attained sufficient set, in a manner such that the introduction of the water will not damage the lining surface.

The waterproof covers shall be kept on the pipe throughout and beyond the curing period. If removal of the covers is necessary for the pipe coating operation, they shall be replaced as soon as practicable after the application of the coating and shall remain on the pipe ends until immediately prior to the installation of the pipe.

F.2.2.7.2 Special Linings

When approved by the District, the pipe and fittings may be lined with a fusion bonded epoxy. The lining thickness shall not be less than 12 mils. See Approved Materials for approved fusion bonded epoxy materials.

Pipe surface preparation and application of fusion bonded dry powder epoxy lining shall be in strict accordance with the manufacturer's specifications.

The fabricator shall inform the District no less than 48 hours in advance of the operation so that the District may observe the complete application process.

F.2.2.8 Testing and Inspection

The District at its option may inspect the plant facilities, materials, fabrication of the pipe, fittings, pipe coatings and linings to be furnished by Contractor.

F.2.2.8.1 Testing and Inspection of Pipe, Specials and Fittings

Testing of pipe and specials to insure compliance with these specifications shall be made in accordance with AWWA C200, except where modified herein.

A hydrostatic shop test shall be performed on each straight section of pipe, under an internal pressure sufficient to develop a tensile stress of 22,000 psi within the walls of the pipe. The test

pressure shall be maintained for not less than 5 seconds for pipe 18 inches in diameter and smaller, and not less than 10 seconds for pipe 20 inches and larger. Defects in welds shall be repaired and all repaired sections shall be retested hydrostatically.

The welded seams in specials or fittings shall be shop tested by the air soap method or the dye check method. Testing shall be conducted by the fabricator and test methods shall be approved by the District. Where the fitting is fabricated from steel pipe cylinders which have been previously tested hydrostatically, no further test is required on seams so tested. Any defects revealed under either test method shall be re-welded by hand and the weld again tested.

The District may, at its option, witness any and all aspects of the manufacture of the pipe, specials and fittings. All cost associated with the performance of the tests or incurred by District for witnessing the manufacture of the pipe and in obtaining test results shall be borne by the Contractor.

F.2.2.8.2 Testing and Inspection of Pipe Coatings

The manufacturer shall test all tape coating systems in accordance with AWWA C214 and all fusion-bonded epoxy in accordance with AWWA C213.

The District may, at its option, witness any and all aspects of the coating and lining of the pipe, specials and fittings. All costs incurred by the District for witnessing the manufacture of the pipe and/or application of lining and coating systems, and tests or obtaining test results shall be borne by Contractor. District, at its option, may require Contractor to conduct field tests under the supervision of the District Inspector. Field tests of pipe coatings shall be in accordance with Section F.10.

F.2.2.8.3 Testing and Inspection of Pipe Linings

The manufacturer shall test all cement mortar lining in accordance with AWWA C205 and all fusion-bonded epoxy in accordance with AWWA C213. Tests to determine fusion bonded epoxy lining thickness shall be made by a magnetic measuring device approved by the District.

The District may, at its option, witness any and all aspects of the coating and lining of the pipe, specials and fittings. All costs incurred by the District for witnessing the manufacture of the pipe and/or application of lining and coating systems, and tests or obtaining test results shall be borne by Contractor. District, at its option, may require Contractor to conduct field tests under the supervision of the District inspector. Field tests of epoxy linings, if applicable, shall be in accordance with Section F.10.

F.2.2.9 Affidavit of Compliance

District may elect to waive any of the above testing and inspection requirements, in which event the District may require the manufacturer to submit affidavits stating that all pipe, coatings and linings have been manufactured and tested in accordance with this specification.

F.2.2.10 Engineered Steel Pipeline

All steel water mains shall be considered to be engineered steel pipelines, unless otherwise specified herein or stipulated by the District. Steel pipe for field fabricated pipeline offsets on PVC mains, for fire hydrant laterals and for service connections larger than 2-inches which are shown as such on the plans or required by the District shall not be considered engineered steel pipelines and are specified in Section F.2.3.7.

F.2.2.10.1 Line and Layout and Fabrication Drawings

Contractor shall submit four sets of the manufacturer's certified shop drawings covering the design, manufacture, and fabrication of steel cylinder pipe, fittings, specials and joint details to the District for approval prior to the start of the fabrication of the pipe.

All engineered steel pipelines require the submittal of satisfactory line and layout drawings and pipe fabrication shop drawings before fabrication of piping may proceed.

Allow 15 working days for District review after District's receipt of the first submittal of shop drawings. Allow 10 working days for subsequent submittals.

Line and Layout Drawings: The line and layout drawings shall be comprised of detailed engineered layout sheets showing pipeline stations along the alignment of the steel pipe, vertical and horizontal angle points, location of all pipe mark numbers, pipe joints, fittings, specials, valves, appurtenances, thrust restraints, etc., the order in which the various pieces of the pipe are to be assembled during construction, tie-in locations and any other information as may be required by the District to determine complete compliance with these specifications.

Fabrication Drawings: The fabrication drawings shall include all spool pieces, spacers, adapters, connectors, fittings, joint details, etc. and indicate the type, thickness and grade of steel used, specific coatings and linings, including thicknesses, standard and special connection details, and any other information as may be required by the District to determine complete compliance with these specifications.

F.2.2.10.2 Pipe Marking Requirements

Each pipe section and appurtenance shall be clearly and permanently marked with the number shown on the approved shop drawings as specified in Section F.2.2.10.1. Additionally, the top of each special and appurtenance shall be marked to allow for proper field fitting.

F.2.2.10.3 Construction Staking

For requirements concerning construction staking, refer to Section F.4.7.

F.2.3 Miscellaneous Pipe and Service Connections

F.2.3.1 General

This section of the specifications applies to the materials, manufacture, and fabrication of miscellaneous piping within the District. All miscellaneous pipe and tubing used within the District shall conform hereto unless otherwise indicated on the Approved Plans or approved by the District.

F.2.3.2 Plastic Tubing

F.2.3.2.1 General

All service connections nominally sized from 1-1/2 inch though 2-inch diameter shall be polyethylene tubing, unless otherwise shown on the Approved Plans.

Plastic tubing used for service connections shall be polyethylene (PE) pressure pipe and tubing with copper tube size outside diameter, manufactured from polyethylene conforming to AWWA C901, ASTM D3350, ASTM D2737 and NSF 61, except as modified herein.

The plastic tubing shall conform to the following:

Material Designation Code	PE 4710 or PE 3608
Standard Pipe Dimension Ratio (SDR)	9
Pressure Class	200 psi

Plastic tubing shall be certified to NSF 61 for use with potable water.

F.2.3.2.2 Materials

Polyethylene extrusion compound shall conform to ASTM D3350 with cell classification of PE 345464 C or higher (higher number pertains to individual cell numbers for the second through fourth numbers).

See Approved Materials for specific plastic tubing materials approved for use within the District.

F.2.3.2.3 Marking

All tubing shall be clearly marked at intervals of not more than 5 feet with the following:

- Nominal size and diameter base (e.g., CTS)
- SDR or minimum wall thickness (e.g., SDR 9)
- Manufacturer's name or trademark
- PE material designation code (e.g., PE 4710)*
- AWWA pressure class (e.g., PC 200)
- AWWA designation number (i.e., C901-08)
- Manufacturer's production (lot) code that includes information such as resin source, manufacturing location, extrusion outlet (line), and manufacturing date
- If not included in the manufacturer's production code, the manufacturing date, including day, month and year in a recognized standard format readily recognized as a date
- Seal or mark of the testing agency that certifies the pipe material for potable water service in accordance with AWWA C901

* Note: Due to recent changes in material designation, product marking may include both older and newer material designations (e.g., PE 3408/PE 4710).

F.2.3.2.4 Packaging, Shipping and Storage

All PE tubing shall be packaged, shipped and stored in a manner which prevents crushing, piercing, excessive heat, harmful chemicals, or exposure to sunlight for prolonged periods (allowable duration for exposure depends on the manufacturer's recommendations). Polyethylene shall be furnished directly from the supplier, coiled in a minimum of 100 feet of tubing per coil. All coils shall be banded, strapped to pallets, and protected in shipment.

F.2.3.3 Copper Tubing

F.2.3.3.1 General

All service connections nominally sized 1-inch diameter shall be copper tubing, unless otherwise shown on the Approved Plans.

Copper tubing shall be nominal or standard size seamless copper tubing, Type K soft copper conforming to ASTM B88.

F.2.3.3.2 Marking

Copper tubing shall be identified with the name or trademark of the manufacturer and the mark indicative of the type shall be permanently incised on each tube at intervals no greater than 1.5 feet.

Tube in straight lengths shall be further identified throughout its length by means of a continuous colored stripe, symbol or logo, including a legend at intervals not greater than 3 feet indicating

the type of the tube; name or trademark of the manufacturer, or both; and country of origin. Color shall be green for Type K (color marking is not applicable to tube furnished in annealed straight lengths or coils).

F.2.3.4 Red Brass Pipe

Red brass pipe used for air valve connections shall conform to ASTM B43, unless otherwise approved by the District. Red brass pipe shall be regular wall thickness unless otherwise approved by the District.

Threads on red brass pipe shall be tapered and conform to ANSI/ASME B1.20.1.

F.2.3.5 Steel Encasement Pipe

Steel encasement pipe shall be fabricated from steel sheets conforming to the material and physical requirements for steel cylinder pipe specified in Section F.2.2.2. Steel encasement pipe shall be of the required length, true and round, and coated as indicated on the plans.

When required by the District, steel encasement pipe shall be furnished with grout holes, spaced 8 feet apart longitudinally and offset 22 degrees from vertical, staggered to the left and right of the top longitudinal axis of the pipe.

The minimum nominal diameter and minimum metal thickness of steel encasement pipe shall be as follows for encasements up to 150 feet in length, unless otherwise shown on the Approved Plans or required by the District:

Nominal Water Main Size [inches]	**Minimum Nominal Diameter of Encasement Pipe [inches]**	**Minimum Thickness of Encasement Pipe [inches]**
6	14	1/4
8	16	1/4
12	20	1/4
14	22	3/8
16	24	3/8
18	27	3/8
20	30	1/2
24	36	1/2
30	42	5/8
36	48	5/8

Unless otherwise required or approved by the District, casing segments shall be assembled with complete joint penetration welds in accordance with AWS D1.1. Adjacent edges shall be beveled as required.

F.2.3.6 Galvanized Steel Pipe

F.2.3.6.1 General

Galvanized steel pipe may be used only in the construction of air valve vent piping, permanent or temporary blowoff assemblies, or jumper pipe assemblies, unless otherwise specifically shown on the Approved Plans.

F.2.3.6.2 Materials

Galvanized steel pipe shall conform to ASTM A53, Type E or S, Grade A or B, Schedule 40. Galvanizing shall be performed by the hot-dip process.

Threads on galvanized pipe shall be tapered and conform to ANSI/ASME B1.20.1.

Galvanized steel pipe for permanent, buried applications shall be tape wrapped in accordance with Section F.10.

F.2.3.6.3 Marking

Each length of pipe shall be marked with:

- Manufacturer's name or trademark
- Specification number (i.e. ASTM A53)
- Size (e.g., 2-inch NPS, Schedule 40)
- Grade (e.g., A or B)
- Type of pipe (e.g., E or S)

For pipe of nominal pipe size 1-1/2 inches and smaller that is bundled, it is permissible to mark the information on a tag securely attached to each bundle. When pipe sections are cut into shorter lengths by a subsequent supplier, the supplier shall transfer complete information to each uncut length or to metal tags securely attached to unmarked bundled pipe.

F.2.3.7 Steel Pipe for Service Connections and Firelines of Nominal Diameter Larger than 2 Inches, Field Fabricated Pipeline Offsets and Fire Hydrant Laterals

F.2.3.7.1 General

Steel pipe shall be used for all service connections and firelines of nominal diameter larger than 2 inches. Steel pipe may be required for field fabricated pipeline offsets and fire hydrant laterals when shown on the Approved Plans.

F.2.3.7.2 Materials

Steel pipe for all service connections and firelines of nominal diameter larger than 2 inches, field fabricated pipeline offsets or fire hydrant laterals (when shown on the Approved Plans) shall

conform to A53, Type E or S, Schedule 40 and be furnished plain end unless otherwise shown in the Approved Plans or required by the District. Fittings, if required, may be flanged or plain end. Flanges shall be used when connecting to valves.

Unless otherwise specified or shown, steel pipe for field fabricated pipeline offsets, service connections and firelines of nominal diameter larger than 2 inches, and fire hydrant laterals shall be furnished as follows:

- Straight Pipe: All straight pipe sections shall be furnished with shop-applied cement mortar lining in accordance with Section F.2.2.7.1 and shop-applied machine-applied tape coating in accordance with Section F.2.2.6.1 unless approved by the District.

- Special Sections, Connections and Fabricated Fittings: Special sections, connections and fabricated fittings shall be furnished with shop-applied cement mortar lining in accordance with Section F.2.2.7.1 and either shop-applied tape coating in accordance with Section F.2.2.6.2 or uncoated. Uncoated special sections, connections and fabricated fittings shall be tape wrapped or coated in the field in accordance with Section F.10.

Flanged joints, flexible joints, coatings and linings shall conform to the requirements stipulated in Section F.2.2.

Welded joints shall be in accordance with District Standard Drawing WSP-1 and Section F.2.2.5.1.

Pipe fabrication shop drawings for steel pipe for field fabricated pipeline offsets, service connections and firelines of nominal diameter larger than 2 inches and fire hydrant laterals are not required unless noted on the Approved Plans or otherwise required by the District.

F.2.3.8 Testing and Inspection

Duly authorized District inspectors shall have access at all times to all places of production, fabrication, and testing for purposes of inspection or observation. Whether or not inspection is made at the plant, pipe will be "spot inspected" upon delivery for condition, quality of workmanship, and compliance with these specifications. All cost incurred by District for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

F.3 VALVES AND APPURTENANCES

F.3.1 Resilient-Seated Gate Valves

F.3.1.1 General

Resilient-seated gate valves shall be used on pipelines of nominal diameter 12 inches and smaller, except where otherwise shown on the Approved Plans. Resilient-seated gate valves shall conform to AWWA C509, except as modified herein.

F.3.1.2 Specific Requirements

Operation: All resilient-seated gate valves shall be non-rising stem and be wrench nut operated. Wrench nut shall turn counter-clockwise to open valve. The wrench nut shall be securely held in place by a retaining nut of such size as to permit the operation of the valve with District valve operating tools. The District's valve operating tool inside measurement is 2-1/8 inches by 2-1/8 inches by 2-1/2 inches deep. Handwheel operated valves are not acceptable unless required by the District.

Valve Ends: Valves shall have flanged ends or push-on ends depending on the application, as required by the District. Threaded valve ends shall be provided for 2-inch gate valves used in blowoffs specified in Standard Drawing TB-3-08.

Protective Coatings: All exposed valve and actuator surfaces shall be coated with fusion bonded epoxy in accordance with Section F.10.4.

Materials: Valves shall be certified to NSF 61 to be suitable for contact with potable water. All wetted materials shall be suitable for service with line content containing chlorine or chloramines.

Affidavit of Compliance and Failure to Conform to these Specifications: When requested by District, the manufacturer and vendor will each furnish an affidavit stating that all the valves furnished for installation within District comply with these specifications. District, at its option, may select at random from the valves furnished, a valve or valves to be disassembled for inspection. Failure to conform to these specifications after certification by the manufacturer and vendor will justify rejection of all valves of this manufacturer in future installations for a period of not less than 1 year. After this period, the valve may then be reevaluated after sufficient evidence is presented to District of this manufacturer's compliance to these specifications.

Certified Drawings: When requested by District, the Contractor or vendor shall furnish 4 prints of certified shop drawings showing the dimensions, construction details and material specifications for all parts used in the construction of the valves. The drawings shall be in sufficient detail to enable the District to check compliance with these specifications and shall include the following information:

- Outline and principal dimensions of the assembled valve with its operator attached
- Component materials and specification numbers (e.g., ANSI, ASTM, etc.) of all valve and operator components
- Coatings
- Any additional information requested by the District

F.3.2 Butterfly Valves

F.3.2.1 General

Rubber-seated butterfly valves shall be used on pipelines of nominal diameter 14 inches and larger and as shown on the Approved Plans. If smaller size butterfly valves are required, the valves will also conform to these specifications.

Rubber-seated butterfly valves shall conform to AWWA C504, except as modified herein.

F.3.2.2 Specific Requirements

Type of Body: Flanged ends, short valve body.

Minimum Classification: Valves shall be at minimum Class 150B and shall be at minimum compatible with the adjoining pipe. For example, Class 150B valve shall be compatible with AWWA C900 DR 18 PVC pipe, while Class 250B valve shall be compatible with AWWA C900 DR 14 PVC pipe.

Maximum Nonshock Shutoff and Flow Pressure: Maximum non-shock shutoff and flow pressure shall be 150 psi.

Flow Rate Through the Valve: Valve must be suitable for continuous and maximum flow velocities of 5 feet/sec and 16 feet/sec, respectively.

Type of Shaft Seal: O-ring.

Materials: Valves shall be certified to NSF 61 to be suitable for contact with potable water. All wetted materials shall be suitable for service with line content containing chlorine or chloramines.

Mating Seats: Seating surfaces shall be stainless steel or nickel-copper alloy. Where required for valves with seats in the body, stainless steel seat retainer rings shall be furnished.

Type of Installation: Valves shall be suitable for buried service.

Actuator Type and Service Conditions: Valves shall be manually actuated and be suitable for open/close service. Actuators shall be gear-type. Operators shall be wrench nut operated; wrench nut shall turn counter-clockwise to open valve.

Valve and Actuator Position: All valves shall be installed with the shaft horizontal. Operators shall be fitted with a 2-inch operating nut to which a vertical extension stem can be added. The wrench nut shall be securely held in place by a retaining nut of such size as to permit the operation of the valve with District valve operating tools. The District's valve operating tool inside measurement is 2-1/8 inches by 2-1/8 inches by 2-1/2 inches deep.

Protective Coatings: Valve shall be coated inside and outside with catalyst-cured epoxy in accordance with Section F.10.

Affidavit of Compliance and Failure to Conform to these Specifications: If requested by the District, the manufacturer and vendor will each furnish an affidavit stating that all the valves furnished for installation within the District comply with these specifications. District, at its option, may select at random from the valves furnished, valves to be disassembled for inspection. Failure to conform to these specifications after such certification by the manufacturer and vendor will result in the rejection of all of the applicable manufacturer's valves for a period of not less than 1 year. After this period, the District, at its option, may reevaluate acceptance of the applicable manufacturer's valves.

Certified Drawings: When requested by District, the Contractor or vendor shall furnish 4 prints of certified shop drawings showing the dimensions, construction details and material specifications for all parts used in the construction of the valves. The drawings shall be in sufficient detail to enable the District to check compliance with these specifications and shall include the following information:

- Outline and principal dimensions of the assembled valve with its operator attached
- Dimensions of the clearance required for the valve disc
- Details showing disc and seats, including provisions for seat adjustment
- Component materials and specification numbers (e.g., ANSI, ASTM, etc.) of all valve and operator components
- Coatings
- Any additional information requested by the District

F.3.3 Fire Hydrants

F.3.3.1 General

All fire hydrants shall be of the wet-barrel type and conform to AWWA C503, except as modified herein.

Fire hydrants shall be acceptable to the applicable fire department serving the City of Fremont, City of Newark and/or the City of Union City or as otherwise directed by the District. See Approved Materials for approved fire hydrant manufacturers and models.

F.3.3.2 Specific Requirements

Hydrant Bury Elbow and Extension Spools for use with AWWA C900 PVC Pipe Hydrant Laterals: Hydrant bury elbow shall be ductile iron or gray iron and shall meet the requirements of AWWA C503. The hydrant bury elbow shall have a push-on inlet end connection when connecting to AWWA C900 PVC hydrant lateral and shall have a flanged with six bolt holes outlet end connection. Hydrant bury extension spools shall be ductile iron or gray iron, shall be of the same material as the hydrant bury elbow, and shall meet the requirements of AWWA C503. Hydrant bury extension spool end connections shall be flanged with six bolt holes.

Hydrant Bury Elbow and Extension Spools for use with Steel Pipe Hydrant Laterals: Hydrant bury elbow shall be ductile iron, gray iron or steel and shall meet the requirements of AWWA C503. Ductile iron or gray iron hydrant bury elbow end connections shall be flanged with six bolt holes. Steel hydrant bury elbow end connections shall be as shown on Standard Drawing WSP-1-08. Hydrant bury extension spools shall be ductile iron, gray iron or steel, shall be of the same material as the hydrant bury elbow and shall meet the requirements of AWWA C503. Ductile iron or gray iron hydrant bury elbow and extension spool end connections shall be flanged with six bolt holes. Steel extension spools shall have end connections as shown on Standard Drawing WSP-1-08 except for the outlet end connection to the break-off spool, which shall be flanged with six bolt holes.

Break-off Spool: A break-off spool with two cast score marks or one machined score mark shall be provided between the hydrant body and the hydrant bury. The break-off spool shall be ductile iron or gray iron, shall be of the same material as the hydrant bury elbow when the hydrant bury elbow is either ductile iron or gray iron, and shall meet the wall thickness requirements of AWWA C503, except at the score mark(s). Hydrant bury extension spool end connections shall be flanged with six bolt holes. The top score mark shall be located within 3 inches of the flange which connects to the hydrant barrel. The maximum length of the break-off spool shall be 12 inches; the minimum length of the break-off spool shall be 10 inches.

Hydrant Gaskets: Hydrant gaskets for connecting hydrant bodies to break-off spools and for connecting hydrant bury extensions spools to either break-off spools or flanged (6 bolt holes) hydrant bury elbows shall be 1/8-inch thick cloth inserted rubber. Hydrant gaskets shall be certified to NSF 61 and shall be suitable for service with line content containing chlorine and chloramines. No lubricant or sealant shall be used when assembling the gasket between the flanges unless the gasket manufacturer recommends it and the lubricant is certified to NSF 61 for use with potable water systems.

Protective Coatings:

- Hydrant interior surfaces shall be coated with fusion bonded epoxy in accordance with Section F.10.4.
- Hydrant exterior surfaces shall be coated with paint as required in Approved Materials.
- Hydrant bury elbows, hydrant bury extension spools, and break-off spools shall be either cement mortar lined in accordance with AWWA C104 and asphaltic coated in accordance with Section F.10.3 or fusion-bonded epoxy lined and coated in accordance with Section F.10.4.

Affidavit of Compliance and Failure to Conform to these Specifications: If requested by the District, the manufacturer and vendor will each furnish an affidavit stating that all the hydrants furnished for installation within the District comply with these specifications. District, at its option, may select at random from the hydrants furnished, hydrants to be disassembled for inspection. Failure to conform to these specifications after such certification by the manufacturer and vendor will result in the rejection of all of the applicable manufacturer's hydrants for a period of not less than 1 year. After this period, the District, at its option, may reevaluate acceptance of the applicable manufacturer's hydrants.

F.3.4 Blowoffs

Blowoffs shall be constructed of the materials indicated on District Standard Drawing TB-3-08 or TB-4-08 and, if applicable, as modified in Section F.7.8.2.

F.3.5 Valve Boxes and Valve Box Extensions

Valve boxes and valve box extensions shall be provided for all valves unless otherwise indicated on the Approved Plans. The material used for valve box extensions shall be PVC pipe as shown on District Standard Drawing VB-1-08. See Approved Materials for approved valve boxes.

F.3.6 Saddles (Service Clamps)

F.3.6.1 General

Saddles (service clamps) shall be used for service line connections to PVC pipe for all services of nominal diameter 2 inches and smaller. All saddles shall conform to AWWA C800. See Approved Materials for approved saddles for use within the District.

F.3.6.2 Specific Requirements

Saddles shall be brass/bronze, multi-piece units, made expressly for AWWA C900 PVC pipe. Silicon bronze pins and/or screws (minimum of 5/16-inch diameter), shall be used to assemble individual saddle pieces.

Saddles shall be configured with internal N.P.T. connection for connecting to corporation stop.

F.3.7 Air Valves

F.3.7.1 General

Air release valves and air and vacuum release valves shall be combination air valves (air valves) and conform to AWWA C512, except as modified herein or shown on the Approved Plans. See Approved Materials for approved air valves for use within the District.

F.3.7.2 Specific Requirements

Connections:

- 3-inch and smaller combination air valves shall be furnished with internal N.P.T. connections.
- 4-inch and larger combination air valves shall be furnished with flat-faced ring flanges compatible with flanges specified in Section F.3.9. Gaskets and nuts and bolts shall be in accordance with the requirements specified in Sections F.3.10 and F.3.11, respectively.

Protective Coatings:

- The interior shall be coated with fusion bonded epoxy in accordance with Section F.10.
- Exterior surfaces shall be coated with the manufacturer's standard coating.

Red brass pipe shall be used for all combination air valve connection piping in accordance with District Standard Drawing AV-1-08 and Section F.2.3.4.

F.3.8 Corporation Stops, Curb Stops, Angle Meter Stops and Miscellaneous Brass Fittings

Corporation stops, curb stops, angle meter stops and miscellaneous brass fittings shall be made of copper alloy (brass) conforming to AWWA C800, except that only brass materials with CDA No. C89520 or CDA No. C89833 (non-leaded) will be allowed and as otherwise modified herein. Written District approval of substitutions will be required.

See Approved Materials for approved brass fittings for use within the District

F.3.8.1 Corporation Stops

Corporation stops shall be furnished as follows:

- 1-inch copper service connections: Corporation stops shall be 1-inch male N.P.T. by 1-inch flare.
- 1-1/2 inch polyethylene service connections: Corporation stops shall be 1-1/2 inch male N.P.T. by 1-1/2 inch compression.
- 2-inch polyethylene service connections: Corporation stops shall be 2-inch male N.P.T. by 2-inch compression.

F.3.8.2 Curb Stops

Curb stops shall be furnished as follows:

- Curb stops shall be configured with N.P.T. connections.
- Curb stops shall be furnished with lock wings.

F.3.8.3 Angle Meter Stops

Angle meter stops shall be furnished as follows:

- Angle meter stop shall be furnished with lock wings.
- 1-inch copper service connection with 1-inch or 3/4-inch meter: Angle meter stops shall be 1-inch flare by 1-inch female N.P.T.
- 1-1/2 and 2-inch polyethylene service connections with 1-inch, 1-1/2 inch or 2-inch meter: Angle meter stop shall be furnished compression by flange. Flanged connections shall be made with brass bolts and nuts.

F.3.9 Steel Flanges

F.3.9.1 General

All steel flanges, except companion flanges and blind flanges, shall be slip on flanges. All steel flanges shall be manufactured in accordance with AWWA C207 unless otherwise shown on the Approved Plans or where herein modified. All steel flanges shall be flat-faced, that is, without projection and without raised face.

All steel flanges shall have the same diameter and drilling as ANSI B16.1 Class 125 cast iron flanges.

Additional requirements related to steel flange installations are specified in Section F.2.2.5.2.

F.3.9.2 Steel Slip-On Flanges

F.3.9.2.1 Hub-Type Flanges

Steel slip-on weld flanges of nominal size 12-inches and smaller shall be AWWA C207 standard steel slip-on hub-type, Class D, and steel slip-on weld flanges of nominal size greater than 12-inches shall be AWWA C207 standard steel slip-on hub-type, Class E unless otherwise required by the District or specified herein.

AWWA C207 Class D and Class E Standard Steel-Hub Flanges							
Nominal Flange Size [inches]	**OD of Flange [inches]**	**Number of Bolts**	**Diameter of Bolts [inches]**	**Class D Flange Thickness [inches]**	**Class D Overall Thickness [inches]**	**Class E Flange Thickness [inches]**	**Class E Overall Thickness [inches]**
4	9.00	8	0.625	0.500	0.875	--	--
6	11.00	8	0.750	0.562	1.250	--	--
8	13.50	8	0.750	0.562	1.250	--	--
10	16.00	12	0.875	0.688	1.250	--	--
12	19.00	12	0.875	0.688	1.250	--	--
14	21.00	12	1.000	--	--	1.375	2.250
16	23.50	16	1.000	--	--	1.438	2.500
18	25.00	16	1.125	--	--	1.562	2.688
20	27.50	20	1.125	--	--	1.688	2.875
24	32.00	20	1.250	--	--	1.875	3.250
30	38.75	28	1.250	--	--	2.125	3.500
36	46.00	32	1.500	--	--	2.375	3.750

F.3.9.2.2 Ring Flanges

Steel slip-on ring flanges shall only be used with concrete anchor blocks for steel offsets as shown on Standard Drawing WSP-2-08.

F.3.9.3 Steel Blind Flanges and Steel Companion Flanges

Steel blind flanges and steel companion flanges of nominal size 12-inches and smaller shall be AWWA C207, Class D, and steel blind flanges and steel companion flanges of nominal size greater than 12-inches and less than 48-inches shall be AWWA C207, Class E unless otherwise required by the District or specified herein.

Outlets in companion flanges shall be sized depending on the application and shall be threaded with N.P.T. threading.

Additional requirements related to steel flange installations are specified in Section F.2.2.5.2.

AWWA C207 Class D and Class E Blind Flange Thickness			
Nominal Flange Size [inches]	**OD of Blind Flange [inches]**	**Class D Blind Flange Thickness [inches]**	**Class E Blind Flange Thickness [inches]**
4	9.00	0.625	--
6	11.00	0.693	--
8	13.50	0.812	--
10	16.00	0.953	--
12	19.00	1.117	--
14	21.00	--	1.875
16	23.50	--	2.000
18	25.00	--	2.125
20	27.50	--	2.375
24	32.00	--	2.625
30	38.75	--	2.875
36	46.00	--	3.209

F.3.10 Flange Gaskets

All gaskets shall be full faced type, made of cloth inserted rubber, with a "rough" finish. Gaskets shall be certified to NSF 61 and shall be suitable for service with line content containing chlorine and chloramines. Gaskets used for nominal pipeline diameters 14-inches and smaller shall be 1/8-inch thick. Gaskets used for nominal pipeline diameters 16-inches and larger shall be 1/4-inch thick. No lubricant or sealant shall be used when assembling the gasket between the flanges unless the gasket manufacturer recommends it and the lubricant is certified to NSF 61 for use with potable water systems. Only one gasket shall be used per flanged joint.

Hydrant gaskets for connecting hydrant bodies to break-off spools and for connecting break-off spools to either hydrant bury elbows or hydrant bury extension spools (6 bolt holes) are specified in Section F.3.3.

Where shown on the Approved Plans or required by the District, flange insulation kits shall be used. See Approved Materials for approved flange insulation kits.

F.3.11 Bolts and Nuts

Unless otherwise specified herein or shown on the Approved Plans, bolts, nuts and washers used for flanged connections shall conform to the following requirements:

- Bolts shall be ASTM A307 carbon steel, Grade B, hexagonal head for Class D flanges and ASTM A193 grade B7, hexagonal head for Class E flanges.

- Nuts shall be ASTM A194 Grade 2H, hexagonal dimensions.

- Washers, if required to protect fusion epoxy or other applicable coatings, shall be forged or rolled steel.

- All bolts, nuts and washers shall be zinc coated and shall have ANSI regular hexagonal dimensions, as specified in ANSI B18.2 for wrench head bolts and nuts and wrench openings.

- All bolts and nuts shall be threaded in accordance with ANSI B1.1 for screw threads, coarse-thread series, Class 2A and 2B fit, respectively.

- When bolt-ups are completed, the bolts shall extend a minimum of 2 threads and a maximum of 5 threads beyond the outside face of nuts.

Refer to Section F.3.9 for required bolt diameters for each respective flange size.

F.3.12 Pipe Couplings

When indicated on the Approved Plans or required by the District, flexible couplings, insulating couplings, transition couplings and/or flanged coupling adapters shall be used.

When connecting PVC pipe to steel pipe, push-on by flange adapters (flange coupling adapters) shall be used.

When connecting PVC pipe to existing asbestos cement pipe, transition couplings shall be used.

In special circumstances, the District may require special couplings, such as grooved joint or ball joint couplings.

See Approved Materials for approved pipe couplings for use within the District.

See Section F.5.5.2.2 and Section F.6.6.3.5 for installation of pipe couplings on PVC pipe and steel pipe, respectively. See Section F.11.4 for additional requirements for installation of insulating couplings.

F.3.13 Tracer Wire

Tracer wire shall be A.W.G. No. 10 stranded copper wire with U.S.E. rated insulation, color black and installed with all non-metallic (PVC, polyethylene, etc.) mains, with all steel offsets for non-metallic mains and with all non-metallic service connections. The tracer wire shall be installed in accordance with District Standard Drawings TW-1-08 and TW-2-08.

See Approved Materials for tracer wire splice materials for use within the District.

F.3.14 Bonding Wire

Bonding wire shall be stranded copper wire of size as indicated on the Standard Drawings or as directed by the District, shall be provided with either HMWPE or XLPE insulation and shall be installed in accordance with District Standard Drawing ET-6-08.

F.3.15 Threaded Insulating Connections

Threaded insulating connections shall be nylon bushings. Nylon bushings shall be used for threading piping and fittings of dissimilar metals as shown on the Standard Drawings. Threads shall be compatible with threads on connected items.

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F.4 EARTHWORK

F.4.1 General

The provisions of this Section apply to trench excavation and trench backfilling for the installation of underground water mains and their appurtenances. The work consists of furnishing all labor, equipment, materials, transportation and services necessary for excavating and backfilling of trenches in accordance with these specifications, except that where City and/or County and/or State Special Provisions require special backfill requirements, such City, County and/or State requirements shall take precedence.

Contractor shall remove paving as may be required; excavate the trenches to required dimensions; place bracing and shoring to conform to the State of California Code of Regulations, Title 8, Construction Safety Orders (Cal/OSHA Standards); provide for drainage of ground and surface water, including silt control; provide flagmen, signage and other provisions for traffic control; restore or cause to be restored all damaged property including pipe, conduits, gas, water, other services, fences, guardrails, monuments, stakes and any other public or private property to the condition that existed prior to the beginning of the work; plug all open abandoned pipe, drains and sewers within the trench area with mortar or concrete or perform other work to abandon the facility in accordance with the pipe, drain, or sewer owner's requirements; backfill and compact the trench and pits; restore the roadway surface; remove surplus excavated material; clean up the site and perform all other work incidental thereto.

Any extraction of groundwater is subject to the District's Replenishment Assessment Act and may be subject to Replenishment Assessment fees. Installation of dewatering wells shall require a permit from the District.

F.4.2 Protection of Property and Structure

Contractor shall call USA (Underground Service Alert) toll free 1-800-227-2600 at least 48 hours before any planned work begins, and thereafter when required.

All underground utilities or structures such as drains, sewers, manholes, catch basins, conduit, ducts, gas lines and other obstructions encountered in the progress of the work shall be adequately protected and maintained by Contractor. Should any underground utility or structure be damaged by Contractor's operation, the owner of the utility shall be immediately notified of the damage. The District shall also be notified of such damage.

Should any water well and/or monitoring well be encountered in the process of the work, the Contractor shall notify the Groundwater Resources Division of ACWD's Engineering Department at 510-668-4460. The contractor shall also take immediate action to secure the top of the well or well casing with a watertight cover, that is secured by a lock or by other means to prevent: 1) the removal of the cover without the use of equipment or tools, 2) unauthorized access, 3) a safety hazard to humans and animals, and 4) illegal disposal of wastes in the well.

Trees, shrubbery, fences, poles and all other surface structures shall be protected unless their removal and/or cutting or alteration is shown on the plans, authorized by the owner or authorized by the District.

Should any surface structure or property be damaged by Contractor's operation, the Contractor shall immediately notify the proper owner or authority and arrange for immediate repair or replacement of same at no cost to the District. The District shall also be notified of such damage.

F.4.3 Maintenance of Traffic

Where required, a schedule of operations affecting traffic and a detailed traffic plan shall be approved by the controlling agency or municipality in advance of the closing of a street and prior to initiation of construction. Contractor shall post suitable signs where required by the controlling agency or municipality indicating that the street is closed or access is restricted and diverting the traffic to necessary detour routes.

Where traffic must cross open trenches, Contractor shall provide suitable bridges. Bridges shall also be provided at street intersections, entrances to private properties and pedestrian ways. The type of bridging used shall conform to the controlling governmental agency's or municipality's specifications.

F.4.4 Maintenance of Utility Controls

Hydrants under pressure, valve pots, valve boxes, meter boxes, postal mail boxes, or other utility controls shall be maintained and accessible at all times until the work is completed, unless otherwise indicated on the plans or approved by the District.

F.4.5 Barricades, Guards and Safety Provisions

Where required or in the opinion of District deemed necessary, adequate barricades, construction signs, flasher lights, guards, etc., shall be placed and maintained in operating order by Contractor throughout the progress of the work and until it is safe for traffic to use the right-of-way. All material piles, equipment and pipe which are, in the opinion of the District, obstructions to traffic shall be similarly marked during the progress of the construction work and until it is safe to use the right-of-way. The spacing between flasher lights shall be not more than 50 feet along the length of the trench where it is adjacent to or within the boundaries of a thoroughfare unless other spacing is required by the controlling governmental agency. Flagmen shall be provided by Contractor as required by the governing agencies or municipalities for the regulation of traffic.

F.4.6 Removal of Existing Pavement

Existing concrete pavement, driveways or sidewalks to be removed for the installation of a water main or appurtenances shall be neatly sawed along the edges of the trench to a depth of not less than 1-1/2 inches with a concrete pavement saw. Bituminous pavement shall be sawcut to clean straight lines.

F.4.7 Construction Staking

Control staking for the installation of the approved water system shall be provided as outlined below.

F.4.7.1 Rough Grading

The portions of the development within the roadway area of proposed dedicated streets and in easement shall be rough graded to approximate subgrade prior to setting horizontal and vertical control survey stakes for water line construction.

F.4.7.2 Surveying Horizontal and Vertical Control Stakes (Cut Stakes)

Horizontal and vertical control stakes consisting of a hub and marker stake shall be placed and maintained not less than 5 feet nor more than 10 feet from the centerline of the main, unless approved by the District. The stakes shall be stationed and marked with the cut from the hub to the flow line of the pipe. A clear line of sight shall be maintained between all stakes and the centerline of the mains directly opposite the stakes.

All construction staking shall be at 50 foot intervals, except on curvilinear streets having a centerline radius of 600 feet or less, where stakes will be set at 25 foot intervals.

All change of grade points shall be staked and the marker stakes so noted.

F.4.7.3 Fire Hydrants, Services and Other Appurtenances

The locations of fire hydrants, service connection and other appurtenances shall each be referenced with 2 offset stakes. These stakes shall be located parallel to the main, at right angles to the line serving the appurtenance and 5 feet on either side of the centerline of the appurtenance. The stakes shall indicate the appurtenance and the cut to the flow line of the pipe and the cut or fill to the top of the curb nearest the appurtenance.

Facilities that are improperly located or constructed shall be relocated or reconstructed as directed by the District prior to acceptance of the water system by District. The District, at its option, may require the improperly located or constructed facility to be abandoned at the main and a new facility installed.

F.4.7.4 Cut Sheets

Two (2) sets of “cut sheets” prepared on the standard District format shall be submitted for stakes placed pursuant to the above and at least 1 set provided to the water main contractor prior to start of construction of the water mains and appurtenances. Cut sheets shall be approved by the District prior to the start of the water main installation by Contractor.

F.4.7.5 Commencement of Work

No work will be permitted nor will inspection by District be provided for the installation of the proposed water system until the following has occurred:

1. Plans signed by District's Engineering Manager.
2. Payment of District's Engineering Fees.*
3. Issuance of "District Permit for Water Main Construction."*
4. 2 sets of signed plans submitted for District use.*
5. 2 sets of "cut sheets" approved by the District.
6. 24 hours notice for inspection.

Items marked with an asterisk (*) are required only for water system construction by developer's contractor. Failure to comply with these requirements will result in District's refusal to accept the work and to supply water to the development.

However, notwithstanding the above, no pipe, valve and/or appurtenance shall be backfilled until the installation of the pipe, valve and/or appurtenance has been inspected and approved by the District. Where backfilling is made prior to inspection and approval, reexcavation and exposure of the pipe, valve and/or appurtenance for examination will be required, at the option of District, before approval of the installation is obtained.

F.4.8 Excavation

F.4.8.1 General

Excavation shall comprise and include the satisfactory removal and disposal of all materials excavated, regardless of the nature of the materials encountered, and therefore shall be understood to include both rock excavation and common excavation when either or both classes are present.

All excavated material shall be stockpiled in a manner which shall not endanger the work or become a menace to the public or environment. Excavated material not required in other areas shall be removed from the job site.

F.4.8.2 Trench Excavation

Water main and appurtenances shall be surveyed and marked with offset stakes prior to excavation. Cut sheets indicating the depth of the water main and appurtenances on the Standard District format shall be approved by the District prior to start of work.

CONTRACTOR SHALL VERIFY EXISTING UTILITIES LINE AND GRADE BY POTHOLING AND HAND DIGGING 200 FEET AHEAD OF THE PIPE LAYING OPERATION. CONTRACTOR SHALL CALL USA (UNDERGROUND SERVICE ALERT) TOLL-FREE 1-800-227-2600 AT LEAST FORTY-EIGHT (48) HOURS BEFORE ALL PLANNED WORK BEGINS.

The trench shall be excavated to the line and grade indicated on the plans or as otherwise required by the District.

Where the bottom of the trench is found to be unstable, to consist of rock or boulders, or to include material which, in the opinion of the District, is unsuitable for proper bedding of the main, Contractor shall over-excavate and remove such unsuitable material to the width and depth ordered by the District. Before the main is laid, a new subgrade shall be prepared by backfilling with an approved material in layers of not more than 6 inches in uncompacted depth. Layers shall be mechanically compacted to meet the compaction requirements specified in Section F.4.10.5.

Where the bottom of the trench is found to consist of material which is unstable to such a degree that, in the opinion of the District, it cannot be removed and replaced with an approved material to properly support the main, Contractor shall construct a foundation for the pipe in accordance with plans prepared or approved by the District.

Where the bottom of the trench, through the negligence of Contractor, is excavated below the grade specified herein, the District shall determine what effect the over excavation shall have upon the placement of the main. When approved to do so by the District, Contractor shall prepare a new subgrade by backfilling with an approved material in layers of not over 6 inches in uncompacted depth. Layers shall be mechanically compacted to meet the compaction requirements specified in Section F.4.10.5.

F.4.8.3 Overexcavation for Pipe Bedding

When required by the District or shown on the plans, the bottom of trench shall be over-excavated a minimum of 4 to 6 inches below grade or as otherwise required by the District, and filled back to grade with select material as hereinafter specified or as otherwise required by the District.

F.4.8.4 Width of Trench

The width of the trench shall be as shown on the plans or as specified hereinafter. The minimum clear trench width measured at the horizontal diameter of the main shall be 1 foot greater than the outside diameter of the main. The maximum clear width of trench at the top of the main shall be not more than the outside diameter of the main plus 2 feet. Greater width of trench at the top of the main shall be permitted only on approval by the District.

Excessively wide and non-uniform trench excavation shall not be permitted.

F.4.8.5 Normal Trench Bracing

The manner of bracing trench excavations shall conform in all respects to the State of California Code of Regulations, Title 8, Construction Safety Orders (Cal/OSHA Standards). Failure to comply with these requirements shall result in immediate suspension of the work. Stoppage of the work shall remain in effect until full compliance with the regulations is obtained. Contractor

shall, and the District may, immediately suspend the work in the event of failure to comply with these requirements.

F.4.8.6 Special Trench Bracing

Where the cost of the work is in excess of $25,000 and where the depth of the excavated trench is 5 feet or more in depth, Contractor shall submit to District for acceptance in advance of the start of the excavation a detailed plan showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trench or trenches. District will review the plan for record only and will not provide approval of the plan. If such plan varies from the shoring system standards established by the State of California Code of Regulations, Title 8, Construction Safety Orders (Cal/OSHA), the plan shall be prepared by a registered civil or structural engineer.

Nothing in this subsection shall be deemed to allow the use of a shoring, sloping, or protective system less effective than that required by the State of California Code of Regulations, Title 8, Construction Safety Orders (Cal/OSHA). Nothing in this section shall be construed to impose tort liability on the District or any of its employees.

The above requirement is set forth in Section 6705 of the Labor Code of the State of California.

F.4.9 Removal of Water

Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water entering the excavations. No main, valves, appurtenances, concrete foundations, or thrust blocks shall be laid in water. Water shall not be allowed to rise over concrete foundations or thrust blocks until the concrete has set not less than 24 hours. No water shall be drained into work built or under construction without prior consent of the District.

Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. Water shall be disposed in such a manner as not to be a menace to the public or the environment and in compliance with all applicable laws and regulations.

Any extraction of groundwater is subject to the District's Replenishment Assessment Act and may be subject to Replenishment Assessment fees. Installation of dewatering wells shall require a permit from the District.

F.4.10 Backfill

F.4.10.1 General

Backfilling of trenches shall be done in such a manner as not to disturb the main, valves, fittings or appurtenances. In all cases, the backfill around the main or appurtenance and to an elevation of 6 inches over the top of the main or appurtenance shall be backfilled with select material as hereinafter specified. Native material shall not be permitted in the area indicated above. The

contractor shall provide, upon request by the District, documentation for the select material which includes the material origin and gradation report.

Tracer wire meeting these specifications shall be installed for all non-metallic water mains and all non-metallic service lines prior to backfilling. Steel offset installations on non-metallic water mains shall include continuous tracer wire, connecting the tracer wires for the non-metallic water mains.

Backfilling of the trench shall not begin until after the installation has been inspected and approved by the District. Backfilling of the trench prior to inspection and approval shall require reexcavation of the trench, if directed by the District, for the purpose of inspecting the installation.

Unless otherwise specified by the District or indicated on the plans, backfilling and backfill materials shall be as specified herein after.

F.4.10.2 Pipe Bedding and Trench Backfill to 6 Inches Above Top of Main

Material for pipe bedding and backfill to 6 inches above top of main or appurtenance shall be imported and shall be free from roots, vegetable matter or other deleterious substance, and shall be of such nature and so graded that it shall bind readily when watered and compacted. Pea gravel shall not be permitted as a backfill material.

When tested in accordance with the State of California, Department of Public Works, Standard Specifications, the material shall conform to the following gradation requirements and shall have a sand equivalent of not less than 20 and shall have an R value of not less than 35.

PIPE ZONE BEDDING AND BACKFILL GRADATION

Sieve Size or Designation	**Percent Passing (%)**
3/8-inch	100
1/4-inch	90 – 100
No. 4 (~0.187-in.)	35 – 100
No. 30 (~0.023-in.)	5 – 40

In place of the above graded material, coarse sand meeting the following gradation requirements and having a sand equivalent of not less than 20 may be used.

PIPE ZONE BEDDING AND BACKFILL SAND GRADATION

Sieve Size or Designation	Percent Passing (%)
3/8-inch	100
No. 4 (~0.187-in.)	95 – 100
No. 8 (~0093.-in.)	80 – 100
No. 16 (~0.046-in.)	50 – 85
No. 30 (~0.023-in.)	25 – 60
No. 50 (~0.012-in.)	10 – 30
No. 200 (0.003-in.)	2 – 10

Sand high in chlorides (greater than 100 ppm) shall not be used as pipe bedding and backfill material.

F.4.10.3 Trench Backfill in Existing or Proposed Future Street Right of Way Above 6 Inches Above Top of Main

Where not in conflict with City, County or State specifications, material used for trench backfill in existing or proposed future street rights of way shall be as specified hereinafter.

Trench backfill material shall be free from roots, vegetable matter or other deleterious substance and shall be of such nature and so graded that it shall compact readily when watered.

When tested in accordance with the State of California, Department of Public Works, Division of Highways Standard Specifications, the material shall conform to the following gradation requirements and shall have a sand equivalent of not less than 20 and shall have an R value of not less than 35.

Sieve Size or Designation	Percent Passing (%)
3-inch	100
1-inch	90 – 100
No. 4	35 – 100
No. 30	5 – 40

F.4.10.4 Trench Backfill in Easement or Other Areas not Within Existing or Proposed Street Right of Way Above 6 Inches Above Top of Main

Where not in conflict with City, County or State specifications, material used for trench backfill not within existing or proposed future street rights of way shall be as specified hereinafter.

Trench backfill above 6 inches above top of the main shall meet the requirements in Section F.4.10.3 except that the top 6 to 12 inches of backfill at the surface shall conform to the adjacent native surface material.

F.4.10.5 Compaction of Pipe Zone Backfill and Trench Backfill

Backfill material shall not be dropped on the pipe and shall be brought up evenly on each side of the pipe to prevent unbalanced lateral loads on the pipe. Backfill around the pipe shall be compacted as specified to form a uniform soil structure. The pipe shall not be damaged by placing or compacting the backfill materials.

The pipe haunch material shall be worked in and compacted to provide complete and uniform contact with the pipe bottom and to ensure that there are no voids in the material.

Pipe zone backfill and trench backfill shall be compacted to a minimum of ninety percent (90%) relative compaction as determined by California Test Method No. 216 or 231 as specified in State Specifications, unless otherwise specified by the District or indicated on the plans.

When backfilling, no material shall be deposited in depths greater than that which shall allow a minimum of ninety percent (90%) relative compaction to be achieved in any portion of that lift. No subsequent lifts shall be placed until the previously compacted lift has been approved.

Hand-held or walk-behind compaction equipment may be used to install the pipe zone backfill material. Larger compaction equipment can be used when the total depth of soil on top of the pipe is sufficient to prevent damage or undue stress on the pipe.

If work is within a State of California Highway or any other jurisdiction where jetting is not permitted, other acceptable methods of compaction shall be used.

When required by the District, the Contractor shall temporarily discontinue portions of his/her work to allow the District or other authorized sources to perform compaction testing safely, without interruptions or interference that may impair the accuracy of the results. The Contractor shall be responsible for providing a safe area for testing, including, but not limited to, trench shoring if applicable.

The Contractor shall not be entitled to any compensation by reason of any such request for temporarily discontinuing portions of his/her work for compaction testing.

F.4.11 Cleanup of Site

When excavating within a street right-of-way or other areas frequented by the public, Contractor shall, at the end of each day's work, remove all excess excavated material and shall maintain the site in a safe, clean and neat condition.

F.4.12 Pavement Replacement

Unless otherwise shown on the plans, when trenches have been excavated in paved streets, the replacement of the base course material and pavement shall be in kind and shall meet the requirements of the controlling agency or municipality.

In replacement of other paved areas, such as shopping centers, etc., an untreated base shall be placed and compacted and have a depth equal to the existing base course material plus 2 inches, but not less than 6 inches. The surfacing shall be replaced in kind unless otherwise stated on the plans or approved by the District.

F.5 INSTALLATION OF POLYVINYL CHLORIDE PRESSURE PIPE AND FITTINGS

F.5.1 General

This section covers the installation of polyvinyl chloride pressure pipe (PVC pipe) and fittings, including the handling, unloading, stringing of pipe and fittings along the trench, making connections of existing mains, cutting of the pipe, inspection, installation of thrust blocks, and other miscellaneous work required by District for the installation of the water system.

All work shall comply with AWWA Manual M23, PVC Pipe-Design and Installation, and AWWA C605 except as may be modified by the approved plans, District Standard Drawings, and/or these specifications.

Contractor shall notify the District not less than 24 hours in advance of the time of unloading or installation of pipe, valves, and appurtenances so that arrangements for inspection of the unloading or installation of the pipe and appurtenances may be made.

F.5.2 Unfit or Rejected Material

All material must be inspected for defects and conformity to the specifications prior to lowering into the trench. Any minor damage to the lining or coating of fittings during handling or installation shall be repaired as specified in Section F.10. Any pipe or fitting whether installed or not, which in the opinion of the District, does not meet the requirements of these specifications or otherwise found unfit, shall be rejected as being unfit. Any PVC pipe with scratches or gouges extending 10 percent or greater into the pipe wall shall be rejected. Contractor shall immediately mark all rejected materials as such and shall remove all rejected materials from the site of the work.

F.5.3 Handling and Unloading Pipe and Fittings

All pipe and fittings shall be loaded for delivery in such a manner as to avoid damage to the pipe or fitting. During delivery and storage onsite prior to installation, pipe ends shall be covered with a tarp or similar covering to protect the inside of the pipe from dirt, dust and contamination.

Fittings shall be kept clean and protected from contamination by dirt, dust, debris, animals and other such contaminants by a manner suitable to the District.

Delivery of pipe and fittings to the site of the work shall not take place until immediately prior to the installation thereof.

All pipe and fittings shall be handled with care to avoid damage. Whether moved by hand, skidways or hoists, the pipe shall not be dropped or dumped against other pipe or other objects.

Contractor shall replace any pipe section or fitting which has been damaged during loading, transporting, unloading, installation, or storage.

F.5.4 Line, Grade, and Preparation of Trench Bottom

All PVC pipe and fittings shall be laid and maintained to the lines and grades shown on the plans. Reference is made to Section F.4.8 for excavation and preparation of trench bottom.

No deviations shall be made from the line or grade shown on the plans except with the approval of the District.

Bell holes are required at bell and spigot joint and pipe coupling locations such that the trench bottom provides uniform support along the entire length of the pipe.

F.5.5 Installation of PVC Water Main and Fittings

F.5.5.1 General

Contractor must notify the District not less than 24 hours in advance of commencing installation to arrange for inspection. Such notice shall be provided not only at the beginning of installation but also before resuming work after any stoppage lasting more than 24 hours.

All water mains and appurtenances shall be carefully lowered into the trench in such a manner as to prevent damage to the pipe. Under no circumstances shall any material be dropped or dumped into the trench.

Great care must be exercised to keep the interior of the pipe clean. All foreign matter, dust or dirt shall be removed from the interior of all water mains and fittings before lowering into the trench. The interior of all water mains and fittings shall be kept clean before, during, and after laying. At the option of the District, the inside of each piece of the main may be swabbed with potable water or otherwise cleaned to remove all dirt prior to installation. Open ends of the mains and fittings within the trench shall be closed by approved means to prevent entrance of trench water, animals, or other foreign matter, when the laying operation is not in progress.

No main or fitting shall be laid in water, or when, in the opinion of the District, the trench conditions or the weather are unsuitable for construction. Any water main which has floated shall be removed from the trench and be re-laid in accordance with these specifications.

F.5.5.2 Installation of Polyvinyl Chloride Pressure Pipe (PVC Pipe)

PVC pipe shall be installed in accordance with AWWA Manual M23, PVC-Pipe Design and Installation, and AWWA C605 except as modified herein.

Field-cut lengths of PVC pipe 24 inches or longer, may be used for making connections to valves, fittings, appurtenances, and closures where necessary.

The cutting and beveling of the main for inserting into the bells of valves and fittings, or for closures, shall be done by the use of a handsaw, a fine tooth hacksaw, a portable power saw (fitted with a steel blade or abrasive disk) or an approved cutting tool manufactured for this

purpose which insures a square cut and simultaneously produce a bevel, if desired, without causing damage to the pipe. See Approved Materials for approved cutting tools.

To ensure a square cut, the location of the cut shall be marked at a minimum of three locations along the circumference of the pipe before cutting the pipe. The bevel of the pipe shall be the same as required for the receiving bell or fitting (normally requiring a shorter and steeper cut). After cutting and beveling, insertion reference marks shall be transferred to the field-cut spigot end. The insertion reference marks shall be transferred at a minimum of three locations along the circumference of the spigot end and shall be square and true. A factory-finished spigot end of the same size or manufacturer's data for the receiving bell end or fitting may be used as a guide for the insertion reference marks.

Insertion reference marks shall be provided for all push-on connections to ensure the correct insertion depth, and PVC pipe spigot ends shall not be over-inserted into bell ends or fittings. During joint installation, the spigot end shall be inserted until the reference marks are flush with the end of the bell or fitting.

PVC pipe may be assembled using a bar and block, however pullers such as a lever or come-along may also be used. Backhoe buckets may not be used directly against pipe surfaces to assemble push-on joints on PVC pipe.

PVC pipe shall not be deflected or bent for horizontal or vertical deflection. PVC pipe shall be installed so that there is no residual stress on any individual length of pipe.

Tracer wire shall be installed for all PVC pipe installation, refer to Section F.5.7.

Refer to Section F.4.8 for excavation and Section F.4.10 for backfill of water main.

Where it is required that the pipe be connected to another pipe, valve, or fitting of different manufacture or joint design, appropriate adaptors approved by the District shall be used to make the connection.

F.5.5.2.1 Minimum Cover and Clearances

The minimum depth of cover listed below shall be provided between the top of the main and the undisturbed subgrade or finished grade whichever provides the greater cover, unless indicated otherwise on the plans.

Nominal Pipe Diameter [inches]	**Undisturbed Subgrade**	**Finished Grade**
6 and 8	2 feet 0 inches	3 feet 0 inches
12	2 feet 6 inches	3 feet 6 inches

Reference is made to Standard Drawings CL-1-08 through CL-5-08 for required vertical and horizontal clearance requirements between District facilities (including water mains, fittings, and appurtenances) and other utilities, objects or structures. A minimum vertical clearance of 12

inches shall be maintained between the water main and all foreign structures, including natural gas or petroleum lines. A minimum horizontal clearance of 10 feet shall be maintained between the water mains and all pipelines of special concern as identified by the District and as indicated in Standard Drawing CL-2-08. A minimum horizontal clearance of 5 feet shall be maintained between the water main and all other utilities unless otherwise indicated on the plans or approved by the District.

If structures, pipes, manholes, etc., are encountered such that the water main must be relocated horizontally, the relocation shall be made as approved by the District.

Reference is made to Standard Drawing WSP-2-08. If foreign structures are encountered such that the water main must be raised, the minimum cover shall be as indicated unless otherwise approved by the District. Where required by the District, a concrete pad shall be installed above the pipe for protection. The concrete pad shall be constructed in accordance with District Standard Drawing WSP-2-08. Concrete for the pad shall be as specified in Section F.5.6.1.

F.5.5.2.2 Joints in PVC Pipe

Joining of PVC pipe shall be with rubber rings for integral bell ends. All rubber rings for integral bell ends shall be furnished by the PVC pipe manufacturer.

Unless a joint includes a bell end from an approved high deflection coupling or from an approved gray iron or ductile iron fitting or appurtenance, pipe deflection is prohibited at a push-on connection or a bell and PVC spigot joint connection. PVC pipe shall be installed so that there is no residual stress on any individual length of pipe. Contractor shall consult the PVC pipe manufacturer for recommended lubrication and installation of bell and spigot joints.

Reference is made to Section F.2.1.3. Only PVC pipe lubricants which are both certified to NSF 61 and listed in the pipe manufacturer’s published list of approved lubricants shall be used to lubricate PVC pipe joints.

Any horizontal or vertical deflection for PVC pipe shall be accomplished through the use of approved fittings or appurtenances. PVC push-on joints with approved AWWA C900 PVC pipe "deflection couplings" or ductile iron or gray iron fittings or appurtenances shall not be deflected more than one and one-half degrees (1-1/2°).

Joining of PVC pipe to a gray iron or ductile iron fitting or appurtenance shall conform to Section 5.5.3.3 of AWWA C605. Prior to joint assembly, the PVC pipe spigot end shall be squarely cut, deburred and only slightly beveled. For factory bevels on PVC spigot ends, the factory bevel shall be shortened or shall be removed and only slightly beveled.

Insertion reference marks shall be provided at a minimum of three locations along the circumference of the pipe for all push-on connections to ensure the correct insertion depth, and PVC pipe spigot ends shall not be over-inserted into bell ends or fittings. Reference marks on the PVC pipe spigot ends shall match the appurtenance or fitting manufacturer’s published insertion depth for the receiving bell end of the push-on connection. During joint installation,

the spigot end shall be inserted until the reference marks are flush with the end of the bell or fitting.

F.5.6 Thrust Blocks, Valve Pads, and Reverse Anchors

Thrust blocks and/or reverse anchors shall be provided for all bends, tees, crosses, reducers, blowoffs and where indicated on the plans or required by the District. Thrust blocks and reverse anchors shall be constructed in accordance with the District Standard Drawings TB-1-08 through TB-4-08, and shall bear against undisturbed earth. If, in the opinion of the District, the earth against which the anchor bears is unsuitable to support the imposed load, Contractor shall provide such additional anchorages as may be required by the District.

Concrete pads shall be installed under all valves as indicated on District Standard Drawings V-1-08 and V-2-08.

Ground against which concrete is to be placed shall be moistened prior to placing so that it will not absorb excessive moisture from the fresh concrete. Forms, if required, shall be smooth, mortar tight, and of sufficient strength to maintain shape during the placing of the concrete. Placing methods shall be such that the concrete will be placed in its final position without segregation. Concrete shall not be allowed to free fall from a height greater than 6 feet. All concrete shall be spaced, placed, and rodded to insure smooth surfaces along form lines and to eliminate rock pockets. The use of mechanical vibrators is not required on properly poured reverse anchors, thrust blocks or valve supports. Thrust and valve support blocks shall be placed in such a manner that pipe and fitting joints will be accessible for repair. No concrete used for thrust blocks, reverse anchors and valve pads shall be in contact with the PVC pipe.

Joint restraint devices shall not be used except with special approval by the District.

F.5.6.1 Portland Cement Concrete

Portland cement concrete shall consist of a mixture of portland cement, fine aggregate to coarse aggregate, regulated so as to produce a plastic, workable and cohesive mixture. The amount of fine aggregate shall be the minimum required to produce sufficient mortar to fill the voids of the coarse aggregate and leave a slight excess for finishing. Each sack of cement shall weigh 94 pounds.

All concrete used shall be Class “A” concrete and shall contain 6 sacks of portland cement and not more than 6-1/2 gallons of water per sack of cement per cubic yard of finished concrete. All material required for portland cement concrete and the procedure for mixing shall meet the requirements set forth in Section 90, State of California, CALTRANS, Standard Specifications, current edition.

F.5.7 Tracer Wire

Tracer wire is required for non-metallic water main and non-metallic service line materials. Tracer wire shall be minimum size A.W.G. No. 10 stranded copper wire with U.S.E. type insulation, color black and installed with all AWWA C900 PVC pipe and polyethylene service connections. Tracer wire shall not be welded or attached to any metallic metal fitting or appurtenance. The tracer wire shall be installed in accordance with District Standard Drawing TW-1-08 and TW-2-08.

Steel offset installations on non-metallic water mains shall include continuous tracer wire, connecting the tracer wires for the non-metallic water mains.

Splices shall be made with connectors, and encapsulated in connector sealing packs. See Approved Materials for tracer wire connectors approved by the District.

F.5.8 Connections to Existing Mains

Refer to Section F.13, Connection to Existing Mains (Closures).

F.6 INSTALLATION OF LINED AND DIELECTRIC COATED STEEL PIPE

F.6.1 General

This section covers the installation of lined and dielectric coated steel cylinder pipe, including the handling, unloading, stringing of pipe along the trench, making connections to existing mains, cutting of the pipe, inspection and other miscellaneous work required by the District for the installation of the water system.

All work shall comply with AWWA C604, Installation of Steel Water Pipe, except as may be modified by the approved plans, District Standard Drawings, and/or these specifications.

Contractor shall notify the District not less than 24 hours in advance of the time of unloading and installation of pipe so that arrangements for inspection of the unloading and installation of the pipe may be made.

For requirements related to steel pipe materials, see Section F.2.2.

F.6.2 Unfit or Rejected Material

Contractor shall inspect all material for defects and conformity to the specifications prior to lowering into the trench. Any minor damage to the lining or coating during handling or installation shall be repaired as specified in Section F.10. Any pipe whether installed or not which, in the opinion of the District, does not meet the requirements of these specifications or otherwise found unfit shall be rejected as being unfit. Contractor shall immediately mark all rejected materials as such and shall remove all rejected materials from the site of the work.

F.6.3 Transportation of Steel Pipe

All pipe shall be loaded for delivery in such a manner as to avoid damage to the lining or coating of the pipe.

Each end of each pipe section 16 inches or larger in diameter will be provided with two 2-inch by 2-inch minimum wood struts wedged into position at right angles to each other to prevent the pipe from becoming out of round. The wood struts shall remain in place in the pipe until just prior to installation.

Waterproof end covers as specified in Section F.2.2.7.1, shall remain in place during transportation of the pipe and during storage of the pipe at the site of the work. Additional windbreak protection shall be provided if necessary to prevent end cover damage during transportation so that pipe and fitting interiors remain clean and protected from contamination.

Delivery of pipe to the site of the work shall not take place until immediately prior to the installation thereof.

F.6.4 Handling and Unloading of Steel Pipe

Pipe shall be removed from the carrier truck by crane, forklift or other suitable equipment in accordance with AWWA M11, manufacturer's requirements, and safe handling practices.

When using a crane, 6-inch minimum width nylon slings attached to each end of a 20 foot-long spreader bar shall be used for pipe lengths of 30 feet or greater. A 6 foot-long spreader shall be used for pipe lengths less than 30 feet. Ropes or cables shall not be used in lieu of nylon slings.

When using a forklift, the forks and any other surface to which the pipe may come in contact shall be covered with a cushioning material which shall protect the coating of the pipe from damage. The distance between the forks shall not be less than 6 feet. A forklift shall not be used to move pipe greater than 30 feet in length.

To facilitate the unloading and installation of the pipe, each pipe section shall be marked with the number shown on the approved shop drawings as applicable.

The unloaded pipe shall be placed on sawdust sacks or sandbag supports and will be sufficiently clear of ground, grass, weeds or other material which may prevent an electrical inspection of the coating as hereinafter specified. Select material with rocks no greater than 3/8-inch size may also be used for pipe support in temporary placement.

No pipe section shall be slid along the ground. Rolling on skids or ground specially prepared so as to prevent any damage to the coating shall be allowed only upon approval of the District.

All pipe shall be handled with care to avoid damage; the pipe shall not be dropped or bumped against other pipe or other objects.

Contractor shall repair, as specified hereinafter, or replace any pipe section which has been damaged during loading, transporting, unloading or as a result of faulty support while being transported or stored on the site of the work.

Excessive coating or lining damage shall be cause for rejection of the pipe as unfit. Contractor shall immediately mark all rejected materials as such and shall remove all rejected materials from the site of the work.

F.6.4.1 Out of Round Pipe

Steel cylinder pipe that is delivered or becomes out of round due to transportation or handling damage, shall be rejected. Contractor shall immediately mark all rejected materials as such and shall remove all rejected materials from the site of the work. Out of round pipe shall be defined as being more than four percent (4%) out of round.

Out of roundness of steel cylinder pipe shall be measured as the difference between the major and minor outside diameters, divided by the pipe O.D.

F.6.5 Line, Grade and Preparation of Trench Bottom

All pipe will be laid and maintained to the lines and grades shown on the plans. Reference is made to Section F.4.8 for excavation and preparation of trench bottom.

No deviations shall be made from the line or grade shown on the plans except with the approval of the District.

F.6.6 Installation of Steel Pipe

F.6.6.1 General

Contractor must notify the District not less than 24 hours in advance of commencing installation to arrange for inspection. Such notice shall be provided not only at the beginning of installation but also before resuming work after any stoppage lasting more than 24 hours.

All water main pipe lengths of 30 feet or greater shall be carefully lowered into the trench by means of a crane or other suitable equipment as to prevent damage to the pipe, equipped with a 20-foot spreader bar with 6 inch-minimum width nylon slings attached to each end, in such a manner to prevent damage to the coating or lining on the pipe. All water main pipe lengths of less than 30 feet in length shall be handled in the same manner, except a 6-foot spreader bar shall be used. Ropes or cables or chains shall not be used in lieu of nylon slings. Under no circumstances shall any material be dropped or dumped into the trench.

Great care must be exercised to keep the interior of the pipe clean.

All foreign matter, dust, or dirt shall be removed from the interior of all water mains before lowering into the trench. The interior of all water mains shall be kept clean before, during and after laying. At the option of the District, the inside of each piece of the main may be swabbed with potable water or otherwise cleaned to remove all dirt prior to installation. Open ends of mains within the trench shall be closed by approved means to prevent entry of dirt, trench water, animals, or other foreign matter when the laying operation is not in progress.

No main shall be laid in water or when, in the opinion of the District, the trench conditions or the weather are unsuitable for construction. Any water main section which has floated shall be removed from the trench and shall be relaid in accordance with these specifications.

F.6.6.2 Inspection of Pipe Coating and Lining

Prior to lowering the pipe into the trench, the pipe coating shall be tested in accordance with Section F.10.2.2.

Contractor shall exercise care and diligence to prevent damage to the lining and to minimize the development of cracks therein. Any defective area in the lining shall be removed to the pipe wall and repaired by hand application to the full required thickness. Mortar used for repair of defective lining shall have the same mix proportions as the lining being repaired. If numerous or

large defective areas occur in the lining of a pipe section special fitting, Contractor shall remove and replace the entire lining.

Failure of coating and/or lining to pass inspection and testing over large areas in any length of pipe shall be cause for rejection of the length of pipe as unfit and shall be immediately removed from the site of the work.

F.6.6.3 Installation of Lined and Coated Steel Cylinder Pipe

The installation of lined and coated steel cylinder pipe shall meet the requirements as specified herein.

F.6.6.3.1 Minimum Cover and Clearances

The minimum depth of cover listed below shall be provided between the top of the main and the undisturbed subgrade or finished grade, whichever provides the greater cover, unless indicated otherwise on the plans.

Nominal Pipe Diameter [inches]	Undisturbed Subgrade	Finished Grade
6 and 8	2 feet 0 inches	3 feet 0 inches
12	2 feet 6 inches	3 feet 6 inches
14 and larger	3 feet 0 inches	4 feet 0 inches

Reference is made to Standard Drawings CL-1-08 through CL-5-08 for required vertical and horizontal clearance requirements between District facilities (including water mains, fittings, and appurtenances) and other utilities, objects or structures. A minimum vertical clearance of 12 inches shall be maintained between the water main and all foreign structures, including natural gas or petroleum lines. A minimum horizontal clearance of 10 feet shall be maintained between the water mains and all pipelines of special concern as identified by the District and as indicated in Standard Drawing CL-2-08. A minimum horizontal clearance of 5 feet shall be maintained between the water main and all other utilities unless otherwise indicated on the plans or approved by the District.

If structures, pipes, manholes, etc., are encountered such that the water main must be relocated horizontally, the relocation shall be made as approved by the District.

Reference is made to Standard Drawing WSP-2-08. If foreign structures are encountered such that the water main must be raised, the minimum cover shall be as indicated unless otherwise approved by the District. Where required by the District, a concrete pad shall be installed above the pipe for protection. The concrete pad shall be constructed in accordance with District Standard Drawing WSP-2-08. Concrete for the pad shall be as specified in Section F.5.6.1.

F.6.6.3.2 Joints in Lined and Coated Steel Cylinder Pipe

Joints shall be installed in accordance with the approved shop drawings. When field conditions are encountered which require a change in the type of joint to be used, the District will determine the type of joint required.

Field welding of pipe joints shall be in accordance with Section F.8 of these specifications and District Standard Drawing WSP-1-08.

The inside of joints shall be completed as soon as possible following the installation of the main. At the end of a day's work, the inside of joints shall be completed to within two joints of the end of the main. At no time shall the end of the main be more than three pipe lengths beyond the last completed inside joint.

The inside of bell and spigot joints in mortar lined main 20 inches and smaller in diameter shall be finished by "buttering" the inside edge of the bell end of the main with a cement mortar prior to the making of the joint. The mortar shall consist of one part cement and one part fine sand with only sufficient water to form a plastic mixture. Prior to the application of the mortar, the lining in both bell and spigot ends of the main shall be dampened to prevent the adjoining surfaces from dehydrating the fresh mortar.

After the joint is made, a rubber sewer ball or a squeegee shall be pulled through the pipe to remove the excess mortar extruded by the joint closure.

Reference is made to Standard Drawing WSP-1-08. The inside of a butt strap joint with a handhole shall be mortared through the handhole using a mortar having the consistency as specified above. The final surface of the joint shall be hand troweled smooth. When installing butt strap joints with pipe coupling handholes, the steel pipe plug shall be lined with mortar on the inside surface before it is placed into the pipe coupling. Sufficient time shall be given for the mortar to set prior to welding the pipe plug to the pipe coupling. When installing butt strap joints with Alternate handholes, the handhole cover shall be lined with mortar on the inside surface before it is placed onto the butt strap. The handhole cover shall be immediately tack welded in place with tack welds at two locations. However, sufficient time shall be given for the mortar to set prior to completing the weld securing the handhole cover to the butt strap.

After closure of a welded joint on a mortar lined main 24 inches or larger in diameter has been made and approved and the joint has sufficiently cooled, the inside of the welded joint shall be mortared from the inside using a mortar having the consistency as specified above and hand-troweled smooth.

F.6.6.3.3 Wrapping and Testing of Exterior Joints in Lined and Coated Steel Cylinder Pipe

Wrapping of exterior joints in lined and coated steel cylinder pipe shall be as required in Section F.10.2.1.

After a joint has been made and wrapped as above specified, the Contractor shall conduct, under supervision of the District, an electrical inspection of the joint coating as specified in Section F.10.2.2.

F.6.6.3.4 Flanged Pipe Joints

Steel flanges shall conform to Section F.3.9. Flanged pipe joints shall conform to Section F.2.2.5.2 and District Standard Drawing ET-6-08.
Each flange shall be attached to the pipe by means of two fillet welds on each side of the flange (both outside and inside). Welding shall be in accordance with AWWA C207 and Section F.8.

After welding, the flanges shall be perpendicular to the centerline of the main, free of warp with faces smooth and true.

Gaskets used for assembling flanged joints shall be as specified in Section F.3.10.

Before installing gaskets, the faces of the flanges shall be clean, free of scratches, nicks and other surface irregularities and shall be smooth and true.

Bolts and nuts for flanged joints shall be as specified in Section F.3.11. Where required because of small clearances on adjacent valves and fittings, studs of the proper size and strength may be used instead of bolts with approval by the District. In bolting up flanges, the nuts shall be tightened in such a way that the flanges in the completed joint shall be parallel and free from unequal stresses.

Care shall be taken to prevent damage to the bolt heads, nuts or threads; and if such damage is done, the damaged material shall be replaced. No flange joint shall be accepted until leakage under test has been stopped. Such leakage shall be stopped only by cleaning flanges or replacement of gaskets or adjustments of tension on the bolt. No other method shall be permitted.

After the joint is assembled, the outside of flanges and bolts shall be cleaned and coated as specified in Section F.10.3.

When required, insulating flanges shall be installed in accordance with applicable details on District Standard Drawing ET-6-08.

F.6.6.3.5 Pipe Coupling Joints

Flexible coupling or insulating flexible coupling joints shall be used only when shown on the plans or approved by the District. Flexible coupling joints shall be installed in accordance with the manufacturer's recommendations.

When indicated on the plans or approved or required by the District, special anchoring devices shall be provided to prevent joint failure.

After the joint is assembled, the outside of joint and coupling shall be cleaned and coated as specified in Section F.10.3.

Flexible couplings shall be installed in accordance with applicable details on District Standard Drawing ET-6-08.

F.6.6.4 Bonding Wire

Bonding wire shall be stranded copper wire with either HMWPE or XLPE insulation, color black and size as indicated on plan or approved by the District. Bonding wires shall be provided and installed in accordance with District Standard Drawing ET-6-08. Bonding wire shall be attached to ferrous metal pipe, fitting or appurtenance by exothermic weld in accordance with the District Standard Drawing ET-1-08.

F.6.6.5 Field Repair of Coatings

When permitted by the District, minor field repair of damaged coatings shall be made and tested using the material and method of application and testing in the applicable subsections of Section F.10.2.

F.6.7 Connections to Existing Mains

Refer to Section F.13, Connection to Existing Mains (Closures).

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F.7 INSTALLATION OF APPURTENANCES

F.7.1 General

This section covers the installation of appurtenances, including the handling, unloading, inspection, and installation of service connections, fittings, valves, fire hydrants, blowoffs, air valves, thrust blocks, curb markings, marker posts, and other miscellaneous work required by the District for the installation of the water system appurtenances. The installation of appurtenances shall be in accordance with these standards and the District Standard Drawings referred to herein, unless otherwise approved by the District.

Contractor shall notify the District not less than 24 hours in advance of the time of unloading and installation of appurtenances so that arrangements for inspection of the unloading and installation of appurtenances may be made.

All ferrous metal fittings, such as tees, crosses, bends, reducers, fire hydrant buries, plugs, flanges, valve bodies, nuts, bolts, galvanized iron pipe, cast iron pipe, etc., shall be coated as specified in Section F.10.

F.7.2 Unfit or Rejected Material

All material must be inspected for defects and conformity to the specifications prior to lowering into the trench. Any pipe, valve or appurtenance whether installed or not which, in the opinion of the District, does not meet the requirements of these specifications or otherwise found unfit shall be rejected as being unfit. Any minor damage to the lining or coating during handling or installation shall be repaired as specified in Section F.10. Excessive coating or lining damage shall be cause for rejection of the appurtenance as unfit. Contractor shall immediately mark all rejected materials as such and shall remove all rejected materials from the site of the work.

F.7.3 Transportation of Appurtenances

All appurtenances shall be loaded for delivery in such a manner as to avoid damage to the lining or coating of the appurtenances.

Delivery of appurtenances to the site of the work shall not take place until immediately prior to the installation thereof.

F.7.4 Handling and Unloading of Appurtenances

All appurtenances shall be handled with care to avoid damage; the appurtenances shall not be dropped or bumped against other appurtenances, pipe or other objects. Under no circumstances shall any appurtenance be dropped or dumped into the trench.

Great care must be exercised to keep the interior of the appurtenance clean. All foreign matter, dust, or dirt shall be removed from the interior of all appurtenances prior to assembly or lowering into the trench. The interior of all appurtenances shall be kept clean before, during and after

assembly or installation. The inside of the appurtenances shall be swept or swabbed to remove all dirt prior to installation.

Contractor shall repair, as specified hereinafter, or replace any appurtenance which has been damaged during loading, transporting, unloading or as a result of faulty support while being transported or stored on the site of the work.

F.7.5 Inspection of Appurtenance Coating and Lining

For lining and coating inspection requirements, reference is made to Section F.10.

F.7.6 Installation of Valves and Fittings

F.7.6.1 Connections to PVC Pipe

Valves and fittings having push-on ends shall be connected to the main by means of bell and spigot joint with integral rubber ring gaskets supplied by the fitting manufacturer. Valves and fittings having flanged ends shall be connected to PVC pipe by means of a push-on by flange adaptor unless other means are approved by the District.

Reference is made to Section F.2.1.3. Only PVC pipe lubricants which are both certified to NSF 61 and listed in the pipe manufacturer's published list of approved lubricants shall be used to lubricate PVC pipe joints. Prior to lubrication for PVC pipe connections to valves and fittings with push-on ends, the spigot ends of the PVC pipe shall be marked at a minimum of three locations along the circumference of the pipe with insertion reference marks corresponding to the valve or fitting manufacturer's published dimension for pipe insertion depth.

Insertion reference marks shall be provided for all push-on connections to ensure the correct insertion depth, and PVC pipe spigot ends shall not be over-inserted into push-on end of the valves or fittings. During installation, the spigot ends shall be inserted until the reference marks are flush with the edge of the push-on ends of the valves or fittings.

Valves and fittings which are required to be bolted together to form a single unit shall be assembled and coated as specified in Section F.10.3 prior to lowering into the trench.

Valve pads shall be provided as shown on District Standard Drawings V-1-08 or V-2-08 unless otherwise indicated on the plans. Fittings shall be provided with thrust blocks as shown on District Standard Drawings TB-1-08 and TB-2-08. For valve pad installation requirements, see Section F.5.6.

F.7.6.2 Connections to Steel Pipe

Fittings may be either welded or flanged to the steel pipe, unless the type of joint is specifically indicated herein or otherwise shown on the plans. Valves must be flanged to steel pipe. O-Ring type joints shall not be used.

The shop drawings submitted for approval by the pipe manufacturer shall detail the type of joint proposed.

When welding attachments to Lined and Coated Steel Cylinder Pipe, the coating shall be removed not less than 3 inches from the end of the weld. Care should be exercised to avoid damage to the coating beyond the area removed. Openings of the correct size and shape shall be cut through the pipe plate and the fitting welded as indicated on the plans.

All damaged lining and coating shall be repaired. A field coating will be applied to all damaged areas and to all areas not previously coated. The areas to be field coated or repaired shall be in accordance with Section F.10.

Before installing gaskets, the face of the flanges shall be inspected to be clean, free of defects, scratches, nicks, and other surface irregularities and shall be smooth and true.

F.7.7 Installation of Fire Hydrants

All fire hydrants shall be installed in accordance with District Standard Drawings FH-1-08 and FH-2-08 at the location indicated on the plans. Hydrant bury extension spools shall be used to meet the vertical dimension requirements of the break-off spool relative to the finished grade as shown on District Standard Drawing FH-2-08. The break-off spool shall be installed immediately below the hydrant body.

If the District determines that a fire hydrant is improperly installed, the hydrant shall be removed and reinstalled properly.

PVC shall be used for fire hydrant laterals unless steel pipe laterals are indicated on the plans or unless directed by the District because of field changes. Steel pipe shall conform to Section F.2.3.7, with all joints fully welded in accordance with Section F.8, Welding. Anodes shall be provided on steel fire hydrant laterals if required by the District. Refer to Section F.11.3.1 for anodes on steel fire hydrant laterals.

Refer to Section F.4.8 for excavation and Section F.4.10 for backfill of fire hydrant laterals.

F.7.8 Installation of Blowoffs

Temporary blowoffs shall be installed at closure points to existing water mains, and shall be removed after all pressure testing, disinfecting and bacteriological approval, and replaced by pipe closure. Size of temporary blowoffs shall be as follows, unless otherwise required or approved by the District:

Nominal Main Size [inches]	Blowoff Size [inches]
6 – 8	2
10 – 12	4
14 – 16	6
18 and larger	8

Permanent blowoffs shall be installed where shown on the plans or required by the District. All permanent underground galvanized steel pipe shall be installed with a zinc anode in accordance with Section F.11.3.

F.7.8.1 Connections to PVC Pipe

Permanent blowoffs on PVC pipe indicated on the plans or required by the District shall be constructed in accordance with the applicable District Standard Drawings TB-3-08 or TB-4-08.

F.7.8.2 Connections to Steel Pipe

Permanent blowoffs on steel pipe indicated on the plans or required by the District shall be constructed in accordance with the applicable District Standard Drawings TB-3-08 or TB-4-08, except when the concrete reverse anchor may be omitted and end cap and blowoff assembly may be installed in accordance with an alternate detail as shown on the approved plans.

F.7.9 Installation of Services for 1 Inch, 1-1/2 Inch and 2 Inch Sizes

Service connections for 1-inch, 1-1/2 inch, and 2-inch services lines shall be installed in accordance with District Standard Drawings S-1-08 and S-2-08. Water meter boxes shall be installed by Contractor in accordance with District Standard Drawings S-3-08, S-4-08, S-5-08, S-6-08, S-7-08, S-8-08 and S-10-08. See Approved Materials for approved water meter boxes. If services and meter boxes are required by the District to be labeled with addresses, reference is made to District Standard Drawing S-11-08.

All underground copper tubing or pipe shall be installed with a zinc anode in accordance with Section F.11, Electrolysis Control.

Angle meter stops shall be adjusted to proper relationship with curb and/or sidewalk prior to pressure testing and prior to meter installations.

The installation of union connectors or splices on service connections shall not be permitted.

Refer to Section F.4.8 for excavation and Section F.4.10 for backfill of service lines.

F.7.9.1 Connections to PVC Pipe

Saddles (service clamps) and corporation stops shall be used for service connections 2 inches and smaller on PVC pipe.

The drilling of PVC pipe for service connections shall be by the use of shell cutters to prevent chips from entering the pipe.

F.7.9.2 Connections to Steel Pipe

Welded couplings and corporation stops shall be used for service connections 2 inches and smaller on steel pipe.

A nylon bushing shall be installed for each service lateral between the corporation stop and the welded coupling as required by District Standard Drawings.

F.7.10 Installation of Steel Service Lines 4 Inches and Larger

Service connections for fire line laterals or for service laterals 4 inches and larger diameter size shall be steel pipe. Steel pipe shall conform to Section F.2.3.7, with all joints fully welded in accordance with Section F.8, and anodes are required in accordance with F.11.3. Refer to District Standard Drawing S-9-08 for additional installation requirements.

Refer to Section F.4.8 for excavation and Section F.4.10 for backfill of service lines.

F.7.11 Installation of Air Valves

Air valves shall be installed where indicated on the plans or at high points in the main as directed by the District.

Installation of air valves, unless otherwise indicated on the plans or approved by the District, shall be in accordance with District Standard Drawing AV-1-08. Red brass pipe shall be used for the air valve lateral line. Refer to Section F.2.3.4 for requirements for red brass pipe. Galvanized steel pipe shall be used for the air valve vent piping. Refer to Section F.2.3.6 for requirements for galvanized steel pipe.

Refer to Section F.4.8 for excavation and Section F.4.10 for backfill of air valve lines.

F.7.12 Installation of Valve Boxes, Valve Box Extensions

Valve boxes and valve box extensions shall be installed on all valves unless otherwise indicated on the plans or directed by the District. Installation of valve boxes and valve box extensions,

unless otherwise indicated on the plans, shall be in accordance with District Standard Drawing VB-1-08. A concrete collar shall be poured around all valve boxes.
Valve boxes installed in unpaved areas shall be installed such that the concrete collar is flush with the valve box lid and the concrete collar slopes away from the valve box lid. The District will determine the grade of the valve box lid when installed in unpaved areas. Any tracer wires present shall be installed in the valve box extension in accordance with District Standard Drawing TW-1-08.

Any valve nut extension stem required by District Standard Drawing VB-1-08 must be provided and installed in accordance with District Standard Drawing VB-1-08.

F.7.13 Testing and Chlorination of Appurtenances

All appurtenances shall be pressure tested and chlorinated concurrently with the main to which they are attached. See Section F.12.

F.7.14 Tracer Wire

Tracer wire is required for non-metallic water main and non-metallic service connections and as required by the District or shown on the approved plans. See Section F.5.7 for tracer wire requirements.

F.7.15 Electrolysis Control

Electrolysis control shall be provided as specified in Section F.11, Electrolysis Control.

F.7.16 Curb Markings and Marker Posts

The location of all valves, blowoffs, air valves, services, etc., shall be marked on the closest vertical curb face, if existing, in accordance with the District Standard Drawing MP-1-08.

Flexible marker posts, provided by the District, shall be used to mark the location of valves, blowoffs, air valves, etc., where there are no curbs in the immediate vicinity or as directed by the District. The flexible posts shall be installed to conform to District Standard Drawing MP-1-08.

A 4-inch by 6-inch by 6-foot redwood marker post conforming to District Standard Drawing ET-3-08 shall be installed for electrolysis test stations in undeveloped areas.

F.8 WELDING

F.8.1 General

Welding of longitudinal seams of steel pipe may be performed automatically by the electric arc method or by an approved resistance method. All other welding shall be done by a process which excludes the atmosphere from the molten metal of the weld.

All field welding shall conform to the latest edition of AWWA C206 unless otherwise modified herein.

Artificial or forced cooling of welded joints is not permitted.

F.8.2 Penetration, Fusion, Slag Inclusion

Penetration is defined as the complete filling of the weld groove with weld metal. Fusion is defined as the bond between beads or between the weld metal and the pipe metal. Slag inclusion is a non-metallic solid entrapped in the weld metal or between the weld metal and the pipe metal. In order to secure adequate penetration and fusion, and to prevent slag inclusion, all position welds shall be made with the parts to be joined secured against movement and with adequate clearance around the joint to allow the welder or welders space in which to work.

F.8.3 Root Bead

The root bead, being the first or stringer bead which initially joins the two sections of pipe; a section of pipe to a fitting, or two fittings, will be made by the vertical welding method. The joint will be free of all foreign matter such as grease, oil, dirt and scale. The welder shall start his or her weld at or near the bottom and weld approximately one-half way up on each side of the pipe. The entire root bead shall be complete around the circumference before the start of the filler or finish beads. Scale and slag shall be removed from each bead, groove and the stopping point of any weld bead. Cleaning shall be thorough and may be done with chipping hammer and wire brush or power tools.

F.8.4 Filler and Finish Bead

The number of filler and finish beads will be such that the completed weld will have a substantially uniform section around the entire circumference of the pipe. At no point will the crown surface be below the outside surface of the pipe; finish head shall be crowned or convex.

Two beads will not be started at the same location. The completed weld will be brushed and cleaned.

The filler or finish welds may be run vertically, either in the down-hill progression or in the up-hill progression at the option of the welder.

F.8.5 Electrode

The welder shall use electrodes which are designated by the American Welding Society as E-6010. Any changes must be approved by the District prior to welding. The amperage will be that suitable to the job and the welder's technique.

F.8.6 Defects

In the event of failures or defects in the weld, the defects shall be entirely removed to clean metal before repairs are made. All slag and scale shall be removed by wire brushing, prior to correcting the defect.

F.8.7 Waiver of Procedure

It is understood that many variables exist in executing the various types of weld jobs. These procedures may be waived from time to time where they are impossible or impracticable.

Waiver of welding procedures shall be based on existing conditions of a particular job and are valid only for the duration of the condition requiring the waiver. Procedure waiver must have prior approval of the District.

F.8.8 Welding Tests

The District shall be free to perform any standard nondestructive or destructive tests necessary to determine that the welded seams conform to these specifications. When tested, the weld metal shall show a strength of not less than the strength of the plate being welded. The costs incurred in performance of the test shall be borne by Contractor.

F.8.9 Certification of Welder

Only certified welders shall be used. When requested, up-to-date certifications shall be provided by the welder for inspection by the District.

F.9 INSTALLATION OF STEEL ENCASEMENT PIPE

F.9.1 General

This section of the specifications covers the installation of steel encasements and steel piping within encasements when used within the District.

F.9.2 Installation of Steel Encasement Pipe

Steel encasement pipe will be installed where indicated on the plans. Prior to the installation of the encasement, the Contractor shall explore and verify the location and elevation of all existing utilities within the limits of the encasement pipe whether or not these utilities are shown on the plans. Contractor shall notify the District immediately of any conflicts or discrepancies. The steel encasement pipe shall be installed accurately to the prescribed line and grade.

F.9.2.1 Installation by Open Trench

When steel encasement is to be installed in an open trench, Contractor shall adhere to all requirements provided in Section F.4, Earthwork, including pipe bedding, backfill and compaction.

F.9.2.2 Installation by Trenchless Methods

All boring, jacking or tunneling operations shall be accomplished by operators proficient in the trade. All equipment shall be of sufficient size and capacity to accurately and efficiently complete the work.

CONTRACTOR SHALL VERIFY EXISTING UTILITIES LINE AND GRADE BY POTHOLING AND HAND DIGGING 200 FEET AHEAD OF THE BORING, JACKING OR TUNNELING OPERATION. CONTRACTOR SHALL CALL USA (UNDERGROUND SERVICE ALERT) TOLL-FREE 1-800-227-2600 AT LEAST FORTY-EIGHT (48) HOURS BEFORE ALL PLANNED WORK BEGINS.

If the encasement pipe is installed prior to the excavation of a receiving pit, the District may require Contractor to sufficiently expose the blind end of the encasement pipe for verification of plan line and grade.

If the encasement pipe is found to deviate from plan line and grade by an amount which in the opinion of the District will require changes in the alignment of the water main, such changes shall be made by Contractor at no cost to District.

Contractor shall notify the District not less than 24 hours in advance of the time of excavation of the bore pit and in advance of the start of steel encasement casing pipe installation.

All work involved in the installation of the steel encasement pipe shall be in accordance with requirements of any governmental agency, other utility, railroad, etc. and shall conform to any

requirements associated with permit from said agencies. The bore and/or receiving pits may require certification by the State Tunnels and Mines Division. The bore pit and receiving pit, if applicable, shall be adequately protected in accordance with Cal/OSHA safety regulations and the requirements of any additional jurisdictional agencies. The Contractor shall pay all inspection and permit fees required of the permit issuing agency.

F.9.3 Installation of Water Mains Within Steel Encasement Pipe

Only steel pipe shall be installed within encasements. Steel cylinder pipe installed within encasements will be separated from the encasement by means of insulators.

Reference is made to District Standard Drawing ET-5-08. Insulators shall be installed at not more than 10 foot intervals with one insulator located at not more than 12 inches from each end of the encasement pipe. Insulators shall completely insulate the water main from the encasement pipe.

Insulators shall be full circumferential on the pipe. See Approved Materials for approved materials and manufacturers of encasement insulators.

Installation of casing insulators shall conform to the manufacturer's instructions and recommendations and District requirements.

All joints shall be fully welded. Butt straps shall be required if requested by the District. The pipe may be pushed or pulled through the encasement unless another method is specifically stated on the plans or required by the District.

F.9.4 Encasement Closure

After the main has been installed, the ends of the encasement pipe shall be closed by the use of a rubber casing end seal. Reference is made to District Standard Drawing ET-5-08. The seals shall be standard pull on, with wrap around casing seals. See Approved Materials for approved casing end seals for use within the District.

F.9.5 Electrolysis Control

Electrolysis Control shall be provided as specified in Section F.11, Electrolysis Control.

F.10 SPECIAL COATINGS AND LININGS FOR FERROUS METALS

F.10.1 General

All ferrous metal including, but not necessarily limited to tees, crosses, bends, reducers, fire hydrant buries, caps, plugs, flanges, valve bodies, nuts, bolts, galvanized pipe, black iron pipe, exposed reverse anchor rods, etc., used for buried service shall, prior to being installed in the trench or connected to the main, be coated with tape, mastic, thermo-curing dry powder epoxy or catalyst curing epoxy, regardless of the manufacturer's coating, unless otherwise approved or specified by the District.

See Section F.11 for electrolysis protection requirements.

F.10.2 Tape Coatings

Tape coatings shall be used where their application will allow the tape to be applied without wrinkles or air pockets. If, in the opinion of the District, the application of tape will result in a finished product which will not provide an acceptable coating, Contractor shall use the type of coating required by the District.

See Approved Materials for tape approved for use within the District.

Application of primer and tape shall be in strict accordance with manufacturer's specifications.

After the application of the primer, the tape shall be firmly wrapped circumferentially on the pipe or appurtenance overlapping each previous wrap by not less than 5/8 the width of the tape, in effect creating a double wrap. Wrinkles, air pockets or loose wrap will not be permitted. Improper wrapping shall be removed, the pipe cleaned and reprimed as required by manufacturer's specifications or by the District and rewrapped.

F.10.2.1 Taping of Pipe Joints

The exterior of steel pipe joints shall be cleaned, primed, and field wrapped with an approved tape coating in accordance with the manufacturer's requirements. Joint coatings shall be applied in accordance with AWWA C209 and C216 and manufacturer's requirements except as modified herein. See Approved Materials for prime and tape wrap for use within the District.

Tape coating of the joint shall overlap a minimum of 3-inches of the existing pipe coating on either side of the pipe joint. Tape coating shall be a continuous double wrap such that approximately 40% of the previous wrap's width shall be visible on the surface. The tape shall be pulled tightly during installation to eliminate wrinkles, air pockets or bubbles, which shall not be permitted.

F.10.2.2 Tape Coating Tests and Repairs

All applied tape coatings shall be tested for holidays and flaws. These tests will be conducted by the Contractor under the supervision of the District inspector at the job site. The decision of the District regarding test results will be final.

Tests for flaws and holidays in the coating system will be conducted using a high voltage wand detector or a garter spring detector acceptable to the District. All areas failing to pass the electrical inspection shall be repaired as approved by the District. In addition, any visible damage to the coating shall be repaired regardless of whether it passes the electrical detector test.

MINIMUM TEST VOLTAGES FOR PIPE COATING THICKNESS	
Coating Thickness [mils]	Test Volts
20	5,600
50	8,800
80	11,200
100	12,500
110	13,100
125	14,000

The optimum travel rate of the holiday detector shall be determined by testing on a tape wrapped pipe section with a known, pin-type holiday.

Defective locations shall be clearly indicated by a circular mark or cross immediately upon discovery by visual examination or by the holiday detector.

Small areas of the coating which fail the electrical detection inspection will be repaired as specified hereinafter.

All holidays and damaged or defective coating shall be repaired immediately by removing all loose tape and outer wrap from the damaged area, applying primer and a patch of the specified tape or outer wrap. The patch shall extend a minimum of 4 inches beyond the damaged area. Prime the tape patch and cover with outer wrap.

The repaired areas shall be re-checked for holidays with a high voltage holiday detector as specified herein.

Obtain approval of District before performing repair work.

F.10.3 Mastic Coatings

Mastic coatings will be used where the application of a tape coating cannot be satisfactorily applied because of the surface configuration such as at fittings and valves.

See Approved Materials for mastic coatings that have been approved for use within the District.

This application of the mastic coatings shall be in strict accordance with manufacturer's specifications to a thickness of not less than 50 mils.

Unless otherwise approved by the District, all mastic coatings shall be applied not less than 24 hours prior to the installation of the item so coated. However, installation of coated items shall not take place until sufficient set has occurred in the coating to allow handling of the coating without damage.

F.10.3.1 Field Repair of Mastic Coating

Minor coating damage occurring during installation may be repaired in place or, at the option of the District, shall be removed from the trench and recoated.

Any improperly applied coating shall be removed, then the item shall be cleaned and recoated as required by the District.

No backfill or concrete pour around any coated item will take place until sufficient curing of the coating or coating repair has occurred and the coating has been approved by the District.

F.10.4 Epoxy Coatings and Linings

Coatings and linings in this classification shall be either thermally cured epoxy or catalyst cured epoxy. Epoxy coatings shall be applied in strict compliance with manufacturer's specifications and shall not be field applied unless approved by the District for repair to damaged sections.

F.10.4.1 Surface Preparation

Surface preparation shall be by approved abrasive blast cleaning methods and shall be finished to NACE-1 standards. No coating shall be applied over a prepared surface on which oxides have formed as the result of delays in applying the coating to the prepared surface. Reblasting of such surfaces to original specifications shall be required if oxide formation is present.

F.10.4.2 Fusion Bonded Epoxy

Fusion bonded epoxy shall be applied to the water facilities specified herein. When directed by the District Inspector, water facilities, whether coated or not coated by epoxy, shall be coated by an approved mastic coating. See Approved Materials for approved epoxy.

Fusion bonded epoxy coatings and/or linings will be inspected by electrical flow detecting methods as set forth in Section F.10.4.4.

F.10.4.2.1 Gate Valves

All exposed valve and actuator surfaces shall be coated with fusion bonded epoxy in accordance with AWWA C550 except that the coating requirements specified therein shall apply to both interior and exterior surfaces. Fusion bonded epoxy coating shall be certified to NSF 61 for use with potable water. Coating dry film thickness shall be 8 mils minimum, 20 mils maximum.

Coated flange faces shall be uniformly coated and free of runs, blisters or other irregularities so as to not interfere with gasket sealing surfaces. Rejection of such valves shall be at the sole discretion of the District.

F.10.4.2.2 Hydrants

Hydrant interior surfaces shall be coated with fusion bonded epoxy in accordance with AWWA C550. Fusion bonded epoxy coating shall be certified to NSF 61 for use with potable water. Coating thickness shall be 8 mils minimum, 20 mils maximum.

Hydrant buries and break-off spools with epoxy lining and coating shall be lined and coated in accordance with AWWA C116. Epoxy coating shall be certified to NSF 61 for use with potable water.

F.10.4.2.3 Air Valves

The interior shall be coated with fusion bonded epoxy in accordance with AWWA C550. Fusion bonded epoxy coating shall be certified to NSF 61 for use with potable water. Coating thickness shall be 8 mils minimum, 20 mils maximum.

F.10.4.2.4 Steel Pipe

When shown on the Approved Plans or required by the District, steel pipe may be coated and lined with fusion bonded epoxy. Fusion-bonded epoxy shall be in accordance with AWWA C213 except where modified herein.

All fusion-bonded epoxy which will be in contact with potable water shall be certified to NSF 61.

The fabricator shall inform the District not less than 48 hours in advance of the operation so that the District may observe the complete application.

Surface preparation and application of the fusion bonded dry powder epoxy coating and lining shall be in accordance with AWWA C213 and the manufacturer's recommendations.

The coating and lining thickness shall be 12 mils minimum. The maximum thickness shall be 20 mils, unless otherwise recommended by the manufacturer and approved by the District. See Approved Materials for approved fusion bonded epoxy.

F.10.4.3 Catalyst Cured Epoxy

Catalyst cured epoxy shall be applied in strict compliance with manufacturer's specification. Catalyst cured epoxy shall be applied in a minimum of two coats having a final minimum dry film thickness of not less than 20 mils unless otherwise specified herein.

Mixing of the two-part coating system shall be exactly as specified by the manufacturer. Application may be by brush or spray.

Curing time for catalyst cured epoxy coatings shall be as specified by the manufacturer for the fully cured condition. No installation of an item so coated, or backfill on any coating repaired by this process, shall be done until final cure of the catalyst cured epoxy system is complete and approved by the District.

See Approved Materials for acceptable catalyst cured epoxies.

F.10.4.3.1 Butterfly Valves

Valve shall be coated inside and outside with epoxy as follows:

Interior Coating: The interior of the valve shall be coated with high-build epoxy in accordance with AWWA C550 and be certified to NSF 61 for use with potable water. Coating thickness shall be 12 mils minimum, 15 mils maximum.

Exterior Coating: The exterior of the valve and actuator shall be coated with high-build epoxy. Surface preparation and coating application shall be performed in accordance with the coating manufacturer's recommendations. Coating thickness shall be 12 mils minimum, 15 mils maximum. Epoxy coated flange faces shall be uniformly coated and free of runs, blisters or other irregularities so as to not interfere with gasket sealing surfaces. Rejection of such valves shall be at the sole discretion of the District.

F.10.4.4 Epoxy Coating Tests

All applied epoxy coating systems shall be tested for thickness and flaws by the coating applicator. Test results for tests conducted by shop-applied epoxy coating applicator shall be made available for inspection by the District. When directed by the District, additional testing shall be conducted by the Contractor under the supervision of the District Inspector at the job site. The decision of the District regarding test results will be final.

Tests for flaws and holidays in the coating system shall be conducted using a low voltage wet sponge device acceptable to the District at a voltage setting of 67.5 volts D.C.

All areas failing to pass the electrical inspection shall be repaired as approved by the District. In addition, any visible damage to the coating shall be repaired regardless of whether it passes the electrical detector test.

Defective locations shall be clearly indicated by a circular mark or cross immediately upon discovery by visual examination or by the holiday detector.

The Contractor shall conduct, under the supervision of the District Inspector at the job, tests to determine coating thickness, which shall be made by a magnetic measuring device acceptable to the District.

Small areas of the coating which fail the electrical detection inspection will be repaired as specified hereinafter.

All holidays and damaged or defective coating shall be repaired immediately in accordance with the instructions for the repair patch materials which are approved for use with the original epoxy coating being repaired.

The repaired areas shall be re-checked for defects with a low voltage wet sponge device as specified herein.

Obtain approval of District before performing repair work.

F.11 ELECTROLYSIS CONTROL

F.11.1 General

Electrolysis control is required where shown on the drawings or where specified herein.

Unless stated otherwise on the drawings, all electrolysis control items shall be installed by the Contractor.

When shown on the drawings that the electrolysis control item is to be installed by the District, the Contractor shall notify the District at least 3 days in advance of the installation of the water main or other affected facility or appurtenance.

F.11.2 Electrolysis Control Requirements

F.11.2.1 Electrolysis Control Requirements for PVC Pipe Installation

When shown on the drawings or required by the District, Contractor shall furnish and install magnesium anodes for gray iron or ductile iron fittings and appurtenances. Anode material, installation and testing shall be as specified in Section F.11.3.

Tracer wire shall not be welded or attached to any ferrous metal fitting or appurtenance.

F.11.2.2 Electrolysis Control Requirements for Cement Mortar Lined and Dielectric Coated Steel Pipe

Two wire test stations, as specified in Section F.11.5, shall be installed along the pipeline or at approximately 500-foot intervals as indicated on the drawings or as required by the District.

Insulating flange kits or insulating flexible couplings shall be installed as shown on the drawings or required by the District. Insulating flange kits or insulating flexible couplings shall be installed by the Contractor at the following locations:

- At the connections between dissimilar metallic pipe materials or connections between pipe with dissimilar linings or coatings (e.g., mortar coated steel pipe and dielectric coated steel pipe).

- At concrete structures such as building foundations and valve pits.

- When shown on the plans or otherwise required by the District, at the meter or fire service end of all steel services.

When indicated on the drawings or required by the District, four wire test stations, as specified in Section F.11.6, shall be installed at buried insulating flange and insulating flexible coupling locations.

All non-insulating flexible couplings and non-insulating flange connections joints shall be bonded as specified in Section F.11.8.

Unless otherwise shown on the drawing or required by the District, magnesium anodes shall be installed on all buried steel pipe and pipelines as specified in Section F.11.3. The number and spacing of the anodes shall be in accordance with the following table unless otherwise required:

PIPE FOOTAGE BETWEEN MAGNESIUM ANODES FOR PROTECTION OF DIELECTRIC COATED STEEL PIPE	
Nominal Pipe Diameter [Inches]	Maximum Pipe Footage Protected by One Anode [feet]
4	207
6	138
8	104
10	83
12	69
14	59
16	52
18	46
24	34
36	16

NOTES:
1. For installations requiring multiple anodes, anodes should be equally spaced along the pipe, if possible.
2. Based on 20 year anode life and 1,100 ohm-cm soil restivity.

F.11.2.3 Electrolysis Control Requirements for Steel Encasement Installation

All steel water mains shall be insulated from the steel encasements as specified in Section F.9.3. When required by the District, a four wire test station shall be installed as specified in Section F.11.6 at encasement installations which encases steel pipe. Encasement insulators may be tested by the District as specified in Section F.11.6.

See Approved Materials for approved materials and manufacturers of encasement insulators.

When shown on the drawings or required by the District, magnesium anodes shall be installed and connected to the encasement pipe as specified in Section F.11.3. These anodes shall be in addition to any magnesium anodes required for the water main.

F.11.2.4 Electrolysis Control Requirements for Miscellaneous Ferrous Metal Installations

When shown on the drawings or required by the District, two wire test stations and/or magnesium anodes shall be installed and connected to the metal as specified in Section F.11.5 and Section F.11.3 respectively.

At concrete penetration locations, all ferrous metals shall be coated and/or tape wrapped to prevent contact between the metal and the concrete. Care shall be taken to prevent contact between the ferrous metal and any reinforcing bars.

F.11.3 Anodes

F.11.3.1 Magnesium Anodes

Magnesium anodes, unless otherwise required, shall be 32 pound standard, "High Potential" alloy that meets or exceeds ASTM B843 Grade M1C alloy requirements and shall be prepackaged in a backfill consisting of 75% Gypsum, 20% Bentonite and 5% Sodium Sulfate. Anode lead wire shall be minimum A.W.G. No. 12 copper wire with type T.H.H.N., T.H.W.N. or U.S.E. insulation. A list of approved anodes can be found in Approved Materials.

Anodes shall be installed as shown in District Standard Drawing ET-7-08. When backfilling the anode, care shall be taken to insure the soil is firmly tamped around the packaged anode; water may be used to aid in compaction.

After backfilling, but prior to paving, the installation may be tested by the District to determine if the anodes are properly connected. Should the tests show a disconnected anode, the Contractor shall immediately perform such work as may be necessary to replace or repair the installation.

F.11.3.2 Zinc Anodes

Zinc anodes, unless otherwise required, shall be as specified on Standard Drawing S-1-08. Zinc anodes shall be prepackaged in a backfill consisting of either 50% Gypsum and 50% Bentonite or 75% Gypsum, 20% Bentonite and 5% Sodium Sulfate. Anode lead wire shall be A.W.G. No. 12 copper wire with type T.H.H.N., T.H.W.N. or U.S.E. insulation. A list of approved anodes can be found in Approved Materials.

Anodes on copper service connections shall be installed as shown in District Standard Drawing S-1-08. Anodes on permanent blowoff installations shall be installed as shown in District Standard Drawings TB-3-08 and TB-4-08. When backfilling the anode, care shall be taken to insure the soil is firmly tamped around the packaged anode; water may be used to aid in compaction.

After backfilling, but prior to paving, the installation may be tested by the District to determine if the anodes are properly connected. Should the tests show a disconnected anode, the Contractor shall immediately perform such work as may be necessary to replace or repair the installation.

F.11.4 Insulation Connections

Insulation connections include: Insulating flange kits and insulating flexible couplings.

Insulating flange kits shall be ANSI Series 15 Type E and shall consist of a 1/8-inch full face, neoprene-faced phenolic insulating gasket, spiral-wound mylar insulating sleeves, and 1/8-inch NEMA Grade G-10 fiberglass epoxy insulating washers.
Insulating flexible couplings shall have, in addition to a standard coupling as specified in Section F.3.12, insulating gaskets which extend under the follower ring and a polyethylene gasket or skirt which extends over one pipe end. Bonding wires are not to be used on insulating flexible couplings.

Installation of insulating flange kits and insulating flexible couplings shall conform to the manufacturer's instructions and recommendations and Section F.11.2.2.

Prior to backfill, the District may test the insulation connection for effectiveness using a GAS Electronics Model 601 Insulation Checker. In the event the test results indicate a shorted insulation connection, the Contractor shall immediately do such work as may be necessary to correct the installation.

A four wire test station, as specified in Section F.11.6, shall be installed at all insulating flexible coupling installations, insulating flange installations and with any steel encasement installed with encasement insulators. After backfilling, the District may again test the effectiveness of the insulation connection using a GAS Electronics Model 702 Insulation Checker. In the event the test results indicate a shorted insulation connection, the Contractor shall immediately do such work as may be necessary to correct the installation.

F.11.5 Two Wire Test Station

Two wire test stations consist of two (2) A.W.G. No. 10 stranded copper wires, type T.H.W.N. or U.S.E. insulation attached to the pipe or appurtenance. Each wire shall be attached to the pipe as shown in District Standard Drawing ET-1-08, with the test lead connections spaced a minimum of 6-inches apart from each other. District Standard Drawings ET-3-08 and ET-4-08 show the installation of the two wire test station in undeveloped and developed areas, respectively. See Approved Materials for approved E.T. valve boxes.

After connection of the wires, but prior to backfilling, the District may test the installation to determine if the test leads are properly connected. After backfilling, the District may again test the test leads to determine if they have been broken or separated during the backfilling operation. Should these tests show the test leads to be improperly connected, broken or otherwise electrically discontinuous, Contractor shall immediately perform such work as may be required to correct the installation at no additional cost to the District.

F.11.6 Four Wire Test Stations

Four wire test stations shall be used at any locations where an insulating flange kit or insulating flexible coupling is used or where steel encasement pipe is installed with encasement insulators. Four wire test stations consist of four (4) A.W.G. No. 10 stranded copper wires, type T.H.W.N. or U.S.E. insulation configured and installed as shown on District Standard Drawings ET-2-08 through ET-6-08, and attached to the pipe and appurtenance as shown in District Standard

Drawing ET-1-08. Wire color and installation shall be as shown on District Standard Drawings ET-5-08 and ET-6-08.

Upon completion of the installation and testing of the insulating flange kit, insulating flexible coupling or steel encasement pipe installed with encasement insulators, but prior to backfilling, the District may test the installation to determine if the test leads are properly connected. Should these tests show the test leads to be improperly connected, broken or otherwise electrically discontinuous, Contractor shall immediately perform such work as may be necessary to correct the installation.

After backfilling, the District may again test the test leads to determine if they have been broken or separated during the backfilling operation. If any damage has occurred, it shall be corrected by the Contractor at no additional cost to the District.

F.11.7 Calibrated Span

The calibrated section of pipe shall be installed (at a location selected by the District) and outfitted with test leads as shown in District Standard Drawing ET-2-08. The distance between each of the four required points shall be measured to the nearest 1 foot and recorded on the record drawing. The color coding of the wires used in the calibrated span will be as shown on District Standard Drawing ET-2-08.

F.11.8 Bonding Jumpers

Bonding jumpers shall be used at all non-insulating flange joints and non-insulating flexible couplings as shown in District Standard Drawings ET-6-08. Contractor shall conduct electrical continuity and resistance tests between each test station installation. Should the tests indicate an open circuit or an unusually high resistance as determined by the District, the Contractor shall locate the deficiencies and rebond the necessary joints until the circuit is continuous and the high resistance is lowered to acceptable values and approved by the District.

F.11.9 Welding Requirements

Wire connectors for test stations and anode connections to steel pipe shall be welded to the pipe as shown in District Standard Drawings ET-1-08 and ET-7-08 and as specified in Section F.8. The Contractor shall take care to prevent burn through of the pipe material. In the event of pipe burn through, the Contractor shall immediately perform such work as may be required by the District to repair the damage.

Wire connections to gray iron and ductile iron shall be exothermically-welded to the fitting as shown in District Standard Drawing ET-1-08. Reference is made to District Standard Drawings ET-6-8 and ET-7-08 for connections to valves and fittings, respectively. The weld mold and weld metal shall meet the manufacturer's recommendations for use with iron fitting material type and for the fitting diameter. The Contractor shall submit a list of proposed materials for the District's review prior to starting work.

The Contractor shall follow the manufacturer's instructions and recommendations for welding. After connection of the wire to the fitting, but prior to backfilling, the Contractor shall test the connection for strength and uniformity of the weld metal, and the District may repeat this testing. Should the inspection show the connection to be weak or non-uniform, the Contractor shall immediately perform such work as may be required to correct the installation.

F.11.10 Coating Repair

Removal and replacement of pipeline and appurtenance coating shall be done so as to restore the coating to the same functional condition as before its removal.

The coating shall be removed in sufficient quantity to permit the installation of the wire and wire connector. After the welding and wire connection is complete, the void remaining after the coating removal shall be refilled with an approved mastic. The wire and connector shall be covered by the application of this material to render the joint impervious to water. After the mastic has cured, the coating around it shall be restored to original condition as specified in Section F.10 or directed by the District.

F.12 TESTING AND DISINFECTING WATER MAINS AND APPURTENANCES

F.12.1 General

All water mains and appurtenances shall be tested for pressure and leakage and then will be disinfected prior to acceptance by District.

Testing and disinfecting of water mains and appurtenances shall be in accordance with the applicable current AWWA Standard C651 except as may be modified herein. The Contractor shall notify the District not less than 24 hours in advance of the actual time of testing and disinfecting so that the District may observe the procedure.

F.12.2 Temporary Connection to Existing District Water Lines

No permanent connection between any water main that has not passed bacteriological testing (hereinafter referred to as an unsterile main) will be made to any existing water main or to any water main that has previously passed bacteriological testing (hereinafter referred to as a sterile main), except as may be approved by the District.

Water required for initial filling or for filling prior to the pressure and leakage testing and for chlorination of an unsterile main shall be obtained from a sterile main by use of a jumper connection, unless otherwise approved by the District. The construction of the jumper connection proposed for use shall conform to District Standard Drawing JP-1-08 unless otherwise approved by the District prior to installation. The jumper assembly shall be disinfected using sodium hypochlorite meeting the requirements in Section F.12.6.

During the pressure and leakage testing on the new unsterile main, the jumper connection shall be vented to atmosphere or disconnected from the sterile main and remain vented or disconnected until after the pressure and leakage tests have been completed. Upon completion and acceptance of the pressure and leakage tests, the jumper connection shall be used to facilitate the flushing and the introduction of chlorine into the unsterile main, and subsequent flushing.

All water shall only be used for construction and testing of the District water system. Any other water use may be obtained using a water meter.

The District reserves the right to install or to require the Contractor to install a metering device on all jumper assemblies, and Contractor shall be liable for water used in excess over the normal flushing and testing procedures as determined by the District.

Upon approval of bacteriological testing, a permanent connection or closure shall be made between the two mains. Requirements regarding connections to existing mains (Closures) are provided in Section F.13.

Water may be obtained through the jumper assembly for normal uses related to construction of the water system. Water for other construction related activities shall be obtained from a hydrant

meter obtained from the District. A hydrant meter may be obtained from the District by contracting the District's Customer Service at (510) 668-4299.

F.12.3 Pressure and Leakage Test

The Pressure and Leakage Test shall consist of two phases. The first phase is the hydrostatic pressure test, where the District will determine if the new unsterile main can maintain a desired pressure for a period of at least two hours. Immediately following a successful pressure test, the second phase, the leakage test, will begin. The leakage test will determine if the unsterile main can maintain the District's allowable tolerances for leakage.

F.12.4 Hydrostatic Pressure Test

All newly laid or repaired water mains shall be hydrostatically pressure tested in accordance with the requirements herein. The hydrostatic pressure test will not be performed until the conditions in F.12.4.1 and F.12.4.2 set forth below have been met.

F.12.4.1 Unimproved Areas

In unimproved areas, that is, in areas where no pavement surfacing of any nature is to be constructed, the hydrostatic pressure test shall be made only after the backfill has been placed and satisfactorily compacted and the general areas have been rough graded to approximately finished grade; all angle meter stops, fire hydrants and other appurtenances have been adjusted and set to final grade and location in accordance with the approved plans and District Standard Drawings; and until not less than 72 hours have elapsed since the last concrete thrust block, reverse anchor or valve pad has been cast.

F.12.4.2 Improved Areas

In improved areas, that is, in areas where a pavement surfacing is to be constructed, the hydrostatic pressure test shall be made only after all other utilities, such as, storm sewers, sanitary sewers, Pacific Gas and Electric, telephone, cable, etc., have been installed; the curbs and gutters have been installed and the street section (up to and including base rock) of the pavement area has been constructed to proper grade, satisfactorily compacted and approved by the City; all angle meter stops, fire hydrants and other appurtenances have been adjusted and set to final grade and location in accordance with the approved plans and District Standard Drawings; and until not less than 72 hours have elapsed since the last concrete thrust block, reverse anchor or valve pad has been cast.

F.12.4.3 Testing Procedure

The purpose of the hydrostatic pressure test is to determine that an unsterile main is able to maintain a desired pressure over the entire period of the test. A hydrostatic pressure test will be deemed successful if the unsterile main is able to maintain the desired pressure during the entire period of the pressure test.

The hydrostatic pressure test shall be not less than 2 hours duration. Contractor may at his convenience conduct a preliminary pressure test at any time prior to District's pressure test provided the conditions in F.12.4.1 and F.12.4.2 set forth above have been met. The results of the preliminary test will not be considered by District.

The amount of water main footage to be tested at one time will be as determined by the District.

Each section of water main to be tested shall be slowly filled with water from the nearest source of a jumper pipe as specified hereinbefore in Section F.12.2. Cement mortar lined steel pipe shall be filled with water not less than 24 hours prior to testing.

All air should be vented from all high points in the water main before conducting any pressure tests.

During the pressure / leakage testing, the jumper pipe assembly shall be vented to atmosphere by opening the corporation stop between the two check valves (refer to District Standard Drawing JP-1-08) and the upstream line valve of the jumper shall be closed.

The hydrostatic test pressure shall be one and one-half times the operating pressure at the average elevation of the water main under test. However, notwithstanding the above, no water main will be tested at less than 150 pounds per square inch pressure, except at severe changes in water main elevations. In these cases, the test pressure at the lowest elevations will be determined by the District. The District reserves the right to require that an unsterile main which has a severe change in water main elevations be pressure tested and leakage tested in segments. The segment of water main to be tested at one time will be as determined by the District.

The specified hydrostatic pressure test shall be measured at the point determined by the District. The pressure shall be applied by means of a pump connected to the main in a manner satisfactory to the District. The pump, pipe connection, bulkheads, pressure gage and all other equipment, materials and labor required for performing the hydrostatic pressure test shall be furnished by Contractor at no expense to District.

The District may check the test pressure by installing a District test gage in place of, or in addition to, Contractor's gage. In case of a difference in pressure readings between gages, District's gage reading will govern in all cases.

F.12.5 Leakage Test

The purpose of the leakage test is to determine if the unsterile main can maintain the District's allowable volume change tolerances. This is achieved by maintaining a desired minimum pressure for at least 30 minutes and then determining the leakage that occurred during that time. Leakage refers to the volume of water that must be added to the tested water main to maintain the test pressure.

A leakage test shall be made on all newly laid or repaired water mains in accordance with the following requirements.

The leakage test shall be held immediately following the hydrostatic pressure test. The total elapsed time of the two tests shall be not less than 2-1/2 hours.

Cement mortar lined steel pipe shall be filled with water not less than 26 hours prior to the leakage test.

At the beginning of the leakage test, the hydrostatic pressure shall be one and one-half times the operating pressure at the average elevation of the water main under test. However, notwithstanding the above, no water main will be tested at less than 150 pounds per square inch pressure, except at severe changes in water main elevations. In these cases, the test pressure at the lowest elevations will be determined by the District. The District reserves the right to require that an unsterile main which has a severe change in water main elevations be pressure tested and leakage tested in segments. The segment of water main to be tested at one time will be as determined by the District.

The pressure and time shall be recorded by the District inspector at the beginning of the leakage test. The District inspector shall monitor the pressure of the water main during the leakage test. The Contractor cannot add any water to the system during the leakage test. If water is added during the leakage test, the leakage test shall be started again. If at any time during the leakage test the pressure falls below 150 psi the test must be stopped, the pressure brought back up and the leakage test started again.

At least 30 minutes after the beginning of the leakage test, the District inspector shall record the time and pressure. If the pressure has fallen during the leakage test, the Contractor shall, under the supervision of the District inspector, add water to return the tested system back to the original pressure at the start of the leakage test. This volume of water added shall be used to determine the amount of leakage that occurred during the leakage test.

F.12.5.1 Allowable Leakage - Polyvinyl Chloride Pipe

The measured leakage for polyvinyl chloride pipe shall not exceed the ranges given in the following table:

ALLOWABLE LEAKAGE PER 1,000 FEET OF MAIN *			
Test Pressure at Lowest Point in Main [psi]			
Pipe Diameter [inches]	Test Pressure		
	150	200	250
	Leakage - [gallons] for 30-minute test		
6	0.25	0.29	0.32
8	0.33	0.38	0.43
10	0.42	0.48	0.58
12	0.50	0.58	0.64

* Table based on 50 joints per 1,000 feet of installed main.

F.12.5.2 Allowable Leakage - Steel Pipe

The measured leakage for steel pipe will not exceed the following:

F.12.5.2.1 Welded Joints

Welded joint steel pipe shall not exceed 1-1/2 gallons per inch diameter per 24 hours per mile of main.

F.12.5.2.2 Flanged Joints

Flanged joint steel pipe shall not exceed 1-1/2 gallons per inch diameter per 24 hours per mile of main.

F.12.6 Disinfection

All newly laid water mains and appurtenances shall be disinfected in accordance with the current edition of AWWA C651 except as modified herein. Disinfection shall be done after the pressure and leakage tests have been performed and accepted.

Prior to disinfection, the water main and appurtenances shall be thoroughly flushed with water from the nearest source by means of a jumper pipe as specified in Section F.12.2.

Chlorine used for disinfection shall be either liquid chlorine or hypochlorite. Tablets shall not be used unless approved by the District. If liquid chlorine is used, the method of application and precautions outlined in AWWA C651 Section 4.1.1 shall be followed, except as may be modified by the District.

If sodium hypochlorite is used, it shall conform to AWWA B300, shall be certified to NSF 60, and shall contain no soluble material or organic substances in quantities capable of producing deleterious or injurious effects. In addition to any other warnings and markings as required by law and regulations, the sodium hypochlorite container shall bear the following:

- Legible statement identifying contents and active ingredient. Label shall indicate that the only active ingredient is sodium hypochlorite. Any inert ingredients shall be labeled as such.
- Net weight of contents
- Name of manufacturer or distributor
- Lot number
- Brand name, if any
- NSF 61 Certification mark

Chlorine shall be applied by the continuous feed method as outlined in AWWA C651, Section 4.4.3, except as may be modified by the District.

Chlorine shall be applied at the beginning of the water main to be disinfected through the tee on the unsterile side of the double check valves on the jumper pipe assembly. The resulting chlorine concentration within the main shall not be less than 50 mg/l (ppm).

Water used to convey the chlorine solution throughout the water main shall be obtained from the existing potable distribution system through a jumper pipe or any other approved potable source of supply. The rate of flow shall be so controlled that water will flow slowly into the unsterile main during the application of chlorine. Valves shall be manipulated so that the chlorine solution in the main being chlorinated will not flow back into the main supplying the water. Any valves on sterile mains shall only be operated by a District representative who is a State-certified distribution operator.

The end of the main being chlorinated shall be kept open and running during the application of chlorine and until the desired chlorine concentration is reached (not less than 50 mg/l (ppm)), after which each angle meter stop, fire hydrant, air valve line, water quality sampling pipe assembly or any other connection to the water main shall be individually opened and flushed with the chlorine solution. After the water main and all connections thereto have been loaded with chlorine to the proper concentration of not less than 50 mg/l (ppm), the water source, chlorine feeder and all other openings to the water main will be closed.

The chlorine solution shall remain in the water main for not less than 24 hours after which time the treated water through the length of the unsterile main will contain not less than 10 mg/l (ppm) of chlorine. In no case shall a chlorine solution of over 50 mg/l (ppm) be held in the main or appurtenances for more than 5 days from the initial injection to the final flushing.

In the event the chlorine residual is less than 10 mg/l (ppm) after 24 hours, or if required by the District, the disinfecting procedure or both the flushing and disinfecting procedures must be repeated.

Upon approval of the chlorine residual by the District, the chlorine solution shall be flushed from the water main through each service, fire hydrant blowoff, air valve line, water quality sampling pipe assembly or any other connection to the water main. Flushing shall continue until the chlorine residual is not more than 0.5 mg/l (ppm) or as determined by the District OR not more than the chlorine residual concentration of the source water coming through the jumper.

Flushing of chlorinated water must comply with all applicable federal, state, and local regulations and best management practices regarding discharge to the storm drain system or any other system or area.

All water discharged during flushing of new water system shall be dechlorinated in accordance with AWWA C651, Section 6.2.

F.12.7 Bacteriological Test

Following the flushing of the chlorine solution from the water main, but not sooner than 12 hours thereafter, the District will secure samples of the water from the water main for laboratory bacteriological examination.

Water quality samples shall be secured through water quality sampling pipe assemblies installed at approved connection point locations along the water main. Water quality sampling pipe assemblies shall be constructed, prepared and protected in accordance with District Standard Drawing SP-1-08. Connection points may consist of angle meter stops on water services, curb stops on air valves laterals or threaded outlets on blowoff risers. If, in the opinion of the District, sufficient number of the above type of connection points are not available, additional temporary connection points consisting of 3/4- inch corporation stops and risers shall be installed in the water main at the locations required by the District.

Fire hydrants shall not be used for water quality sampling pipe assembly connection points.

Reference is made to District Standard Drawing SP-1-08. A sampling pipe assembly shall be connected to each approved connection point location. The sampling pipe assembly shall be constructed of all new materials and shall be free of dirt, mud, or other contamination. Riser piping from the connection location to the ball valve shall be Type L copper, red brass, PVC or galvanized steel. A 3/4-inch ball valve shall be installed at the top of the sampling pipe assembly with a barbed 90° brass elbow outlet which shall be turned so as to project toward the street or other drainage facility. The barbed outlet of this brass elbow shall extend at least 18-inches above grade. The sample pipe assembly shall be clearly labeled “DO NOT DRINK/NO BEBER.”

Prior to connecting the sampling pipe assembly to the tap, the sampling pipe assembly shall be flushed clean and disinfected with a chlorine solution containing not less than 5% sodium hypochlorite solution. Sodium hypochlorite shall meet the requirements in Section F.12.6. Flushing of the chlorine solution from the sampling pipe will be done just prior to the collection of the sample.

Two (2) samples, at least 24 hours apart, shall be taken from each sampling point by the District. The sampling pipe assembly may remain in place until after the second sample has been obtained or may be removed between samplings. If the sample pipe assembly is left in place, the end of the pipe shall be covered to prevent the entrance of dust or other contamination and to prevent use by construction activities or by consumption. If the sample pipe assembly, or any part thereof, is removed between samples, the sampling pipe assembly shall be cleaned and chlorinated and flushed as above prior to collection of the next sample.

The District will notify Contractor of the results of the coliform bacteriological tests. Should either the first or second day’s bacteriological tests prove positive, that is, fail to pass the bacteriological test, this indicates that the main may be contaminated. Flushing, chlorination and bacteriological sampling shall be repeated as often as necessary until satisfactory results are

obtained. If isolated sample points indicate positive results, flushing and resampling of those points may be approved by the District.

Notwithstanding the above, the District may, at its sole discretion, require any and all work by the Contractor to ensure a sanitary water main and water system. The District's determination of such requirements shall be final and the work will be at no cost to the District.

Upon District approval of bacteriological testing, all temporary taps shall be securely closed and all sampling pipe assemblies removed, with the exception of those to be used to take verification samples after closures. The water main closure may then be performed to the existing District distribution system (see Section F.13). In no case shall the water main be placed in service or water used therefrom until the disinfection produces satisfactory results.

If a newly laid main or portion thereof requires repair or replacement after chlorination due to accidental breakage, etc., extreme caution shall be taken not to contaminate the interior of the undamaged water main with mud, dirt, trench water, etc. If in the opinion of the District the breakage may have caused the water main to become contaminated, the water main or damaged portion thereof shall be rechlorinated and retested in accordance with these Specifications. NOTE: Any repair or replacement must be witnessed by the District's Inspector.

F.12.7.1 Closure After Disinfection

Refer to Connection to Existing Mains (Closures), Section F.13.

F.12.8 Contractor's Responsibility for Testing and Disinfection

Notwithstanding anything contained herein, it shall be the sole responsibility of the Contractor to construct a water main capable of passing the pressure and leakage tests and to affect a disinfection of the water main. District inspection during the construction and testing of the water facilities, and performance of laboratory testing to determine the sterility of the water mains, shall not abrogate Contractor's responsibility in this regard.

It shall also be the responsibility of Contractor to prevent the consumption of water for any and all uses from unsterile mains whether by their workmen, subcontractors or any other person who may come in contact with the water from the unsterile main.

Contractor shall indemnify and save District harmless from any suits, claims or actions brought by any person or persons for or on account of any damages, sickness or death sustained or arising out of the consumption of water from the unsterile main.

F.13 CONNECTION TO EXISTING MAINS (CLOSURES)

F.13.1 General

Connections to ends of existing water mains shall be performed by the Contractor under full District inspection after all pressure / leakage testing, flushing and chlorination are completed, and after negative bacteriological tests have been accepted by the District. See Testing and Disinfecting Water Mains and Appurtenances, Section F.12.

F.13.2 Closure Schedule

Due to analytical requirements of closure verification samples, no closures shall be permitted to begin on any day later than the Wednesday of any normal workweek. For closures that occur on any week which includes a District holiday, the District will determine the allowable closure day.

F.13.3 Closure After Disinfection

Contractor shall notify the District not less than 48 hours prior to making the closure so that valves may be closed and advance notice of the shutdown may be given to all customers affected. Contractor shall stipulate the expected duration of the shutdown. In general, shutdowns shall be kept as short as possible and shall be made at times when there will be the least impact to existing District customers. If, due to the nature of the demand on the system, or for any other operational reasons, a shutdown of the system is not possible during normal working hours, the District will specify the date and time when a shutdown can be made, and Contractor shall adjust his schedule accordingly.

The District will close all valves in making a shutdown, and open all valves in restoring pressure to an existing main and initiating pressure in the new installation. Contractor shall not operate any valves within District's distribution system.

Where connections are to be made at an existing blowoff, Contractor shall, under full inspection by District, remove the blowoff assembly and make the closure, unless otherwise indicated on the plans or approved by the District.

Prior to the closure, Contractor shall excavate a sump sufficiently deep to receive the residual water in the mains that cannot be dewatered by any other method without flowing back into the water mains. Water will then be pumped out of the sump hole, away from the excavation for the closure.

Water level within the sump shall not be allowed to backflow into the water mains after it comes into contact with the trench. Should this contaminated water backflow into water main, the end caps, etc. will be temporarily reinstalled, and the full disinfection procedure will be repeated.

Once piping is taken apart, work must continue without interruption until the closure is complete. In no case shall incomplete closure be left overnight unless there is a completed water tight seal (such as a minimum of one complete welding pass on a steel pipe closure).

The maximum completed closure pipe length shall not exceed 18 feet. The pipe used to make the connection shall be cleaned and disinfected with a swab saturated with a 5% sodium hypochlorite solution or by a means approved by the District. Sodium hypochlorite shall meet the requirements in Section F.12.6.

After the closure is complete, District will collect a water quality verification sample, which will be analyzed by the District in accordance with Section F.12, Testing and Disinfecting Water Mains and Appurtenances. Contractor shall provide suitable taps or other sample points as necessary to provide for verification sampling. Disinfection of sampling pipe assemblies shall use sodium hypochlorite meeting the requirements stated in Section F.12.6.