

SECTION 21 - DOMESTIC WATER FACILITIES DESIGN CRITERIA

21-1 DEFINITIONS

Refer to Section 1-2 of these standards.

21-2 OTHER REQUIREMENTS

Ordinances, requirements, and applicable standards of governmental agencies having jurisdiction within the area served by the City's Water Division shall be observed in the design and construction of water mains and facilities. Such requirements include, but are not limited to, current revisions of the following:

1. "Standard Specifications for Public Works Construction," latest edition, including all applicable supplements, prepared and promulgated by the California Chapter of the American Public Works Assn. and the Associated General Contractors of America.
2. State Health Ordinances regulating the separation between water supply and sewerage facilities.
3. The Uniform Plumbing Code as amended by the City of Madera.
4. Road encroachment regulations of the City of Madera, County of Madera, State of California, Madera Irrigation District, and railroad permits where applicable.
5. American Water Works Association Standards.
6. Titles 17 and 24 of the State Health and Safety Code regulating cross connection control and back-flow prevention and the City of Madera Municipal Code regulating cross connections for the City Water System.

21-3 GENERAL REQUIREMENTS

21-3.1 Scope

The design and construction of water mains, facilities and other appurtenances for the City of Madera shall comply with these specifications, or permit requirements of various governing bodies, except where specific modifications have been approved by the Engineer, in writing.

21-3.2 Standard Criteria

The City of Madera Standards set forth the procedure for designing and preparing plans and specifications for water mains, facilities and appurtenances to be built within the City's water service area. These standards shall include the attached specifications on design and installation of ductile iron pipe, and polyvinyl chloride (PVC) pressure pipe.

Whenever, water and sanitary sewer plans are to be designed and installed under one project, said Work shall be shown on the same construction plans. In this case the developer's engineer shall supply the City the original tracings for the final record.

21-4 WATER MAIN PRESSURES, CAPACITIES, AND SIZES

21-4.1 Quantity of Domestic Flow

Water needs shall be determined from maximum potential population and land use of the area to be served. For design purposes, the design domestic flow shall equal the peak hour demand. In order to determine the design domestic flow, the following criteria shall be used, unless otherwise approved by the Engineer.

1. 5 G.P.M. per service plus fire flow. For commercial, manufacturing and industrial, the Engineer shall be contacted for approval of values to be used.

21-4.2 Quantity of Fire Flow.

Fire flow shall be determined, using the Insurance Services Office Guide for Determination of Required Fire Flow, latest edition or as designated by the City of Madera Fire Department. Criterion for fire system design requires that the system pressure at the point of delivery should be at least 20 pounds per square inch under peak hour flow conditions, plus fire flow.

Fire Flow at residential fire hydrants shall be a minimum of 1,500 GPM with a water system residual pressure of 20 pounds per square inch.

Design of water main sizing shall include fire flow requirements and domestic and/or industrial water demand.

21-4.3 Pressure

Water mains shall be designed so that service pressures range between 45 and 60 psi, except under fire flow conditions where a residual pressure of 20 psi is allowable.

21-4.4 Velocity

Water mains shall be designed to provide a mean velocity not more than five (5) feet per second under Maximum Daily Demand flow.

21-4.5 Head Loss

Water mains shall be designed to provide a mean head loss of not more than five (5) feet per thousand feet of pipe under Maximum Daily Demand flow.

21-4.6 Hazen-Williams "C"

Pipe analysis shall be performed by assuming a value of 110 for Hazen-Williams coefficient "C".

21-4.7 Minimum Water Main Size

Water Mains shall have an inside diameter of six (6) inches or more, where fire flow is to be transported. Four (4) inch mains may be permitted by the Engineer for cul-de-sacs, 150 feet and shorter when the main serves less than five services and when no fire hydrant is connected to the main.

21-5 LOCATION OF AIR RELEASE VALVE ASSEMBLIES

Air release valve assemblies shall be located at all points where air pockets may form and at locations shown and/or established by the Engineer.

21-6 LOCATION OF BLOW-OFF ASSEMBLIES

Blow-off assemblies shall be located at low points and dead ends, where sediment may collect.

Fire hydrants may be substituted for blow-off assemblies. Design class shall be compatible with the pipeline Working pressure.

21-7 FIRE HYDRANT ASSEMBLIES

Location of, and fire flow rate at, fire hydrant assemblies shall be approved by the City of Madera Fire Dept. prior to approval of plans by the Engineer.

21-8 WATER MAIN LOCATIONS

21-8.1 Water Main Location in Roads or Streets

The centerline of water mains shall be located in public streets in accordance with the Standard Drawings. Water line locations shall be dimensioned from property line and centerline or section line of the street.

21-8.2 Curved Water Main Requirements.

In curved streets the water main shall not cross the center line, but shall follow the street curvature using joint deflections or fittings or as shown on the drawings. Bending of PVC pipe barrels to accomplish horizontal or vertical curves is not permitted.

21-8.3 Joint Deflections for Curved Water Main

Deflection in joints of pipe shall be as limited by manufacturers recommendation.

21-8.4 Elbows

Elbows shall be placed at locations where coupling deflection would exceed the allowable, as limited by manufacturer's recommendation.

21-9 SEPARATION OF WATER MAINS AND SANITARY SEWERS

21-9.1 Basic Separation Standards

The "California Water Works Standards" sets forth the minimum separation requirements for water mains and sewer lines. These Standards, contained in section 64630, Title 22, of the California Administrative Code, specify:

- a. Parallel Construction: The horizontal distance between pressure water mains and sewer lines shall be at least 10 feet.
- b. Perpendicular Construction (Crossing): Pressure water mains shall be at least one foot above sanitary sewer lines where these lines must cross.
- c. Separation distances specified in (a) shall be measured from the nearest edges of the facilities.

- d. Common Trench: Water mains and sewer lines must not be installed in the same trench.

The potential for contamination of the water supply increases when water mains and sanitary sewers are not adequately separated. Therefore, when adequate physical separation cannot be attained an increase in the factor of safety should be provided by increasing the structural integrity of both the pipe materials and joints.

21-9.2 Exceptions to Basic Separation Standards

Local conditions, such as available space, limited slope, existing structures, etc.; may create a situation where there is no alternative but to install water mains or sewer lines at a distance less than that required by the Basic Separation Standards. In such cases, alternative construction criteria as specified in Section 21-11 should be followed, subject to the special provision in Section 21-10.3.

Water mains and sewers of 24 inches diameter or greater may create special hazards because of the large volumes of flow. Therefore, installations of water mains and sewer lines 24 inches diameter or larger should be reviewed and approved by the health agency prior to construction.

21-9.3 Special Provisions

The Basic Separation Standards are applicable under normal conditions for sewage collection lines and water distribution mains. More stringent requirements may be necessary if conditions, such as, high groundwater exist.

Sewer lines shall not be installed within 25 feet horizontally of a low head (5 psi or less pressure) water main. New water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less. In the installation of water mains or sewer lines, measures should be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipeline.

Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit, such as a septic sewage which produces corrosive hydrogen sulfide.

21-9.4 Sewer Force Mains

Sewer force mains shall not be installed within ten feet (horizontally) of a water main. When a sewer force main must cross a water line, the crossing should be as close as practical to the perpendicular. The sewer force main should be at least one foot below the water line.

When a new sewer force main crosses under an existing water main, all portions of the sewer force main within ten feet (horizontally) of the water main shall be enclosed in a continuous sleeve.

When a new water main crosses over an existing sewer force main, the water main shall be constructed of pipe materials with a minimum rated Working pressure of 200 psi or equivalent pressure rating.

21-10 ALTERNATE CRITERIA FOR CONSTRUCTION

There are two situations encountered when the Basic Separation Standards for sewer and water cannot be attained, as shown in Figures 1 and 2 on pages 108 and 109 of these standard specifications.

Case 1 – New sewer line – new or existing water main.

Case 2 – New water main – existing sewer line

For Case 1 – The alternate construction criteria apply to the sewer line.

For Case 2 – The alternate construction criteria may apply to either or both the water main and sewer line.

The construction criteria should apply to the House laterals that cross above a pressure water main but not to those House laterals that cross below a pressure water main.

Case 1: New Sewer Being Installed (Figures 1 and 2), Special Construction Required for Sewer

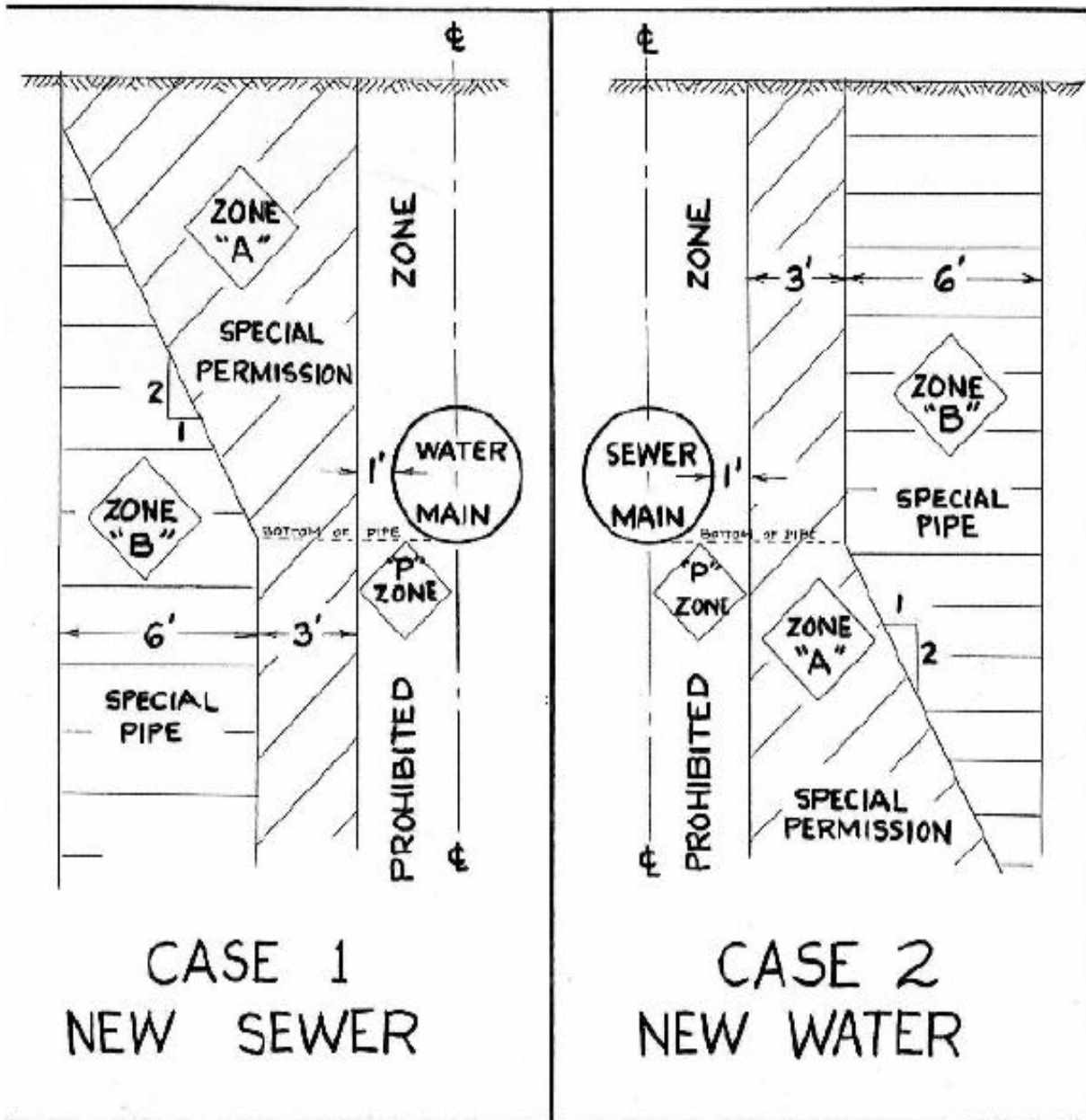
1. Sewer lines parallel to water mains shall not be permitted in this zone without approval from the responsible health agency and water supplier.
2. A sewer line placed parallel to a water line shall be constructed of:
 - a. Extra strength vitrified clay pipe with compression joints.
 - b. Plastic sewer pipe with rubber ring joints (per ASTM D3034) or equivalent.
 - c. Ductile iron pipe with compression joints.
 - d. Reinforced concrete pressure pipe with compression joints (per AWWA C302-74).
3. A sewer line crossing a water main shall be constructed of:
 - a. A continuous section of ductile iron pipe with hot dip bituminous coating and mechanical joints.
 - b. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered on the pipe being crossed.
 - c. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered on the pipe being crossed.
 - d. Any sewer pipe within a continuous sleeve.
4. A sewer line crossing a water main shall be constructed of:

- a. Ductile iron pipe with hot dip bituminous coating and mechanical joints.
- b. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered on the pipe being crossed.
- c. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered on the pipe being crossed.
- d. Any sewer pipe within a continuous sleeve.
- e. Any sewer pipe separated by a ten-foot by ten-foot, four-inch-thick reinforced concrete slab.

Case 2: New Water Mains Being Installed (Figures 1 and 2) Zone

- 1. No water mains parallel to sewers shall be constructed without approval from the health agency.
- 2. If the sewer paralleling the water main does not meet the Case 1, Zone B, requirements, the water main shall be constructed of:
 - a. Ductile iron pipe with hot dip bituminous coating.
 - b. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
- 3. If the sewer crossing the water main does not meet the Case 1, Zone C, requirements, the water main shall have no joints in Zone C and be constructed of:
 - a. Ductile iron pipe with hot dip bituminous coating.
 - b. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
- 4. If the sewer crossing the water main does not meet the requirements for Case 1, Zone D, the water main shall have no joints within four feet from either side of the sewer and shall be constructed of:
 - a. Ductile iron pipe with hot dip bituminous coating.
 - b. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.

PARALLEL CONSTRUCTION (CROSS SECTION OF TRENCH)

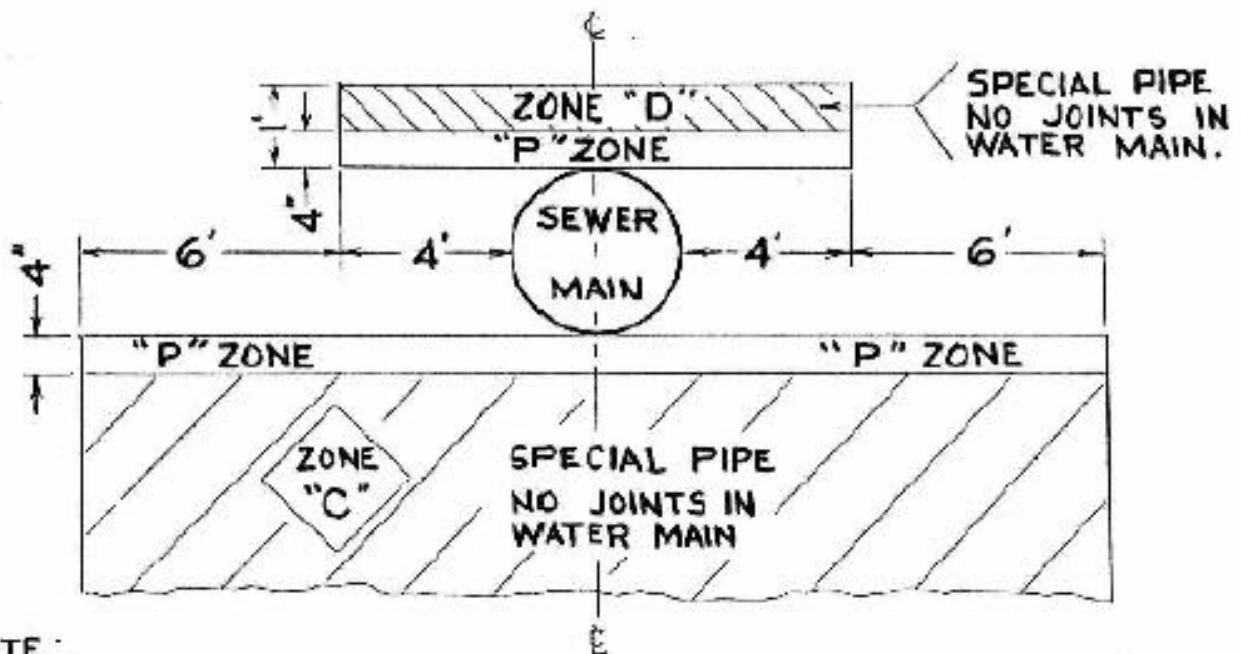


NOTES:

1. ZONES ARE IDENTICAL ON EITHER SIDE OF CENTER LINES.
2. "P" ZONE IS A PROHIBITED CONST. ZONE PER SECTION 64630, TITLE 22, CALIF. ADMINISTRATIVE CODE.

NOTE:

0 CASE 1
NEW SEWER



CASE 2
NEW WATER

21-11 PROCEDURE FOR WATER AND SEWER SYSTEM INSTALLATIONS IN SUBDIVISIONS

1. Installation of all sewer mains, laterals and manholes and backfill.
2. Installation of all water mains, services and hydrants and backfill.
3. Compact all sewer trenches.
 - a. Make preliminary pressure test. (Optional)
 - b. Locate and repair leaks, if any.
 - c. Recompect if necessary.
4. Compact all water trenches.
 - a. Make preliminary pressure test. (Optional)
 - b. Locate and repair leaks, if any.
 - c. Recompect if necessary.
5. Items (d) and (e) may be done simultaneously if conditions permit.
6. All trenches should be identified. Contractor shall also locate and mark sewer and water on curb face when constructed.
7. Compaction tests on sewer and water taken by City.
8. Final air test for sewer and pressure test for water, providing all leaks are repaired and all compaction tests have been approved.
9. Any failure of final tests would require contractor to reinitiate sequence of Work starting with Item (h).
10. The Water Division will construct the wet tie to connect to the City's system. This will allow the Contractor to sterilize and flush the newly constructed system. There is often an associated charge for the construction of these wet ties.
11. Flushing water mains shall not be allowed in street area if it conflicts with sewer and water installations. Often done after compaction tests have passed. Water seeps into trenches and holds up developers paving while street dries out.
12. If storm sewers are to be installed, they shall be constructed first, unless otherwise directed.

21-12 EASEMENTS

Non-metallic pipes may be allowed in easements which are neither confined or interior easements.

21-12.1 Easements

The minimum width of a water facility easement shall be approved by the City Engineer.

21-12.2 Water Main Location in Easement

The water main shall be located 5 feet north or west of the center line of the easement except where otherwise approved by the Engineer.

21-12.3 Where Easements Follow Common Lot Lines

The full easement width shall be on one lot, in such a manner that access to lines will not be obstructed by walls, trees, or permanent improvements. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines, but the water line shall not be located on the lot lines.

21-13 STRUCTURAL REQUIREMENTS

21-13.1 Buried Facilities

All structures and pipe placed underground shall be of sufficient strength to support with an adequate factor of safety the following applicable loads: the backfill, road surfacing, H-20 truck loading with impact, high loading to be specified by the Engineer or as required by permits for crossing state highways, railroad tracks, canals, and streams. Calculations showing factor of safety may be required by the Engineer.

21-13.2 Other Pipes and Structures

Water lines designed to cross under other pipes or structures shall be protected from damage and shall be constructed in order not to endanger the other pipe or structure. Minimum clearance between outside of pipes or between pipes and other structures is 12 inches unless otherwise approved by the Engineer.

21-13.3 Flexible Joints

Flexible joints which will allow for differential settlements or other movement of water pipe, facilities, adjacent pipe and adjacent structures shall be provided where water lines enter encasements or other structures. Flexible joints shall be within three feet of such structures. Any deviations from these requirements shall require approval from the Engineer.

21-13.5 Mechanical Restrained Joints

Restrained joint fittings shall be provided at all tees, crosses, reducers, bends, caps, plugs and valves such that the pipe is fully restrained in any one given direction. These shall meet Uni-B-13 and ASTM F 1674-96 for PVC and be UL/FM approved through 12" for both ductile iron and PVC. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, shall be used to insure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used through 14" with a minimum safety factor of 2:1. Gland shall be Megalug by EBAA Iron, Inc., Uni- Flange by Ford Meter Box Co. Inc., or approved equal. Push-on Restraint When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used through 14". Harness assemblies including tie bolts shall be manufactured of ductile iron conforming to ASTM A536-80. Harness shall be manufactured by EBAA Iron, Inc., Ford Meter Box Co. Inc., or approved equal.

21-14 DUCTILE IRON PIPE AND DUCTILE IRON FITTINGS

Ductile iron pipe and associated fittings shall conform to the applicable sections of the Standard Specifications.

1. Fabrication
Ductile iron pipe shall be pressure class 350 ductile iron for sizes up to and including 12 inch and pressure class 250 ductile iron from 14 inch to 20 inch; complete with all accessories and conforming to ANSI/AWWA C151/A21.51,

unless otherwise indicated on the construction plans. Ductile iron pipe shall be eighteen (18) foot laying lengths.

2. Joints

Joining of ductile iron pipe shall be with elastomeric-gasket bell ends or couplings. The joints and rubber gaskets shall be in conformance with ANSI/AWWA C111/A21.11.

3. Inspection and Testing

City at its discretion may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor. Testing of the pipe to insure compliance with these specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

4. Affidavit of Compliance

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this specification.

5. Fittings

All fittings for use with ductile iron pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All mechanical joint or push-on joint fittings shall be rated for 350 psi Working pressure in sizes 4" through 24".

Flange fittings shall be rated to 250 psi Working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern.

In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of fire hydrant, blowoff, and pumping connections, which shall have flange by mechanical; reducers shall have flange by mechanical joint ends; elbows may be either mechanical joint or flanged ends.

6. Appurtenances

All appurtenances used in conjunction with the ductile iron pipe shall meet the City Standard Specifications.

21-14.1 Confined Public Easements

All confined public easement construction shall be ductile iron.

21-14.2 Polyvinyl Chloride (PVC) Pressure Pipe

Polyvinyl chloride (PVC) pressure pipe shall conform to the applicable sections of the Standard Specifications.

1. Fabrication

Polyvinyl chloride pressure pipe shall be Class 150 DR 18 for 12" and smaller and Class 235 DR 18 for 14" and larger and shall conform to AWWA C-900 latest edition for 12" and smaller and AWWA C905 latest edition for 14" and larger, unless otherwise indicated on the construction plans.

All Polyvinyl Chloride (PVC) pipe shall be twenty (20) foot laying lengths. PVC Pipe shall have cast iron pipe outside diameters (C.I.O.D.)

2. Joints

Joining of PVC pipe shall be with elastomeric-gasket bell ends or couplings. The bell ends shall be an integral thickened bell end (IB) or an integral sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or sleeve-reinforced bell equal, at all points, to the DR Requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel.

If bell ends are not part of the pipe, one PVC coupling, manufactured of the same material and by the same manufacturer as the pipe, shall be furnished with each length of pipe together with two (2) rubber rings. The coupling shall be designed to insure a water-tight joint with the pipe. The coupling body and socket shall have a wall thickness equal to the pipe barrel thickness with which the coupling is to be used.

All rubber rings shall be furnished by the pipe manufacturer. These rubber rings (Elastomeric Gaskets) shall be manufactured to conform with the requirements of ASTM F-477.

3. Hydrostatic Proof-test

Each length of pipe shall be proof-tested at four (4) times its rated pressure class for a minimum dwell of five (5) seconds.

4. Inspection and Testing

City at its discretion may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor.

Testing of the pipe to insure compliance with these specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

5. Affidavit of Compliance.

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this specification.

6. Fittings

All fittings for use with Polyvinyl chloride pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All mechanical joint or push-on joint fittings shall be rated for 350 psi Working pressure in sizes 4" through 24". Flange fittings shall be rated for 250 psi Working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern.

In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of fire hydrant, blowoff, and pumping connections, which shall have flange by mechanical joint; reducers shall have flange by mechanical joint ends; elbows may be either mechanical joint or flanged ends. A/C to C.I.O.D. PVC adapter rings may not be used.

7. Appurtenances

All appurtenances used in conjunction with PVC shall meet the City Standard Specifications.

21-15 VALVES

21-15.1 Butterfly Valves

1. ARE NOT ALLOWED

21-15.2 Gate Valves

1. General.

These specifications designate the requirements for the manufacture and installation of gate valves. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valves as shown on the plans and herein specified.

2. Materials and Workmanship.

Gate valves shall be non-rising stem resilient seated type. Valves shall conform to the latest version of AWWA C-509 and C-550. Valve bodies shall be ductile iron and wedges shall be fully rubber encapsulated.

The stem shall have two O-rings above the collar and one O-ring below the collar. Stem seals must be replaceable with the valve under pressure. The stem material shall be stainless steel [ANSI-420], low zinc bronze or manganese bronze. The waterway shall be full size. No cavities or depressions are permitted in the seat area. Valve body and bonnet shall be electrostatically applied, fusion bonded, epoxy coated both inside and out by the valve manufacturer. The

coating shall meet the requirements of AWWA C- 50 and NSF 61 approved. All valve body and bonnets bolts and nuts shall be type 304 stainless steel.

All valves must be tested by hydrostatic pressure equal to the requirements in the AWWA C-509 specifications prior to shipment.

Tapping gate valve assemblies shall be used only in conjunction with tapping sleeves and shall be furnished and installed by the City Water Division.

Nuts and bolts used for bolting flanged-end gate valves to pipeline flanges above ground, shall be hexagonal head machine bolts and hexagonal nuts conforming to ASTM A307, Grade B. All buried flanged-end gate valves shall be bolted to the pipeline flanges with Ni-Cad nuts and bolts or approved equal.

1. Gaskets
Gaskets for flanged-end gate valves shall be ring face 1/8".
2. Valve Ends
Valves may be provided with mechanical joint ends, push-on joint ends, flanged ends, mechanical joint by flange ends or push-on joint by flange ends.

21-16 APPURTENANCES

21-16.1 Air Release Valve Assemblies.

1. General
Air release valve assemblies shall be furnished and installed by the Contractor at all points where air pockets may form and at the locations shown and/or established in the field by the Engineer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valve assemblies shown on the plans and herein specified. See Standard Drawing W-13.
2. Materials, Fabrication and Installation
Materials shall be in accordance with the Standard Drawings. The valve shall be a 'Val-matic model 3/4-25VC' or approved equal.

21-16.2 Water Service Assemblies (2 inches and smaller)

1. General
Water service assemblies shall be furnished and installed by the Contractor at the locations shown on plans or established in the field by the Developer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the assemblies as show on the plans and herein specified. The Contractor shall perform the installation of the lot services in accordance with the Standard Drawings. The developer shall provide the City with a plan showing the "As Built" location of all services.
2. Materials, Fabrication, and Installation
 - a. Materials. Shall be those designated on the standard drawings or plans.

b. Pipe and Fittings.

Service pipe shall be Type K soft copper tubing. Solder fittings shall be soldered with 95% tin / 5% lead or silver solder (pure).

Pipe Size	Stop	Service Pipe	Meter Stop
1"	1"	1"	1"
1-1/2"	1 1/2"	1 1/2"	
2"	2"	2"	

3. Service Saddles.

Service saddles shall be used for all 1", 1-1/2", and 2" taps made on ductile iron and PVC pipe. A circumferential type stainless steel band or bands shaped to fit the actual O.D. of the pipe shall be used. Double strap bands shall provide a minimum bearing width of 1-1/2 inches per band along the axis of the pipe. Single strap bands shall provide a minimum bearing width of 3 inches per band along the axis of the pipe. Saddles shall not have lugs that will cut into the pipe when the saddle is tightened. Saddles are to be Jones, Ford, Mueller or approved equal. Multiple O.D. range saddles shall not be used.

4. Service Taps.

In no case shall a service tap be made in a main closer than 18 inches to a bell coupling joint, or fitting. Service taps shall not be less than two feet apart. Service taps shall be located opposite the service locations so that the service laterals will be perpendicular to the street centerline. Service tap locations varying more than two feet from the perpendicular must be approved by the Engineer prior to installation. Service taps shall be in accordance with the Standard Drawings. Where dissimilar metals are joined, a dielectric connection, approved by the Engineer shall be provided. Hole size drilled in the pipe shall be the same size as the corporation stop. The cutting tool shall be a shell type (hole) cutter which will retain the coupon.

Tapping sleeves and corp stop valves shall be used for service connections of 2 inches and smaller. For ductile iron water mains, double strap ductile iron service saddles must be used.

5. Service Boxes

Service casing and covers and meter boxes and covers shall be furnished and installed by the Contractor as shown on Standard Drawings. All service casings shall be complete and in place at the time of acceptance of the subdivision. All services shall be marked by an "X" or "W" clearly visible on the curb face. Minimum size 1 1/2" X 1 1/2" maximum 3" X 3".

6. Curb Stops in Driveways

Under normal circumstances, water services shall not be permitted in driveways, except where physical constraints prevent otherwise, and with the following conditions:

- i. Curb stops remaining in driveways shall be placed inside a meter box with an H20 rated traffic lid.
- ii. Services must be relocated by City Forces after the sterilization phase of the new water system has been passed. The cost for relocation will be charged to the Contractor for the actual cost of labor, equipment and materials.

21-16.3 Valve Service Casing and Lid

Valve Service Casing and Lid Shall conform with Standard Drawings. Valve covers shall be cast-iron Kearney Manufacturing Roll-in Frame No. KP 2050 and Roll-in Cover No. KP 3050 or approved equal and shall be marked as shown on the Standard Drawings.

Covers shall be seated flush with the surface of the natural ground or paved surface such that they may not be damaged by, or present an obstruction or rough surface to traffic. Covers shall have a stabilizing concrete collar constructed when the valve is outside the pavement area.