

APPENDIX B

**PUBLIC UTILITY DESIGN AND CONSTRUCTION SPECIFICATIONS FOR WATER
DISTRIBUTION AND WASTEWATER COLLECTION**

STRASBURG SANITATION AND WATER DISTRICT

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EXHIBIT B TO RULES AND REGULATIONS

PUBLIC UTILITY DESIGN AND
CONSTRUCTION SPECIFICATIONS

FOR
WATER DISTRIBUTION
AND
WASTEWATER COLLECTION

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PART I

WATER SYSTEM STANDARD SPECIFICATIONS Distribution System Design and Layout

- 1.01 General. The purpose of this chapter is to provide information for the design and layout of a water distribution system acceptable to the District.
- 1.02 Quality of the Distribution System. The purpose of these Standard Specifications is to ensure that only proven high quality materials are installed using first class workmanship. Determination of the best materials and constructions methods are based upon lowest life cycle costs, not upon lower initial costs. Sizing and layout of the system are parts of the total consideration of design, operation and maintenance of a water supply system that yields optimum quality service at the lowest total cost to the customer.
- 1.03 Sizing of Distribution Mains. All mains shall be sized large enough to provide for domestic, irrigation, and fire protection flows to the area requesting service and shall meet the following requirements:

The District reserves the right to size mains to provide service for projected future needs. In business and industrial areas main sizes may be increased in adherence to the recommendations of the Insurance Services Organization to provide adequate fire flows.

Planned Building Groups may be treated the same as Industrial and Business areas because of the high fire risk.

All water mains shall be sized in accordance with the following criteria:

- Flow velocity shall not exceed two feet (2') per second on a peak day demand day.
- Flow velocity shall not exceed five feet (5') per second on a peak demand day during fire flow conditions. Fire flow requirements shall be determined by the Fire Protection District and submitted to the District in writing.
- Minimum design pressure shall be thirty-five (35) PSI, maximum design pressure shall be one hundred and twenty (120) PSI for all flow and static conditions.
- Minimum diameter of water mains is eight inches (8") wherever fire hydrants are connected. Smaller lines may be accepted only where no fire hydrants are located upon approval by the District Engineer.

1.04 Fire Protection.

- a. Fire Hydrants. The number and location of fire hydrants in a given area is determined by the District. Normal practice is to install fire hydrants on the corners of street intersections. If fire hydrants are to be installed at locations other than street intersections, they shall be located on lines which are established by extending property lot sidelines into the streets. Any other proposed location must be approved by the District. See Standard Drawing No. 1.

Fire hydrant branch lines shall be set at right angles to street mains. The hydrant shall be set at the end of the branch line and shall face the branch line. No horizontal or vertical bends or offsets shall be used in installing fire hydrant branch lines unless approved by the District. Under no circumstances shall any size or manner of tap be made on a fire hydrant branch line between the hydrant and hydrant valve.

- b. Private Mains. When required in business, industrial and building group areas where increased fire protection is necessary, private fire mains and hydrants may be needed. Location of these facilities to be determined and approved by the District.

Private mains shall be treated as large service lines and will require valves to be installed at the

connection point to the "District Main" and at the property line. Domestic service, irrigation and/or fire sprinkler lines may be extended to the buildings and area providing all service line and meter installation requirements are complied with.

All private main extensions shall be limited to single platted lots. Extensions will not be allowed to cross lot lines for the purpose of serving two or more platted lots and building complexes. Responsibility for a private main must remain with one property and one ownership.

Private main extensions, to include fire hydrants, shall be installed in accordance with these Specifications and shall be inspected by the District.

- 1.05 Pumping Facilities. Booster pumping facilities may be allowed on mains supplying water from the District Distribution System only where specifically authorized by the District. The District will prohibit the installation of pumping facilities where, in its opinion, such installations would be injurious to the operation, or future operation, of the District's system.

All proposed booster pumping facilities shall be considered as a special feature and will be dealt with on an individual case basis. This may include pressure testing of the total installation when determined necessary by the District.

- 1.06 Storage Facilities. Water storage reservoirs are required throughout the distribution system to maintain adequate supply during peak demand periods. Storage reservoirs may also be required adjacent to and on the suction side of pumping facilities. The size, location and type of storage reservoirs shall be determined by the District. All proposed storage facilities shall be considered a special feature and will be dealt with on an individual case basis.

- 1.07 Layout of the Distribution System.

Width Requirements for District Installations. All District mains shall be installed in dedicated public streets of 50 feet minimum width. When the District determines it is not possible or feasible for an installation to be made in a dedicated street, the installation shall be made in a right-of-way or easement. The conditions under which such an exception will be allowed will be determined for each individual case, and only rights-of-way and easements which conform to the requirements of the District will be accepted. The minimum width right-of-way or easement which will be accepted by the District is a twenty foot (20') exclusive or a forty foot (40') non-exclusive right-of-way or easement. If at the determination of the District, it is not feasible to meet the above requirements, installations may be made in streets, alleys, rights-of-way or easements of other widths when authorized by the District Manager.

Dedicated Streets. Pipe alignment shall be parallel to property lines. Normal practice is to lay the pipe on the south side or the west side of the street, 10 feet from the center line of the street. In any case, pipe alignment shall always be within an established roadway, between the limits of the curb and gutter. Minimum clearance for the edge of the gutter pan shall be 4 feet in all cases.

Fire Hydrants. All fire hydrants will be installed within dedicated streets or in the rights-of-way or easements as herein above defined. See Standard Drawing No. 1. Fire hydrants shall be installed only at location designated by the District.

- 1.08 Line Valves. Line valves are required approximately every 400 feet in the distribution system. Where blocks exceed 400 feet in length, one or more line valves may be required between intersections. Street intersections carrying heavy traffic, or containing major water distribution mains in both directions may require as many as four (4) valves, one in each direction. All tee intersections of distribution mains, with the exception of hydrant tees, will require a minimum of two (2) line valves. Where necessary, the Inspector shall require the installation of additional line valves in order to avoid exposing existing customers to high chlorine residual during disinfection of pipelines. See Standard Drawing No. 2.

- 1.09 Connections to Mains for Fire Sprinkler Lines. Sprinkler heads found in hotels, motels, public assembly places, warehouses, etc. are supplied by a fire line. The fire line shall be sized by the persons responsible for the structure it protects. The District will not size fire lines.

1.10 Clearance and Encasement Design for Sanitary Sewer Crossings. Normal design and construction practice shall provide for at least 24 inches separation between the crown of a sewer pipe and the bottom of the water main where the water main is laid over or above a sanitary sewer. Where a sewer passes over or is less than 24 inches under a water main, one of the following design and construction procedures shall be followed:

- a. One length of pipe at least 20 feet long shall be constructed in the sewer and centered over or under the water main. Joints between the sewer pipe and the special pipe should be encased in a concrete collar at least 6 inches thick and extending at least 6 inches either side of the joint. This shall be in addition to the use of a pre-manufactured adapter coupling such as a Mission, Fernco or Caulder coupling with stainless steel tightening bands.
- b. Reinforced concrete encasement shall be installed around the sewer pipe. In general, the encasement shall be a minimum of 12 inches thick and extend a distance of 10 feet either side of the center of the water main.

Where water mains pass under sewers in addition to one of the two items above, the following shall be accomplished to provide protection:

- a. A vertical separation of at least 24 inches between the invert of the sewer and the top or crown of the water main.
- b. Adequate structural support for the sewer pipe to prevent excessive deflection of joints and settling on and breaking the water main.

As previously stated in these Specifications, parallel installations of water mains with sanitary sewer shall provide for a 10 foot horizontal separation. Where special conditions exist which prohibit a horizontal separation of 10 feet, a water main may be laid closer to a sanitary sewer provided that:

- a. It is constructed in a separate trench with undisturbed soil material between the water main and the sewer main.
- b. The elevation of the crown of the sewer is at least 24 inches below the bottom of the water main pipe. Such separation shall be undisturbed or compacted soil material.
- c. Where a minimum of 24-inch vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction.

Materials

- 2.01 Materials and Testing. Detailed technical specifications for purchase or approval of materials are included in this chapter. All materials shall conform to this Specification and to all limitations on acceptable makes and styles.

All materials furnished shall be new and undamaged. Everything necessary to complete all installations in accordance with the Standards of the District shall be furnished and installed whether shown on approved drawings or not; and all installations shall be completed as fully operable, functioning parts of the District's system.

Acceptance of materials, or the waiving of inspection thereof, shall in no way relieve the applicant of the responsibility for furnishing materials meeting the requirements of the Specifications.

New water industry products or materials will be tested, if it is the opinion of the District that the product or material has some merit. The District will establish the criteria for testing or evaluating the product. The District reserves the right to accept or reject any product or material regardless of the test results.

- 2.02 Size of Mains. The size of mains shall be in accordance with Section 1.03 of these Specifications.
- 2.03 Distribution System Piping. The District has established minimum design safety factors and materials for system piping. The following minimum AWWA pressure classes for acceptable types of pipe are required:

a. Pipe Pressure Classes/Rating

Ductile Iron Pipe (DIP)

Class 350, all system pressures up to 30"

Meet requirements of AWWA Standard C151

Polyvinyl Chloride Pipe (PVC)

AWWA C900, DR14 greater than 130 psi, less than 175 psi static pressure (12 inches or less)

AWWA C900, DR 18 less than 130 psi static pressure (12 inches or less)

AWWA C905, DR 25 (12" or greater)

b. Ductile Iron Pipe

1. General. All ductile iron pipe shall be manufactured in accordance with AWWA Standard C151 and ANSI A21.51 "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids," with the following additional requirements or exceptions.
2. Size of Pipe. This specification shall cover ductile iron pipe in 4-inch, 6-inch, 8-inch, 10-inch, 12-inch, 16-inch, 20-inch, 24-inch, and 30-inch nominal diameters.
3. Joint Type. "Push-on single gasket" type conforming with applicable requirements of AWWA Standard C111 and ANSI A21.11, "Rubber-Gasket Joints for Ductile-Iron and Cast-Iron Pressure Pipe and Fittings."
4. Class and Type. Pipe furnished under this specification shall conform to the following thickness classes as a minimum:

4" - 30" Diameter: Class 350
5. Pipe Length. Pipe furnished under this specification shall have normal laying lengths of either 18 feet or 20 feet. Random lengths are not acceptable.
6. Material Strength. Iron used in the manufacture of pipe furnished under this specification shall have 60/42/10 physicals.
7. Cement Mortar Lining. Pipe furnished under this specification shall have standard thickness

cement mortar linings in accordance with AWWA Standard C104 and ANSI A21.4, "Cement-Mortar Lining For Ductile-Iron Pipe and Fittings for Water."

c. Polyvinyl Chloride Pipe

1. General. All polyvinyl pipe shall be manufactured in accordance with AWWA Standard C900, "Polyvinyl Chloride (PVC) Pressure Pipe, 4-Inch Through 12-Inch, For Water," with the following additional requirements or exceptions. For PVC pipe sized 15" through 24", pipe shall be manufactured in accordance with AWWA Standard C905.
2. Size of Pipe. This specification shall cover polyvinyl chloride pipe in 4-inch through 24-inch nominal diameters with ductile iron equivalent outside diameters.
3. Joint Type. Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint.
4. Pipe Length. Each length of pipe will be a standard laying length of 20 feet. Random lengths shall not be acceptable.
5. Manufacturer. The only PVC pipe approved for installation within the District's water distribution system shall be:
 - (a) JM Eagle, municipal PVC water pipe, DR-25, DR-18 and DR-14, meeting specifications AWWA C-900 & C-905, NSF 61 approved, minimum Cell Class 12454, ASTM Resin Specification D-1784.
 - (b) Diamond Plastic Corporation, municipal PVC water pipe, DR-25, DR-18 and DR-14, meeting specifications AWWA C-900 & C-905, NSF 61 approved, minimum Cell Class 12454, ASTM Resin Specification D-1784.
 - (c) North American Pipe Corporation, municipal PVC water pipe, DR-25, DR-18 and DR-14, meeting specifications AWWA C-900 & C-905, NSF 61 approved, minimum Cell Class 12454, ASTM Resin Specification D-1784.

2.04 Pipe Fittings. All ductile iron fittings used in the District's water distribution system shall meet the latest AWWA Standard C110 and ANSI A21.10 or AWWA Standard C153 and ANSI A21.53.

All fittings shall be furnished with mechanical joint ends and shall conform to the following:

- a. General. All ductile iron fittings shall be manufactured in accordance with the following AWWA Standards: C104, "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water"; C110, "Ductile Iron and Gray Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids"; C111, "Rubber-Gasket Joints for Ductile-Iron and Cast-Iron Pressure Pipe and Fittings"; C153, "Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids"; with the following additional requirements or exceptions.
- b. Cement Mortar Lining. All sizes of ductile iron fittings shall be furnished with a cement-mortar lining of standard thickness as defined in referenced specifications and given a seal coat of bituminous material and remain in accordance with AWWA standard C104
- c. Type of Joint. All fittings shall be furnished with mechanical joint ends conforming to referenced specifications.
- d. Thickness Class. All fittings shall be 350 psi pressure rating and shall conform to the dimensions and weights shown in the tables of referenced specifications.
- e. Material. All fittings shall be made from ductile iron. No PVC joints will be allowed.

2.05 Gate Valves. Gate valves shall be the same size as the main. Valves shall open to the left (counterclockwise). Gate valves shall conform to the following:

- a. General. All valves shall be manufactured in accordance with AWWA Standard C509 with the following additional requirements or exceptions.
- b. Valve Description. Valves shall be resilient wedge, ductile iron body, fully bronze-mounted, with non-rising stem, resilient seat and epoxy lined.
- c. Service. All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. The operating pressure for all sizes shall be 200 psi. If valve is larger than 14", it shall meet the requirements of AWWA Standard C515 and be modified to meet 250 psi working pressure.
- d. Valve Stems. Valve stems shall be threaded so that the valve can be opened by turning to the left (counterclockwise). The stem shall be non-rising and be sealed with "O" ring packing. All valves shall be equipped with a 2-inch square wrench nut.
- e. Extension Stems. Provide wherever operating nuts are 5 feet or more below grade. The stems shall consist of solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem. Connect to valve by flexible socket coupling bolted through the extension and operating nut on the valve.
- f. Types of End Connections. All valves shall have a mechanical joint end with gasket, gland and fasteners conforming to the ANSI A21.11 (AWWA Standard C111, "Rubber-Gasket Joints for Ductile-Iron and Cast-Iron Pressure Pipe and Fittings"). Plain rubber gaskets shall be used except that in certain conditions, the District may require the use of special rubber gaskets.
- g. Manufacturer. Because of the problems associated with stocking repair parts for all makes of valves, only the following makes are acceptable for use in the District's distribution system:

New Style Mueller
M&H
Waterous (Series 2500)

2.06 Valve Boxes. All buried valves shall be provided with a 6-inch cast iron valve box, slip type. The valve box shall be of a design which will not transmit shock or stress to the valve and shall have enough extension capability to be raised to final street grade. Valve boxes shall conform to the following:

- a. General. The manufacturer of valve box components shall be experienced in their design and construction, shall be regularly engaged in their manufacture and shall have produced valve boxes which have given successful service for a period of at least five (5) years. See standard drawing No. 3
- b. Materials. Valve box parts shall be made of gray cast iron.

Use of an aluminum alloy as a casting material is not acceptable.
- c. Approved Patterns. Valve boxes shall be the three-piece adjustable slip type and only the following pattern acceptable:

Tyler Slip Type 6-Inch Cast Iron Valve Box Assembly Series 6855 or equal.
- d. Coating. Box, cover and base coated by dipping in asphalt varnish.
- e. Cover. Deep socket type with the word "WATER" cast in top for water applications.

2.07 Fire Hydrants. Within the District's distribution system where maintenance, repair, replacement, and parts stocking is the responsibility of the District, only one (1) hydrant as listed is acceptable.

a. General. All fire hydrants shall be designed and manufactured in strict compliance with AWWA Standard C502, "AWWA Standard for Dry-Barrel Fire Hydrants." All references made in this specification are to the above standard unless otherwise noted.

b. Acceptable Brand and Service Limitations:

Mueller Super Centurion 200 - Static Pressure Less than 200 PSI

c. Size of Hydrant. Hydrants shall have a main valve opening size of 5-1/4 inches and shall be ordered for a 5-foot 6-inch bury unless otherwise approved by the District or designated otherwise on the drawings.

Hydrant bury will be measured from the bottom of the hydrant lateral pipe to finish grade line. Hydrant bury shall be adjusted to provide the minimum required cover on all portions of the hydrant lateral piping.

d. Type of Hydrant. All hydrants shall be the traffic model type. Hydrants shall be the three-way type with one (1) pumper nozzle and two (2) hose nozzles all located on the same horizontal plane.

e. Inlet Connection. Hydrant base shall be provided with a mechanical joint inlet to accommodate 6-inch diameter ductile iron pipe, all in accordance with ANSI A21.11 (AWWA Standard C111, "Rubber Gasket Joints for Ductile-Iron and Cast Iron Pressure Pipe and Fittings"). Incorporated into the base shall be two (2) lugs for rodding or strapping of pipe.

f. Main Valve Assembly. The main valve of the hydrant shall be 5-1/4-inch diameter compression type which closes with the water pressure.

Gasket for valve shall be a replaceable type fabricated of a resilient material, with a threaded bottom plate or nut, complete with seal to prevent leakage of the hydrant shaft.

The valve assembly shall include one or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position.

All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation in accordance with Section 3.10 of these specifications.

g. Operating Shaft Nut. The operating nut shall have a pentagon cross section. Bushings in the bonnet shall be so constructed that it will prevent the operating nut from traveling during opening or closing operation; the bushing shall house a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

The hydrant shall open by turning the operating nut to the left in a counter-clockwise direction and shall have an arrow on top of the bonnet to designate the direction of opening.

h. Pumper Nozzle and Cap. The pumper nozzle shall be 4-1/2 inch nominal diameter with four threads per inch (National Standard). Threads shall be right-hand.

Nozzle cap shall be furnished with a synthetic rubber gasket installed in a retaining groove and the dimensions and shape of the nozzle cap nut shall be the same as the operating shaft nut.

Nozzle caps shall be furnished with security chains with one end of each securely attached to the upper barrel section of the hydrant.

All nozzle caps shall be removed by turning counterclockwise.

- i. Hose Nozzles and Caps. The two hose nozzles shall be 2-1/2 inch nominal diameter with seven and one-half threads per inch (National Standard). Threads shall be right-hand. Each hose nozzle shall include a nozzle cap with nut, security chain and shall be removed by turning counterclockwise.
- j. Color. The upper exposed section of the hydrant above ground shall be painted Rustoleum 1210 - Fire Hydrant Red or equal. The buried portion of the hydrant shall be given a bituminous coating in accordance with Section 681 of AWWA Standard C106.

2.08 Corrosion Protection Systems. The testing of the corrosiveness of the soil which a water main passes through may be required by the District. If so required, the testing shall be accomplished by the Applicant. The need for protection will be determined by the District based on the information submitted by the Applicant and/or other information available to the District.

- a. Polyethylene Encasement Material. If determined by the District as a requirement, the pipe, fittings, rods, and appurtenances shall be wrapped in polyethylene in accordance with Section 3.26. Polyethylene Material shall conform to the following:
 - (1) General. A polyethylene encasement material shall be manufactured in accordance with AWWA Standard C105, "Polyethylene Encasement For Gray and Ductile Cast-iron Piping For Water And Other Liquids," with the following additional requirements or exceptions.
 - (2) Materials. The raw material used to manufacture polyethylene film shall be Type 1, Class A, Grade E-1, in accordance with A.S.T.M. Standard Designation D-1248.

Tensile Strength	1200 PSI minimum
Elongation	300% minimum
Dielectric Strength	800 V/Mil Thickness minimum
Thickness	0.008" (8 mils) minimum Nominal with minus tolerance not exceeding 10% of nominal
Melt Index	0.4 maximum

- b. Cathodic Protection.
 - (1) Where DIP is used the entire pipe and fitting system shall be bonded continuously. A minimum of 17 lbs (sacrificial anode) per 400 feet of distribution line is required at separation not to exceed 400 feet. Additionally fire hydrant sets and fitting and/or valve clusters must have a minimum of 9 lbs (sacrificial anode) per grouping with groupings not to exceed 4 fittings/valves. See standard drawings.
 - (2) Where PVC is used each fitting requires a minimum of 1 lb (sacrificial anode) per each fitting. Additionally, fire hydrant sets must have a minimum of 9 lbs (sacrificial anode). If fitting groups are bonded, each grouping must have a minimum 9 lbs (sacrificial anode) per grouping with groupings not to exceed 4 fittings/valves. See standard drawings.

2.09 Concrete Thrust Blocks, Anchors and Structures. Concrete thrust blocks and anchors shall be sized for the internal pipe pressure and soil bearing capacity. Standard sizes and shapes of thrust blocks and anchors are shown on Sheets 8 of the Standard Drawings.

Thrust reaction blocking shall be concrete of a mix not leaner than 1 part cement to 2-1/2 parts sand and 5 parts stone, and having a compressive strength of not less than 3000 psi after 28 days. See Section 3.20 of these Specifications. The concrete and any required reinforcement shall meet the following criteria:

a. Materials:

Cement. All cement used shall be Portland Cement acceptable under the "Standard Specifications and Tests for Portland Cement," ASTM Designation C150 of the American Society for Testing and Materials. Cement used shall be Type II.

Aggregates. All the fine and coarse aggregates shall meet soundness requirements, deleterious substance limits and grading limits as set forth in the latest edition of "Standard Specifications for Concrete Aggregates" ASTM Designation C33. The limits for deleterious substances and physical property requirements of the coarse aggregates shall be selected for the applicable class designation from those listed under severe weathering regions, Table 3, ASTM Designation C33. The maximum size aggregate that is practical for the structure design and placing conditions shall be used in the concrete.

Water. The water used in all concrete shall be free from objectionable quantities of silt, organic matter, alkali, salts, and other impurities.

Admixtures. An air-entraining agent shall be used in all concrete. The agent used shall conform to "Standard Specification for Air-Entraining Admixtures for Concrete," ASTM Designation C260. The amount of air-entraining agent used shall be such as will affect the entrainment of $5\% \pm 1\%$ of volume of the concrete.

A water-reducing admixture (WRA) may be used unless otherwise noted by the District. The admixture shall conform to ASTM Designation C494 for Type A or Type D chemical admixture, shall contain no calcium chloride, and shall be compatible with the cement being used.

The Contractor shall be responsible for any difficulties arising or damages occurring as a result of the selection and use of any admixture such as a delay or difficulty in concrete placing or damage to concrete during form removal.

b. Concrete Quality. All Concrete shall have a minimum 28-day compressive strength of 3,000 psi and a maximum slump of 4 inches.

c. Testing. When determined necessary by the District, field control tests consisting of aggregate gradation tests, slump tests, air content tests, and making compression test cylinders, shall be performed by qualified personnel in the presence of the Inspector.

d. Concrete Reinforcement. Reinforcements shall be accurately formed and shall be free from loose rust, scale and contaminants which reduce bond. Unless otherwise shown on the drawings or specified herein, all requirements shall conform to the latest ACI Standard 318 and the International Building Codes.

Reinforcements shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips.

e. Reinforcement Material. All deformed reinforcing bars shall conform to ASTM Standard A615, Grade 60.

2.10 Mechanical Joint Restraint. Mechanical joint pipe restraints may be used for restraining fittings, valves and hydrants to reduce the installation of concrete reverse anchors, thrust reaction blocks and/or steel tie rods; however, anchors, thrust blocks and/or tie rods will still be required where indicated on plans and standard drawings.

a. When mechanical joint pipe restraints are installed on ductile iron pipe, the length of pipe to be restrained shall be determined in accordance with the "Ductile Iron Pipe Research Association" (DIPRA) Recommendations, "Thrust Restraint Design for Ductile Iron Pipe." See Standard Drawings Nos. 14 and 15.

Ductile iron pipe shall be restrained with Series 1100 mechanical joint ductile iron retainer glands

manufactured by EBAA Iron Sales, Inc. or an approved equivalent.

- b. Polyvinyl chloride (PVC) pipe may be restrained with the use of mechanical joint restraints subject to approval of the District. Refer to Standard Drawings for typical installation details.

PVC pipe mechanical joint restraints shall be series 2000 PV Megalug Retainer Glands manufactured by EBAA Iron Sales, Inc. or an approved equivalent.

2.11 Casing Pipe. Installation of mains through rights-of-way or easements of others, such as highways, railroads, etc., may require casing pipes for bores. The type of casing material and its properties will be specified by the agency granting permission to cross. Such crossing shall be subject to approval by the District to avoid conflicts in requirements or standards between the District and the persons or agency granting permission to cross. See Section 3.24 of these Specifications.

2.12 Responsibility for Materials.

- a. Material Furnished by Contractor. The Contractor shall be responsible for all material furnished by him/her and shall replace at his/her own expense all such material found defective or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work and materials found defective during the warranty period.
- b. Responsibility for Safe Storage. The Contractor shall be responsible for the safe storage of material furnished by or to him/her, and accepted by him/her and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

2.13 Handling of Materials.

- a. Hauling of Materials. All materials furnished by the Contractor or to the Contractor shall be delivered and distributed at the job site by the Contractor.

All pipe, valves, fittings, hydrants and accessories shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe shall not be skidded or rolled against pipe already unloaded.

- b. Unloading at the Site of Work. When distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be installed in the trench.
- c. Care of Coatings and Linings. All materials shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the replacement or repair of the damaged material shall be done to the satisfaction of the District. All material handling equipment and material handling methods shall be approved by the District.

2.14 Pressure Accessories.

- a. Pressure Gauges.

- | | |
|------------------|--|
| 1. Type: | Dial, liquid filled |
| 2. Range: | Downstream: 0 to 150 psi
Upstream: 0 to 300 psi |
| 3. Accuracy: | 3% full scale range |
| 4. Dial size: | 3-1/2" diameter |
| 5. Accessories: | Isolation ball valve on nipple; snubbers on nipple |
| 6. Design basis: | U.S. Gauge P580L-1 |

Pipe Installation

- 3.01 **Approval by the District.** Throughout these Specifications many handling and installation procedures, tools, equipment, and materials will require approval by the District. Approval by the District shall in no manner render the District liable for any injuries suffered or equipment damaged. Approval by the District is used solely as a means to insure quality control and safety.

Safety of workers shall be provided as required by the Occupational Safety and Health Act (OSHA). The Contractor is solely responsible for job safety.

- 3.02 **Handling of Materials.** Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. If, however, any part of the coating or lining is damaged, the replacement or repair of the damaged pipe shall be done to the satisfaction of the District. Any pipe or fittings that are not acceptable to the District shall be removed from the job site immediately. All pipe handling equipment and pipe handling methods shall be approved by the District in conjunction with the methods and equipment recommended by the manufacturer.

- 3.03 **Inspection and Preparation of Pipe and Fittings.** Before placing pipe in the trench, each pipe or fitting shall be thoroughly cleaned of all foreign material, kept clean at all times thereafter, and carefully examined for cracks and other defects before installation. Bell ends and spigot ends are to be examined with particular care. Defective pipe or fittings shall be laid aside for inspection by the District Inspector who will prescribe corrective repairs or rejection.

All lumps, blisters and excess coating shall be removed from the bell-and-spigot end of each pipe and fitting, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean, dry and free from oil and grease before the pipe or fitting is installed. Dirt and any other material must be removed from the barrel of the pipe before installation.

- 3.04 **Cutting and Fitting of Pipe.** Pipe shall be cut, whenever necessary, to conform to location of fittings, line or grade. All cuts shall be straight and true, and in a workmanlike manner so as to leave a smooth end without damaging the pipe or its cement lining. All burrs shall be removed from the ends of cut pipe, and the end lightly rasped or filed. All tools used in cutting pipe shall be approved by the District.

- 3.05 **Pipe Joint Lubrication.** Joint lubricant shall be supplied by the pipe manufacturer, and approved by the District. Joint lubricant shall be non-toxic, and water soluble.

- 3.06 **Pipe Alignment and Grade.** In laying pipe, the intent is to lay to a set line and grade within a tolerance of 3 inches plus or minus. On slopes of zero grade, the intent is to lay to grade. Fittings, valves and hydrants shall be installed at staked locations and elevations; spigots centered in bells; and all valve and hydrant stems plumb.

In new developments, street right-of-way and/or property line and lot corner points must be set and in visible evidence before water installations can proceed. In existing areas sufficient right-of-way, property or easement delineation must be recovered or established before water installation can proceed. Offset stakes for alignment and grade shall be set by the Contractor's, Owner's or Developer's engineer. Any replacement of stakes shall be at the expense of the Contractor, Owner or Developer.

When laying pipe on curves, the intent is to lay to the staked alignment. The pipe shall be kept in alignment by placing all deflecting joints or bends on the curve. Short lengths shall be used as necessary to accomplish the curvature without exceeding individual deflections specified by the District. See Standard Drawing No. 10. Bends shall be used whenever individual deflections exceed those specified by the District.

For pipes with an internal diameter of 10 inches or less, the depth of fill over the pipe measured from the proposed finish grade over the pipeline to the top of the pipe shall be a minimum of 4.5 feet and maximum of 5.5 feet unless otherwise specified. All pipes with an internal diameter of 12 inches or more shall be installed to the depth shown on the required plan and profile drawings.

If difficulties arise when crossing an interference and where specifically approved by the District or its Inspector, deviations from the above minimum and maximum depths of cover may be permitted.

Any changes in alignment and grade must be authorized by the Inspector and shall be accomplished by the installation of additional fittings. "Breaking" of joints is permitted only when installing pipe on horizontal or vertical curves.

Pipe shall be laid with the bell ends facing in the direction of laying, unless directed otherwise by the District. Where pipe is to be installed on a grade of ten percent (10%) or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade.

3.07 Deviation From Alignment and Grade Occasioned by Other Structures. Whenever obstructions not shown on the plans interfere to such an extent that alteration in the plans is required, the District shall have the authority to determine the best method of correction. The District may order a deviation from the line and grade of the structures and/or removal, relocation and reconstruction of the obstructions.

3.08 Temporary Bulkheads. Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be of such design as to prevent water, debris, children and animals from entering the pipe. All temporary plugs shall be provided by the Contractor and approved by the Inspector.

3.09 Frost. No pipe or appurtenant structure shall be installed upon a foundation into which frost has penetrated, or at any time when the Inspector deems there is danger of ice formation or frost penetration at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

3.10 Earthwork. See standard drawing No. 9 for typical pipe trench and earthwork requirements.

a. Embedment Materials. All water and sanitary sewer mains are to receive one of the following embedment materials extending from the bottom of the excavation to 12 inches over the pipeline.

(1) Concrete. The pipeline embedment with concrete shall utilize concrete having a 28-day compressive strength of a minimum of 3000 psi and other characteristics as set forth in these Specifications.

(2) Granular Material. Well-graded, crushed stone or gravel meeting the requirements of ASTM C33, Gradation 67 (3/4" to No.4).

(3) Fine Granular Material. Natural or manufactured sand meeting the following requirements:

Well-Graded Sand

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
3/8	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No. 100	2 - 10

(4) **Squeege Sand**

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
3/8 inch	100
No. 200	0 - 5

- (5) **Selected Backfill.** Selected soil free from rocks, clods or stones greater than 1-1/2" in any dimension as approved by the District's representative. Granular material, fine granular material or squeege sand may be substituted for selected backfill.

b. **Backfill Materials**

- (1) **Suitable Material.** Soil obtained from the excavation that is free of frozen material, stumps, roots, brush, other organic matter, debris and other items. In addition, suitable material shall meet the following requirements:
- (2) **Upper Portion of Trench.** Material placed within one (1) foot of pavement subgrade or finished surface in unimproved areas shall be soil free from rocks, greater than 6 inches in nominal diameter.
- (3) **Other Portions of Trench.** Material within 6 inches below and 12 inches above the pipe shall contain particles of a size to conform to the embedment class required but in no case shall it contain rocks greater than 1-1/2 inches in any dimension. From a point 12 inches above the pipeline to within one (1) foot of the pavement subgrade or finished surface in unimproved areas, maximum size of any rock in the trench backfill shall be 18 inches nominal diameter.
- (4) **Public Highways.** Provide and install material in conformance with the Colorado Department of Transportation requirements where they do not conflict with other provisions of these regulations. Should a conflict exist, submit a request for clarification to the District in writing prior to proceeding with work.
- (5) **Flowable Fill.** At the District's option, or if required by the right-of-way's governing body, utility trench backfill meeting the following requirements (flowable fill), may be used in lieu of native backfilling in any excavation regardless of width or depth. Concrete slurry type full depth backfill will not be allowed within the public right-of-way. Compaction and testing of utility trench backfill will not be required if material meeting the following specification is used:

FLOWABLE FILL SPECIFICATIONS

<u>Ingredient</u>	<u>lbs / cubic yard</u>
Cement	43 (0.47 sack)
Water	325 (39 gallons or as needed)
Coarse Aggregate (Size #57)	1700
Sand (ASTM C-33)	1845

c. **Trench Backfilling and Compacting**

- (1) Place backfilled material above embedment materials in a manner to prevent damage or misalignment of the pipeline. Place in lifts of a thickness necessary to acquire the specified backfill density or in conformance with other regulatory requirements. Backfilled material shall conform to the requirements of Section 3.10.b of these specifications.
- (2) **Backfill Density Requirements.** Unless otherwise specified or required by local governing authority, all backfill should be placed in a manner to achieve the density specified below.

- State Highway
100% of maximum in shoulder areas
Flowable Fill within all paved areas
- Paved roadways, sidewalks and other areas to receive pavement
95% of maximum density for entire trench depth
- Gravel roadways
95% of maximum density for entire trench depth
- Sodded or lawn areas over a dedicated easement or right-of-way
90% of maximum density
- Zone 6" below to 12" above pipe
95% of maximum density for all pipelines
- Adams / Arapahoe County
100% of maximum in paved areas parallel to traffic
95% in shoulder areas
Flowable Fill in paved areas perpendicular to traffic

d. Field Quality Control

- (1) Density Testing and Control. Density testing as may be required by the District's representatives shall be the responsibility of the Contractor and/or Developer. Results of such density testing shall be reported directly to the District by the testing agency. All reports shall be submitted with the seal and signature of a registered professional engineer experienced in the testing of soil materials.
- (2) Soil Compaction Tests. Conduct in accordance with the requirements of ASTM D698-07 or AASHTO T99, "Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch Drop." Use method A, B, C or D as appropriate on soil condition and judgment of the testing laboratory. Samples tested shall be representative of materials to be placed (or altered). Obtain optimum moisture density curve for each type of material or combination of materials encountered or utilized. Use test results as a basis for compaction control. Testing includes Atterberg Limits, grain size determination and specific gravity.

3.11 Lowering of Material Into the Trench. Proper implements, tools and facilities satisfactory to the District shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and their protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fitting, valve, hydrants or water main accessories in handling, the damage shall be immediately brought to the attention of the Inspector. The Inspector shall prescribe corrective repairs or rejection of the damaged items.

3.12 Laying of Pipe. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Inspector may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home with a slow steady pressure without jerky or jolting movements and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space. No wooden blocking shall be left at any point under the pipeline.

No pipe shall be laid when, in the opinion of the District, trench conditions are unsuitable.

3.13 Ductile Iron Pipe. There is only one nominal dimension of the spigot outside diameter and the bell inside diameter for each size of push-on joint pipe. In some existing older pipelines, some variation in outside spigot diameter may exist. When connecting to an existing line, care should be exercised to ensure that the outside diameter of the existing line is the same as the outside diameter of the push-on joint or mechanical joint pipe being installed, otherwise a special adapter to join the two lines may be necessary.

a. Push-On Joint. Immediately before joining two lengths of ductile iron pipe, the inside of the bell, and the outside of the spigot end, and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The rubber shall be flexed inward and inserted in the gasket recess of the bell socket. Since different manufactured brands of pipe require different types of gaskets, the Contractor shall exercise caution to ensure that the correct type of gasket is used.

A thin film of approved gasket lubricant shall be applied to either the inside face of the gasket, or the spigot end of the pipe, or both.

The spigot end of the pipe shall be placed in the bell end with care to prevent the joint from contacting the ground. Pipe furnished without a depth mark on the spigot end shall be marked before assembly to assure insertion to full depth of the joint. The pipe shall be kept in straight alignment and the joint shall be completed by pushing the pipe home with a slow, steady pressure without jerky or jolting movements by using a forked tool or jack-type tool or other device approved by the District. If pipe is pushed home with a backhoe bucket, a wooden shield must be placed between the backhoe bucket and the end of the pipe. The spigot end of field cut pipe lengths shall be filed, or ground to resemble the spigot end of such pipe as manufactured.

Upon completion of joining push-on joint pipe, an inspection shall be made to assure that the gasket is correctly aligned in the gasket recess of the bell socket and not twisted or turned.

Whenever it is necessary to deflect push-on joint pipe, the amount of deflection shall not exceed the maximum deflections specified by the District. See Standard Drawing No. 10.

b. Mechanical Joint Pipe. Before joining mechanical joint cast or ductile iron fittings to ductile iron pipe, the outside of the spigot, the inside of the bell and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter.

Normal practice is to lubricate the joint with a soap solution; however, in cold weather the joint may be assembled dry if approved by the Inspector. Extreme care should be exercised in making dry joints.

The cast iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland.

The pipe shall be pushed in until the spigot end fully penetrates the bell. The gasket shall then be pressed into place within the bell evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting; the bolts inserted and the nuts screwed finger tight, then tightened with a torque limiting wrench. Torques for the various sizes of bolts shall be as follows:

<u>Bolt Size</u>	<u>Ft. Lbs.</u>
5/8 inch	45-60
3/4 inch	75-90
1 inch	85-100
1-1/4 inch	105-120

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce equal pressure on all parts of the gland.

Whenever it is necessary to deflect mechanical joint pipe, the amount of deflection shall not exceed the maximum deflections specified by the District. See Standard Drawing No. 10.

3.14 Polyvinyl Chloride Pressure Pipe.

- a. Elastomeric Gasket Joint. Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.

Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.

Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling must be in accordance with the manufacturer's recommendations. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.

The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion. Upon completion of joining the pipe, an inspection shall be made to assure that the gasket is correctly aligned in the gasket recess of the bell socket and not twisted or turned.

Deflection may not be allowed at the joints of some PVC pipe. When these types of pipe are to be installed, bends shall be used where deflection is required.

Installation of PVC pipe will be in accordance with the manufacturer's recommendation. A solid No. 12 coated copper wire will be attached to all PVC pipe for the purpose of future location. See Standard Drawing No. 7.

- b. Pipe Storage. Pipe stored outside, and exposed to sunlight for more than thirty (30) days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover pipe. Air circulation shall be provided under the covering.
- c. Handling of Pipe in Cold Weather. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling and installing PVC pipe during cold weather.

3.15 Installation of Valves. Valves shall be handled in such a manner as to prevent any injury or damage. All joints shall be thoroughly cleaned before installation.

Valves shall be located at the points on the main as indicated on Standard Drawing No. 2, unless specified otherwise by the District.

Valves shall be set and joined to the pipe in the manner previously specified for cleaning, laying and joining push-on and mechanical joint pipe. Valves shall be set in such a manner that the valve stems are plumb. If necessary to provide a firm subgrade or surface on which to install a valve, solid precast concrete blocks or a cast-in-place concrete pad may be placed beneath the valve body. If cast-in-place concrete is used, extreme care shall be taken to assure that flange bolts are not constrained by the concrete. No wood blocking will be allowed.

Valves shall be operated prior to installation to ensure good operating condition.

Where necessary, the Inspector shall require the installation of additional valves not shown on the plans. See Section 1.08 of these Specifications.

3.16 Valve Boxes.

- a. Installation. A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve, and shall be centered and plumb over the operating nut of the valve, with the box cover set to the required elevation. It will be the responsibility of the Developer to insure that valve

boxes are plumb and raised to the proper elevation.

Paving of any street requires that all existing valve boxes be located and prepared for final raising to the finish street surface as shown on Standard Drawing No. 3.

- b. Inspection. Prior to paving, a final inspection is required and can be arranged by contacting the District. Inspections should be requested twenty-four (24) hours in advance of need.

- 3.17 Installation of Fittings. All fittings in the District's Water Distribution system shall be mechanical joint in compliance with the material specification. Fittings shall be set and joined in the manner described in Section 3.13.b of these Specifications.

The use of "wyes" in main extensions or private pipe extensions is strictly prohibited except in special installations as directed by the District.

- 3.18 Fire Hydrants.

- a. Installation. All hydrants shall be staked for location and grade. Final location and grade shall be in accordance with the approved drawings. Offset stakes not further than 12 feet from the fire hydrant are acceptable. All hydrants shall stand plumb and be installed as indicated on Standard Drawing No. 1.

Each hydrant shall be connected to the main by a 6-inch branch line. An independent 6-inch gate valve shall be installed on each fire hydrant branch.

No service line connections shall be installed between the fire hydrant and the fire hydrant control valve.

- b. Anchorage. The bowl of each hydrant shall be well braced against the unexcavated earth at the end of the trench with a concrete thrust block. The bottom of the hydrant bowl and the hydrant valve shall be supported with eighteen by eighteen by four inch (18"x18"x4") pre-cast concrete blocking slabs. The hydrant shall be tied to the hydrant valve and the hydrant valve tied to the tee with anchor pipe or with two, 3/4-inch all thread galvanized rods as shown on Standard Drawing No. 1.

Mechanical joint pipe restraints in conformance with Section 2.10 of these Specifications may be used in lieu of all-thread rods.

Whenever a fire hydrant is installed at the termination point of a main extension (such as in a cul-de-sac), then tie rods and concrete reverse anchors will be required for both the fire hydrant valve (which in this case is also a line valve on the main) and the fire hydrant lateral or branch line connected to the fire hydrant. See Standard Drawing No. 1. Additional concrete anchors or tie rods may be required at the direction of the Inspector.

If bends are needed to bring a hydrant to a desired horizontal or vertical position, special concrete reverse anchors, anchor pipe, mechanical joint pipe restraints or all thread tie back rods, or a combination of all these along with a riser may be required. In any case, a riser no longer than 2 feet will be acceptable and it will be the Contractor's responsibility to set the safety flange at the proper grade.

- c. Drainage. Whenever a hydrant is set, drainage shall be provided at the base of the hydrant by placing rock from the bottom of the trench, to at least 12 inches above the barrel flange of the hydrant, and to a distance of 12 inches around the elbow. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be 6 inches. The minimum of rock placed shall be 1/3 cubic yard. The rock shall be a well-graded gravel, cobble, or crushed rock, free of dirt.
- d. Hydrant Protection in Corrosive Soils. In areas where soil resistivity requires corrosion protection, all ductile iron branch lines and hydrants shall be protected. All pipe, rods and fittings, from finished ground level on the hydrant barrel up to and including the tee, shall be encased in polyethylene wrap. The type of polyethylene and manner in which it is to be installed shall conform to Section 3.26 of these Specifications. Bedding material shall be as specified in Section 3.10 of these Specifications. All fire

hydrants to be cathodically protected with a 9 lb anode.

- 3.19 Dead Ends and Blow Offs. All dead ends on new mains shall be closed with cast iron plugs or caps; such dead ends shall be equipped with suitable concrete anchors and blow off facilities.

The Contractor shall furnish, install or remove temporary blow offs at locations shown on the drawings or designated by the District. See Standard Drawing No. 12.

The Contractor shall install permanent blow offs where indicated on the drawings. A permanent blow off is defined as one which will be left in place at the completion of all proposed installations. Refer to Standard Drawing No. 12.

- 3.20 Thrust Blocks and Anchors.

- a. Installation. Thrust blocks and/or anchors shall be constructed at all bends, tees, plugs and fittings which require reaction support due to unbalanced line thrust. Care shall be taken not to block outlets or to cover bolts, nuts, clamps or other fittings or to make them inaccessible. The Standard Drawing No. 8, shows the size and shape of thrust blocks and anchors. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. If in the opinion of the District, the soil bearing capacity is not sufficient to provide adequate restraint based on minimum bearing areas shown on the Standard Drawings, then the minimum bearing area shall be increased to a size that will ensure adequate restraint. In every instance, the thrust block or anchor shall bear against undisturbed earth. When it is impossible, through over excavation or other cause, to pour a thrust block or anchor against undisturbed earth, harness rods or mechanical joint pipe restraints shall be required to anchor the fittings to the main.

Thrust blocks will be required on large taps regardless of whether a tapping sleeve or tapping saddle is used.

All debris, water or ice shall be removed from the place to be occupied by the concrete. Concrete shall not be placed on frozen subgrade. Concrete shall be placed in the presence of the Inspector unless inspection has been waived prior to the placement.

- b. Form Work for Thrust Blocks and Anchors. All forming for concrete thrust blocks and anchors will be done by bulkheading around the shape of the thrust block or anchor with burlap or reinforced paper sacks filled with sand or earth. Sacks shall be of a size easily handled when full, and shall be left in place in the trench. Wood forms may be used in some cases; however, all wood will be removed before backfilling.

No horizontal struts or braces required for trench shoring shall remain in the concrete thrust blocks. Prior to placing concrete, the forms and ditch bank shall be inspected and approved by the Inspector.

- c. Concrete and Curing Time. Thrust blocks shall be concrete of a mix not leaner than 1 part cement to 2-1/2 parts sand and 5 parts stone, and having a compressive strength of not less than 3,000 psi after 28 days.

Minimum curing time for concrete thrust blocks regardless of additives shall be thirty-six (36) hours for anchors containing 2 cubic yards or less, forty-eight (48) hours for anchors containing more than 2 cubic yards but less than 6 cubic yards, and seventy-two (72) hours for anchors containing more than 6 cubic yards but less than 12 cubic yards. Anchors containing more than 12 cubic yards will be cured as directed by the District Inspector. Curing time for anchors having flanged rods or other accessories embedded in them for the purpose of tying pipe and/or fittings directly to the anchor will require approximately twenty-five percent (25%) additional curing time.

No water main will be charged or pressurized without the approval of the Inspector. All thrust blocks and anchors must meet the minimum curing time unless, under certain circumstances, the Inspector may elect to shorten or extend the time of curing.

- d. Compaction of Fill Over Thrust Blocks and Anchors. Backfill may be placed over thrust blocks and anchors once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block or anchor for a minimum of thirty-six (36) hours after placement or as directed by the Inspector.

- 3.21 Vaults. Vaults may be precast or poured-in-place and shall be constructed in accordance with these Standard Specifications. Precast vaults shall be so designed that all joints and corners are waterproof. Precast and poured-in-place vaults shall be made waterproof after construction by use of sealants, epoxies or other approved methods. All dimensions, locations and elevations shall be coordinated by the Developer and Contractor and meet the requirements of the District.

Concrete footers shall be required as indicated on the drawings.

All vaults shall be constructed to meet H.S. 20-44 traffic loading conditions and 300 psf surcharge load.

- 3.22 Harness Rods. Harness rods and lugs shall be used at all bends and fittings where thrust blocks cannot be used due to existing field conditions or where harness rods and lugs are specifically required by these Specifications, installation plans, or the Inspector.
- 3.23 Bridging and Encasement of Pipe. Under certain conditions when the water main is to be installed over or under an existing or proposed utility or structure, the District may require bridging or encasement of the pipe.

If, in the opinion of the District, there exists the possibility of settlement of the pipe being installed over an existing utility or structure, then bridging of the pipe shall become necessary. This condition shall also apply to other underground utilities or structures being installed over existing water mains. The District shall determine the size and location of the concrete bridging. 3.24 Encasement or Sleeve Pipe. Wherever it is necessary to provide an encasement or sleeve for the water main, the water main shall not be inserted into the encasement or sleeve pipe without providing insulating skids for each joint of the water main. Insulating skids shall be of a type such as the "P.S.I. Model A12 Steel Casing Insulators" or equivalent. In addition, no encasement or sleeve pipe shall be installed without protecting the ends of the pipe with adequate open joint masonry which will deter dirt and debris from entering, but at the same time will allow water to escape from the encasement or sleeve pipe. Encasement pipes shall be protected both inside and out with corrosion resistant materials having a bituminous base. Encasement or sleeve pipe, size, length, type and sidewall thickness will be determined by the District.

3.24 Connections to the District's System.

- a. Connections. Connections to the District system shall be in a neat and workmanlike manner. An Inspector shall be present at all times during the construction of the connection. The connection is subject to approval by the District. Under no circumstances shall a non-disinfected main, which cannot be isolated, be connected to an existing distribution main in service.
- b. Tapping Existing Mains. The Contractor shall be responsible for making or arranging for all taps for main extensions. Permits for service taps shall only be issued to a master plumber unless otherwise approved by the District. The Contractor shall notify the District a minimum of twenty-four (24) hours prior to tapping. Once the tap is complete, the Contractor shall be responsible for protection of the tapping sleeve or saddle and the tapping valve against freezing or other damage. The Contractor shall also be responsible for all backfill, compaction, paving, curb and gutter, etc.
- c. Operation of Valves. In connecting to the District's system, it may be necessary to operate existing valves.

Valves on the District's system that must be operated to make a connection shall be operated by District personnel only. The Contractor shall give the Inspector forty-eight (48) hours' notice to arrange for operating valves. Both the Contractor and the Inspector shall be present when the valves are operated.

- d. Interruption of Service. Installation of a connection that will require closing existing valves may cause an interruption of water service to existing District customers. Affected customers must be notified twenty-four (24) hours in advance.

The District Inspector will arrange for all notification to both residential customers and the fire department; however, the Contractor will be responsible to furnish the Inspector all necessary information as to the date and time the interruption will begin and the total time required to complete the installation.

A normal interruption shall be a maximum of two hours. If the interruption will be greater than two hours, the work shall be done in a manner to minimize the inconvenience to customers, such as working at night in a continuous operation until service is restored. A connection which will require an interruption longer than two hours shall be subject to review by the District as to the appropriate timing of the connection.

If, in the process of installing a connection, there exists an industry or building in the area that cannot be out of water, such as a hospital or other special customer, appropriate means shall be taken to provide and convey water. The water and means of conveyance shall be approved by the District.

3.25 Corrosion Protection Systems.

- a. Dissimilar Materials. Insulation shall be installed as required by the District. Particular care shall be taken to insulate between dissimilar materials.
- b. Insulating Joints. Whenever it is necessary to join pipe of dissimilar metal, or when designated by the District, a method of insulating against the passage of electrical current shall be provided. Special care shall be exercised during the installation of these joints to prevent electrical conductivity across the joints. See Section 2.08 of these Specifications.
- c. Polyethylene Encasement Material. Whenever designated by the District, the metallic pipe and all appurtenances shall be wrapped in polyethylene. The polyethylene encasement shall prevent contact between the pipe and bedding material, but is not intended to be a completely air-tight and water-tight enclosure.

Prolonged exposure to sunlight will eventually deteriorate polyethylene film. Exposure to sunlight shall be kept at a minimum. See Standard Drawing No. 4.

The polyethylene shall have a minimum wall thickness of eight (8) mils and conform to the specification set forth in this part.

A 2-inch wide, ten-mil thickness polyethylene pressure-sensitive tape shall be used to close seams, secure to pipe or hold overlaps.

Polyethylene pipe wrap material shall be applied to line pipe in the manner shown on Standard Drawing No. 4.

Damage to polyethylene wrapped pipe in the trench prior to and during backfill shall be repaired to the satisfaction of the District.

Before the Contractor taps a water main, the trench, pipe and polyethylene wrapping shall be in a state of readiness. The Contractor digging the trench shall repair or replace any damaged polyethylene prior to tapping.

- d. Insulating from Concrete. Areas of metal pipe and appurtenances which are to be in contact with concrete thrust blocks, bridging blocks, anchors or encasement may be required by the District to be protected against corrosion prior to installing concrete. The following types of protection systems are acceptable:
 - (1) Application of cold-applied mastic coating with high electrical resistivity, similar to Roskote Mastic A-51, manufactured by Royston Laboratories.
 - (2) Application of a cold-applied primer and corrosion resistant pipe wrap, similar to the primer and pipe tape manufactured by the Protecto Wrap Company.

Other proposed protection systems may be accepted following review and approval of the District.

3.26 Disinfection. The following procedure shall apply to all main extensions within the District's water service area. Pipe extensions shall be chlorinated in accordance with AWWA C651, "Disinfecting Water Mains." The Contractor shall provide material for disinfection of all water mains.

Calcium hypochlorite granules with a minimum of 65 percent available chlorine or 5-g calcium hypochlorite tablets shall be used for disinfection. Application rates shall comply with AWWA C651.

The following table denotes the amount of calcium hypochlorite granules to be placed at the beginning and end of the main and at 500-foot intervals to obtain disinfection.

<u>Pipe Size</u>	<u>Calcium Hypochlorite Granules (ozs.)</u>
4"	0.5
6"	1.0
8"	2.0
12"	4.0

The following table denotes the number of 5-g calcium hypochlorite tablets required per 20-foot joint for dose of 25 mg/l. Chlorine tablets shall be attached to the inside top of the pipe using a water based, non-toxic glue (DOW 78) just prior to the pipe installation of the trench.

<u>Pipe Size</u>	<u>No. of Tablets</u>
4"	1
6"	2
8"	4
10"	6
12"	7
16"	13

After the calcium hypochlorite has been placed in the pipeline by the Contractor, disinfection must be completed within ten (10) calendar days.

After the pipe is filled with water and chlorine, and unless approved otherwise by the District, the chlorinated water shall be held in contact with the pipe for twenty-four (24) hours. At the end of the twenty-four (24) hour period, the water in the pipeline shall be tested by the District to ensure a residual chlorine content of not less than twenty-five (25) mg/l.

The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public.

Samples of water will be collected for bacteriological examination and residual chlorine content testing before the pipe is put into service. Testing of residual chlorine and sampling will be done by the District.

No main which has been disinfected and flushed shall stand stagnant for more than fifteen (15) days without being reflushed.

3.27 Pressure Testing. All mains and appurtenances shall be subject to pressure testing performed by the Contractor. All mains shall be subjected to a test pressure of 150 psi at the lowest point in the portion of the system being constructed. The test pressure shall be placed on the pipeline and the line isolated from other water sources. After a two (2) hour period, water shall be added to the line to return the pressure to the specified test pressure. The quantity of water required to return the pressure to the specified level will be measured.

The maximum allowable leakage at the specified test pressure shall not exceed ten (10) gallons per day per inch of pipe diameter (inside diameter) per mile of pipe.

ALLOWABLE LEAKAGE

Pipe	Diameter Allowable leakage in 2 hours, Gallons				
	250 psi	225 psi	200 psi	175 psi	150 psi
4"	0.47	0.45	0.95	0.40	0.37
6"	0.71	0.68	0.64	0.59	0.55
8"	0.95	0.90	0.85	0.80	0.74
12"	1.42	1.35	1.28	1.19	1.10
16"	1.90	1.80	1.70	1.59	1.47
20"	2.37	2.25	2.12	1.98	1.84
24"	2.85	2.70	2.55	2.38	2.21

3.28 Acceptance and Release for Taps. A new main shall be accepted by the District and released for taps when the following conditions have been met:

- a. The main and all appurtenances have been installed to the satisfaction of the Inspector and all pertinent notes and measurements have been made.
- b. Disinfection has been completed and the main has been flushed, charged and received a passing bacteriological test.
- c. Pressure testing has been completed satisfactorily.
- d. All tapping methods have been approved by the District.
- e. As constructed record drawings and other supporting information shall be furnished to the District within two weeks of the completion of construction of any pipeline segment. The District shall find the record documents satisfactory before permitting the main to be put in service and accepted for maintenance.

3.29 Acceptance of Mains and Service Lines Including Curb Stops.

- a. Preliminary Acceptance. Preliminary acceptance of mains will be granted by the District following the Developer's completion of all curbs, gutters, grading and paving, plus all curb stop and street valve boxes being set at proper grade.
- b. Final Acceptance. Approximately one year following the preliminary acceptance, the District will reinspect the curb stop and street valve boxes for centering, plumb and grade. The Contractor and Developer will be notified of any defects in materials and workmanship and these defects must be promptly corrected in accordance with these Specifications. Corrections must be made immediately. If no defects are found or corrections are made as required by the Inspector, a letter of acceptance will be issued, following receipt of proper documents giving clear title to all mains and appurtenances. Service lines beyond the corporation stop on the main are the property of the Developer and/or Owner. Preliminary and final acceptance can be granted in phases of development after all the conditions of current specifications have been met.

The Developer shall be responsible for repairing any deficiencies in the workmanship for a period of one year after preliminary acceptance. This shall include but not necessarily be limited to removal and replacement of surfacing materials (pavement, curb and gutter, sidewalk) which are damaged due to soil settlement.

- c. Repair and Maintenance prior to Final Acceptance. Repair and maintenance of mains and services prior to final acceptance by the District will be the sole responsibility of the Developer and/or Contractor. Repair and maintenance will be accomplished to the current specifications of the District.
- d. Meters. Meters will be maintained by the District from the time of installation.

Service Lines and Meters

4.01 All New Service Lines and, Where Applicable, Service Line Replacements.

- a. Required water plans must be approved by the District and all water connection and tapping charges due must be paid before water taps will be made. All replacement water taps are subject to the water tap fee unless otherwise approved by the District.
- b. Tapping permits must be applied for at the District Office and paid for at least 24 hours prior to tapping.
- c. All service taps on water mains within the water distribution system shall be accomplished by the Contractor, who shall notify the District a minimum of 48 hours prior to tapping.
- d. No water taps shall be made unless property corners are clearly marked so measurements of taps and curb boxes can be made at the time of tapping.
- e. Excavation of the tapping hole is the responsibility of the Contractor and shall be done in accordance with these Standard Specifications.
- f. Minimum normal size tap for a water service is 3/4 inch. The Contractor shall be responsible for furnishing all necessary materials. For service line sizes in excess of 2 inches, the corporation shall be a tapping valve and the curb stop shall be a gate valve.
- g. Cribbing, sheeting or sloping of the banks of tapping holes is the responsibility of the Contractor and will be in accordance with the rules and regulations of the Colorado Department of Public Health and Environment, Water Quality Control Division, 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530, and OSHA as applicable.
- h. Barricading of tapping holes is the responsibility of the Contractor and shall be in accordance with construction, installation and repair of right-of-way openings for subsurface utilities for work within the Strasburg Sanitation and Water District or other applicable regulatory agency.
- i. Backfilling and compaction of tapping holes shall meet the specifications of the governing body in whose jurisdiction work is being done; i.e., Strasburg Sanitation and Water District, Adams County, Arapahoe County, or State of Colorado.
- j. Replacement of Existing Corporation Stops: Where an existing corporation stop is to be replaced with a new corporation stop of equal or larger size, the Owner of the property shall be responsible, at his/her expense, to have the old corporation stop excavated and shall contact the District which will shut off the old corporation at no expense to the Owner. Backfill, compaction and replacing of the corporation stop following shut off by the District is the responsibility of the property Owner at his/her expense.
- k. Abandoning Existing Taps: Where an existing water tap is to be abandoned, the Owner of the property shall be responsible, at his/her expense, to have the corporation stop excavated and then contact the District which will shut off the corporation at no expense to the Owner. Backfill and compaction will be the responsibility of the property Owner at his/her expense.
- l. Multiple Service Taps: No service line within the District's water service area will serve more than one customer. Each house, building or business shall have an individual tap and service line from the water main to the house, building or business, and an individual meter.

4.02 Water Service Line Excavations for All New and Replacement Service Lines.

- a. Excavation, safety and backfilling to include proper compaction of water service line ditches are the responsibility of the Contractor all in accordance with the specifications of the governing body in whose jurisdiction the work is being done; i.e., Strasburg Sanitation and Water District, Adams County, Arapahoe County, or State of Colorado.

- b. Water service line ditches must enter the lot as near ninety degrees (90°) to the property line as is practical and not at an extreme angle unless otherwise approved.
- c. Water Service Line Ditches and Separation of Water Service and Building Sewer: Except as permitted below, the water service line and the building drain or building sewer shall be not less than 10 feet apart horizontally and shall be separated by undisturbed or compacted earth. Such a separation shall be maintained in all public rights-of-way and easements. The water service line may be placed in the same trench with the building drain or building sewer provided approval is given by the District and the following conditions are met:
 - (1) The bottom of the water service line at all points shall be at least 18 inches above the top of the sewer line at its highest point. The water service line and building sewer shall be separated by a clear horizontal distance of no less than 24 inches.
 - (2) The water service line shall be placed on a solid shelf excavated at one side of the common trench.
 - (3) No joints in the water service line shall be permitted between the corporation stop and the curb stop without prior approval of the District. In no case will soldered joints be allowed.
 - (4) The materials and joints of sewer and water service lines shall be installed in such a manner and shall possess the necessary strength and durability to prevent the escape of solids, liquids and gases there from under all known adverse conditions such as corrosion, strains due to temperature changes, settlement, vibrations and superimposed loads.

4.03 Service Line Installation and Material for All New and Replacement Service Lines.

- a. An expansion loop as shown in Standard Drawing No. 16 must be left in the service line where it is connected to the corporation stop at the water main to allow for expansion and contraction. Existing water services or taps which are not 3/4-inch or larger and do not consist of polyethylene or that will not meet the specifications referred to in this section will not be permitted. If the existing tap has been deleted from the water system at the time of demolition, under no circumstances will the District allow a service to be reconnected. It would constitute a new tap and service.
- b. Water service lines shall conform to the following minimum diameter.
 - 1) 3/4-inch diameter for townhomes (attached single family) and patio homes, single family residential.
 - 2) Multi-family and commercial service lines shall be sized in accordance with the applicable local building code and subject to the review and approval of the District.
 - 3) Minimum diameters described above may be increased to provide for satisfactory delivery pressures as determined by the District.
- c. Water service line material between the corporation and the curb stop shall be as follows:
 Plastic pipe will be Pure-Core Blue or Driscoplex 5100 Ultra-Line HDPE pipe Dr7, two hundred (200) PSI with stainless steel stiffeners.
- d. Water service line joints – all joints shall be comprised of flared compression fittings. However, now joints will be allowed between the corp stop and the curb stop, curb stop and meter, and then meter to residence.
 - (1) Copper tubing shall have flared fittings as manufactured by the Mueller Co.
 - (2) No sweat or welded joints shall be allowed underground.
 - (3) Dissimilar type of material - copper tubing to galvanized iron
 - (a) Iron pipe O.D. x copper tube size O.D.
 - (b) Insulating coupling
 - (c) Romac Industries, Inc., Style 702 compression coupling
 - (d) Rockwell/Smith Blair adapter gasket for steel pipe to copper tubing
 - (e) Equivalent product of other manufacturers

- e. All water service lines shall have a minimum cover of 5 feet except at the expansion loop and will be determined by the street cut and/or by the finished grade of the property.
- f. Water service lines from the corporation to the curb stop shall have a maximum cover of 6 feet unless otherwise approved.
- g. Where a 1-1/2-inch or larger water service line crosses another utility or any underground structure, the water service line shall preferably pass over the other utility or structure, but in no instance shall there be less than 6 inches clearance between the water service and the other utility or structure. The space between the water service line and the utility or structure shall be backfilled with sand when the clearance is less than 12 inches.

Where any water service line passes under a sewer main, the sewer main shall be constructed of cast iron or Schedule 40 polyvinyl chloride (PVC) pipe for 6 feet each side of the water service line.

- h. HDPE service lines shall be the same size from the corporation stop to the curb stop or secondary valve. Then, if necessary, the size of the service line may be increased or reduced only after the curb stop or secondary valve to the meter by one size. HDPE service lines shall be installed horizontally in a “snake-like” laying configuration to allow for both expansion / contraction movement of the pipe in the trench. The HDPE service line shall consist of one (1) piece of continuous pipe from the corporation stop to the curb stop / secondary valve with no fittings or connections allowed. The curb stop / secondary valve may not be placed under concrete or paved driveway areas. If the service line needs to be extended to accommodate moving the curb stop / secondary valve out of a concrete or paved area, the valve must be abandoned, poly wrapped in full open position and the new valve will be routed to the closes edge of the concrete.
- i. 12 gauge insulated solid core tracer wire, as specified herein, shall be extended from the main to the foundation of the house / structure. Tracer wire shall be extended up the outside of the curb stop box, as specified herein and approximately eighteen inches (18”) at foundation.
- j. Tapping saddle: A tapping saddle shall be used on all service line connections to the water distribution system. Tapping saddles shall have the following characteristics:
 - (1) Double strap
 - (2) Brass body
 - (3) Brass straps
 - (4) AWWA tapered thread pattern (cc)
 - (5) Acceptable manufacturer: Mueller Co., Typical Catalog No. BR-2-B-0684-CC-100 for 6" pipe, 3/4" tap; Romac 202 BS; same series for larger sizes
- k. Corporation stop
 - (1) Conform to AWWA C800
 - (2) AWWA tapered thread pattern inlet (cc)
 - (3) Flared compression fitting outlet for PE tubing
 - (4) Same size inlet and outlet
 - (5) Acceptable manufacturers: Mueller Co., Catalog No. H-15000; Ford FB-1001-NL; McDonald 74701 B
- l. New service lines on single family units will be installed to enter the property 10 feet inside the front property line farthest from the garage and/or driveway unless otherwise approved by the District.

4.04 Curb Stop and Curb Box for All New and Replacement Service Lines.

- a. All service lines, regardless of size, must have a curb stop and curb box installed in accordance with the Standard Drawings. The curb box shall be centered over the curb stop and shall be plumb. The following location will be accepted by the District:

All curb stop boxes will be installed 6 inches from the public right-of-way line unless designated

otherwise by the District.

- b. The curb stop supplied by the Contractor shall be installed in accordance with of these Specifications.
- c. The responsibility of the Contractor for the curb box ends only when sidewalks, curbs, driveways, etc. have been installed and all backfilling and compaction has been completed. They are subject to review for alignment at the end of the one-year warranty period.
- d. Curb stops: Mueller Co. Model H-15204; McDonald 6100-33 (for each respective line size), Ford B46 Series (333 through 777 for ¾" through 2").
- e. Curb boxes: Tyler series or equal. Enlarged bases required for 1-1/2-inch and 2-inch curb stops.

4.05 Water Meters - General

- a. All water supplied by the District to a newly developed property must be metered except for fire lines. All water meters shall become the property of the District.
- b. All water meters are supplied and installed by the Owner or customer. If repair or replacement is necessary during the warranty period, the replacement meter will be accomplished by the District at the builder's expense. If repair or replacement is necessary after expiration of the warranty period, the District shall accomplish such repair or replacement.
- c. Acceptable locations for ¾-inch water meters shall be limited to outside water meter pits, basement, utility room or utility closets unless otherwise approved. Locations for 1-1/2-inch or larger water meters shall be approved by the District prior to installation of the water meter loop.
- d. Water meter locations selected shall provide adequate protection against freezing.
- e. Water meters installed in the District shall be the Invensys SR II
 - (1) ¾-inch diameter:
 - (2) Other sizes: As approved by District
 - (3) Bronze body

4.06 Inside Water Meter Installations Only

- a. Inside residential water meter locations must be in the basement or other lowest level of the residence. When installed in a crawl space with an earth floor, a rock-filled sump, 1-1/2' deep, 1-1/2' in diameter shall be installed beneath the meter location. Where plastic pipe is used for inside installations, plastic will not be used within 3 feet of the meter loop.
- b. Inside ¾-inch water meter locations shall be such that the water meter is unobstructed on one side, easily accessible for reading or servicing, with a minimum of 8 inches clearance around the remainder of the meter with a minimum of 3 feet of clearance above the meter. Meter locations shall not require stooping or crawling to gain access to the meter. Meters will not be installed in attic spaces and shall be on or near the floor. Approval prior to construction for crawl space installation may be granted by the District.
- c. Inside ¾-inch water meter loop installations shall include an inlet and outlet valve as shown on Standard Drawings. Inlet and outlet valves shall be full opening water way, straight or angle body meter ball valves.
- d. Water main installations shall incorporate necessary backflow prevention devices as specified herein.

4.07 Water Meter Pit Installations Only

- a. The locations of the meter pit for ¾-inch through 1-inch water meters will be one foot (1') inside of the curb stop. If a problem arises on the location, the location will be determined by the District.