

## Chapter 8. WATER SYSTEM

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### 8.1 Introduction

All water distribution systems constructed within the City of Northglenn shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include special criteria established by the City for overall hydraulics of the water utility system. Special criteria shall be outlined at pre-application meetings, as determined necessary by the Engineering Division.

In the case of water mains larger than 12 inches, the Designer shall submit construction specifications to the Engineering Division for review and acceptance prior to the Engineering Division's review of the construction drawings.

#### 8.1.1 Interruption of Service

The Engineering Division will operate all existing valves, hydrants, blow-offs and curb stops. NO VALVE OR OTHER CONTROL DEVICE ON THE EXISTING PUBLIC SYSTEM WILL BE OPERATED FOR ANY PURPOSE BY ANYONE OTHER THAN THE CITY WITHOUT PRIOR WRITTEN AUTHORIZATION. Twenty-four hours prior to the interruption of service, the Contractor shall notify all users whose service will be interrupted in order for them to make provisions for necessary water storage. For water mains servicing commercial areas (i.e., restaurants) 48 hours prior notice shall be given and work affecting the shutdown shall only be performed between the hours of 1:00 a.m. and 5:00 a.m. No line in service will be shut down for more than a four-hour period at one time. Prior approval by the Engineering Division is required for all shutdowns.

#### 8.1.2 Water Breaks

If notification prior to shutdown is impossible, the Contractor shall notify all users within one hour after the shutdown. Since prior notification was not possible, it will be the responsibility of the Contractor to supply potable water to the users affected. The Developer/Contractor shall also contact the Engineering Division and Fire District in reference to this emergency shutdown within one hour. All fire line valves are owned and operated by the Fire District.

#### 8.1.3 Meter Set Installation Reinspection Fee

Water tap fees provide for inspection of the meter set only. Where additional inspections are made necessary by incomplete or faulty work, no fee shall be charged for the first two inspections; however, a fee will be charged for the third inspection and each subsequent inspection. This fee shall be charged to the holder of the permit and paid to the City before any additional inspections will be made.

### 8.2 Design Criteria

#### 8.2.1 Scope

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Designer to correctly and efficiently design the overall water system for a particular project or development. The Engineering Division recommends that the Designer plan a pre-application/pre-design meeting to review and answer concerning design questions.

#### 8.2.2 Design Flow

The flows used to design the water system for a particular Project vary depending on the type of land use associated with the Project. There are two general categories for which flow rates are given: residential Project and commercial/industrial Project. Once the specific type of development is determined, the peak flows are calculated based on average demand, peak day, and peak hour factors. With each type of development, there is also a unique fire

flow that shall be considered when designing the system. The Fire District shall provide the required fire flows to be used in the analysis.

The following is a list of the criteria to be used in the preparation of all water system analyses:

**Table 8.1: Water System Analyses Criteria**

	Residential	Commercial/Industrial
Assumptions	2.9 people/unit for all single-family residential units <sup>(1)</sup> 1.8 people/unit for all multi-family units, including apartments	For planning purposes only use 1,000 gallons per day per acre for average demand.
Average Demand	151 gallons/capita/day <sup>(2)</sup>	300 gallons/day/1,000 square foot floor area (gross) <sup>(3)</sup>
Peak Day Factor	2.5 <sup>(2)</sup>	2.5 <sup>(2)</sup>
Peak Hour Factor	4.0 <sup>(2)</sup>	4.0 <sup>(2)</sup>

<sup>(1)</sup> From "1988 Population and Household Estimates," or latest edition published by the Denver Regional Council of Governments with revisions by the City of Northglenn Planning Department.

<sup>(2)</sup> From "Evaluation of Potable Water Storage Distribution and Pumping System", 1998.

<sup>(3)</sup> From "Water Supply and Sewerage Fifth Edition," E.W. Steel and Terence J. McGhee

**Table 8.2: Fire Flow**

Fire Flow to be determined by the Fire District		
Fire Flow Analysis	Analyze system to the greater value:	
	Max Day plus Fire Flow	Peak Hour
Minimum Residential Pressure plus Fire Flow	20 psi <sup>(4)</sup>	

<sup>(4)</sup> Exceeds the minimum requirements of the latest adopted International Building Code.

### 8.2.3 Hydraulic Design

State of the art engineering practices and techniques shall be used when analyzing and designing the hydraulics of the proposed water system. The Engineering Division shall review any proposed modeling software to determine if it is acceptable.

### 8.2.4 Operating Pressures Within the Distribution System

Static pressure within the distribution system shall be a minimum of 40 pounds per square inch during the maximum hour demand and a maximum of 125 pounds per square inch static pressure at the main. The maximum pressure

fluctuation at any location in the distribution system between maximum hour demand and minimum hour demand shall not exceed 30 pounds per square inch.

### 8.2.5 Pressure Regulating Stations

Pressure reducing valve (PRV) installations are used to control pressure between distribution zones. For main extensions, the Designer should determine the need for a pressure regulating valve installation based on existing zones and the existing distribution system. Plans shall be submitted as part of the utility study indicating size, type, and location of the PRV installation. All calculations shall be submitted to the Engineering Division for review with the Utility Study. A PRV will be required if directed by the Engineering Division.

### 8.2.6 Sizing of Mains

#### **Distribution Mains**

All mains shall be sized large enough to provide for domestic, irrigation and fire protection flows to the area serviced. The maximum acceptable head loss for six, eight and twelve-inch mains is two feet per thousand feet of main. The minimum diameter for water mains in residential areas, including cul-de-sacs, shall be 6 inches. All schools, shopping centers, business parks, industrial parks and high-density residential areas shall be looped with mains at least 8 inches in diameter. All waterlines shall be looped and not be built as dead-end lines, except when the lines extend into cul-de-sacs serving not more than 12 single-family residential units.

For development projects, oversizing of mains may be required by the City, and the recovery of the costs of such over sizing shall be in accordance with the Municipal Code.

#### **Transmission Mains**

All transmission mains shall be sized in compliance with the City's "Northglenn Treated Water System Modeling Evaluation", latest edition.

### 8.2.7 System Layout – Design

#### **Pipe Within Right of Way or Easements**

All mains shall be installed in dedicated Right-of-Ways or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Waterlines shall not be installed adjacent to and directly below any concrete such as sidewalks, curbs or gutters. Water lines shall typically be located 5 feet north or west of street centerline or 5 feet north or west of a curbed median.

#### **Minimum Cover**

All mains shall be installed in dedicated Right-of-Ways or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Waterlines shall not be installed adjacent to and directly below any concrete such as sidewalks, curbs or gutters. Water lines shall typically be located 5 feet north or west of street centerline or 5 feet north or west of a curbed median.

#### **Horizontal & Vertical Spacing**

Water mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility, per Colorado Department of Public Health and Environment “Design Criteria for Potable Water Systems” (latest revision).

- **Exception.** In re-development areas or physically constrained areas, the Engineering Division may allow a water main may be laid closer than ten feet to a parallel sewer main if it is laid in a separate trench and if the

elevation of the invert of the water main is at least 24 inches above the crown of the sewer main. In addition, PVC C-900 is used for the sewer main.

- **Extend Along Frontage.** Water mains shall be designed such that they extend the entire frontage of the property to be served or as approved by the Engineering Division.
- Under no circumstances shall the vertical clearance between any lines involving a waterline, sanitary sewer line or storm sewer be less than 24 inches.

**Casing Requirements**

When the water main passes under a highway, railroad or waterway, there shall be a minimum of five feet of cover and a steel casing shall be installed in accordance with the Standard Drawings. The steel casing shall extend the entire width of the Right of Way or easement of the crossing structure or as otherwise approved by the Engineering Division. In all cases, valves shall be located such that the water main at such crossings can be completely isolated without interruption of any services.

**Main Crossing Scenarios**

**Table 8.3: Main Crossing Scenarios**

<p>Water Main crossing over Sanitary Sewer Main</p>	<p>When there is less than 24 inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900 Class 235 may be used.</p>
<p>Water Main crossing over Storm Sewer Main</p>	<p>When there is less than 24 inches of vertical clearance between the water main and the storm sewer, each joint of the storm sewer within ten feet of the centerline of the crossing shall be encased in concrete. Crossing details shall be approved by the Engineering Division.</p>
<p>Sanitary Sewer Main crossing over Water Main</p>	<p>The sanitary sewer line should not be designed over a waterline. In all cases, regardless of vertical clearance, the sanitary sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900 may be used.</p>
<p>Storm Sewer Main crossing over Water Main</p>	<p>In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing.</p>

**8.2.8 Easements**

All mains shall be in an easement which has a width of at least two times the depth to the pipe invert. The minimum easement shall be 20 feet in width for one utility, 30 feet in width for two utilities, and 40 feet in width for three utilities. Site specific circumstances may dictate the need for wider easements.

The main shall be located a minimum of 10 feet from and parallel to the edge of the easement. All City required easements shall be for the exclusive use of the City of Northglenn.



### **Meters and Fire Hydrants**

Meters and fire hydrants not installed within the Right of Way will require an easement dedication ten feet wide and extending three feet behind the meter or fire hydrant. If the meter or fire hydrant easement is longer than ten feet, then the width of the easement shall be a minimum of 20 feet. The fire hydrant shall be centered in such easements.

### **Limits of Use in Easements**

No landscaping (except grass and private irrigation systems) nor permanent structures (mailboxes, sheds, buildings, etc.) shall be placed in the easement.

The easement agreement, provided by the City, shall state that any temporary structures (including paving and fencing) placed in the easement shall be removed and replaced by the owner of the land when requested by the City so that maintenance can be performed. The owner of the land shall agree to hold the City of Northglenn harmless for any replacement of structures removed from the easement.

The following statement shall appear on all official development plans and all final plats.

“All public water, storm sewer and sanitary sewer mains and appurtenances located in public Right of Way shall be maintained by the City of Northglenn Public Works Department. All public water, storm sewer, sanitary sewer mains and appurtenances under private drives are located in utility easements. City is responsible for maintenance of these water, storm, and sanitary sewer facilities. City is not responsible for repair or replacement of private drive, curb and gutter or landscaping damaged during utility repair or maintenance.”

### **8.2.9 Future Connections**

#### **Dead End Line**

A blow-off, as shown in the ***Standard Drawing, W-22***, is required at the end of any water main which terminates and is anticipated to be extended in the future. When a future main extension is anticipated, the main shall be valved so that only one valve will have to be closed when the main is extended. The Engineering Division prefers a hydrant for flushing of dead-end line.

#### **Valve Restraint**

The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. Restraint shall be made by the use of a mechanical joint anchoring tee (swivel tee), cross, or by installing a minimum of two full lengths of pipe on the extension side of the valve.

No service taps shall be allowed on a main which can be extended in the future between the single valve to be closed and the dead end.

### **8.2.10 Services**

#### **One Service for each Structure**

Each separated structure shall be served by a separate service line and meter. No pressure booster facility of any kind shall be allowed on any service line between the public main and the meter. All service line pressure booster facilities shall be privately owned and maintained.

#### **Horizontal Spacing**

Water service lines shall be located a minimum of 10 feet away from all sewer services (measured horizontally). All service lines shall be constructed perpendicular to the front property line of the property they are going to serve and not more than 5 feet from the side of a front property line.

**Same Size Services**

All service lines and meters connected to these will be the same size.

**Issuance of Water Taps**

Water taps cannot be issued prior to a building permit and/or tap entitlement approval.

**Size of Service Lines**

All service lines 3/4-inch through 2-inch shall be copper and shall be installed continuous without joints between the corporation stop at the water main and the meter or curb stop.

**Minimum Cover**

Services shall have a minimum of 5 feet of cover and be laid as shown on the ***Standard Drawing W-24***.

**Service Connections**

Service connections (3-inch, 4-inch, 6-inch, or 8-inch) to new lines shall be made with mechanical joint anchoring tees (swivel tees) or reducing mechanical joint anchoring tees (swivel tees) if installed at the time of main line construction. Connections shall be reviewed and accepted by the City.

**Sizing**

**Table 8.4: Pipe Sizing Suppliers**

Meter Size	Supplier
1 ½” meter on 2” line	1 pair Ford A67 adaptors
1” meter on 2” line	1 pair Ford A47 adaptors
1” meter on 1 1/2” line	1 pair Ford A46 adaptors
5/8” x ¾” meter on 1” line	1 pair Ford A24 adaptors
Other sizes	Contact Public Works Department

Size changes shall be accomplished by providing a full-sized meter vault and setting for the line size installed and using industry standard adapters to install a reduced size meter in the full-size line.

**8.2.11 Transmission Mains**

All water mains 16 inches and larger in diameter shall be classified as "transmission mains."

**Air and Vacuum Release Valves**

All transmission mains shall have air and vacuum release valves installed at all high points on the line, and on each side of butterfly valves as shown on ***Standard Drawing W-18***.

### **Blow-Off Assemblies**

All transmission mains shall have blow-off assemblies installed at all low points on the line, constructed as shown in ***Standard Drawing W-19***.

### **Limits of taps on Transmission Lines**

No service line taps nor any taps less than six inches in diameter shall be made to transmission mains. Exceptions to this will be for air and vacuum release valves only.

### **Valves on Transmission Lines**

Valves on transmission mains shall be placed no more than 1,200 feet apart. Where there are connections to transmission mains, all connecting mains shall be valved at the connection. If the connection main is 16 inches or greater in diameter, there shall be a minimum of two valves at a tee connection and three valves at a cross connection.

#### **8.2.12 Unlawful Connections**

No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted or contaminated water, mixtures or substances to enter any portion of such piping from any tank, receptacle, equipment or plumbing fixture by reason of back siphonage, suction, back pressure or any other cause, either during normal use and operation or when any such tank receptacle, equipment or plumbing fixture is flooded or subject to pressure in excess of the main line operating pressure. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by the City and any pipes, conduits or fixtures containing or carrying water, chemicals, liquids, gases, or any other substances from any other source.

#### **8.2.13 Appurtenances**

##### **Valves**

- **Residential Valves Locations.** Residential distribution systems shall be valved to ensure that no more than 600 feet of main or 18 residential units and 1 fire hydrant will be out of service in the event of a single water main break. Valve placement shall be such that there are at least two valves at every tee and three valves at every cross.
- **Valves on 12" plus Lines.** Valves larger than 12 inches shall be butterfly valves. Main line valves shall be located at a point on the main which is intersected by an extension of the side property line of lots in the subdivision.
- **Locations Not Permitted.** Under no circumstances shall a valve be located in concrete areas such as sidewalks, crosspans, aprons or gutters. Valves are permitted to be located in concrete pavements or asphalt.
- **Valve Locations for Water Lines in Easements.** Valves located on water mains in easements shall be located at the connecting tee, cross, or elbow.
- **Location of Butterfly Valve Operators.** Butterfly valve operators shall be located on the north or east side of the water main.
- **Concrete Collar.** Any valve located in a greenbelt area shall have a 6-inch-wide by 6-inch-thick concrete collar around the valve box.

##### **Fire Hydrants**

- **Maximum Spacing.** The maximum distance, as measured along the centerline of the street, between fire hydrants shall be 500 feet in residential areas and 300 feet in business and other high-value areas.

- **Dead End Line.** One fire hydrant will be allowed on dead-end line provided that the line is an 8” line. The number and location of fire hydrants in a given area shall be approved by the Fire District.
- **Location of Hydrants at Intersections.** When hydrants are to be installed at locations other than street intersections, they shall be located on the extension of property side lot lines. In no case shall a hydrant be located closer than 5 feet to obstructions, driveways, etc.
- **Location within the Right of Way.** The fire hydrant shall be located within the Right of Way or easement and on the same side of the street as the water main. Fences, landscaping, etc., shall in no way hinder the operation of the fire hydrant. In addition, clear distances to the fire hydrant shall be no less than 60 inches of these STANDARDS AND SPECIFICATIONS.
- **Lateral Lines.** The fire hydrant lateral lines shall be set at 90 degrees to mains. The fire hydrant lateral line shall be no more than 70 feet in length from the main. No horizontal bends or offsets shall be used in fire hydrant lateral lines. Under no circumstances shall any tap be made on a fire hydrant lateral line.

#### **Thrust Blocks**

- **Uses for Thrust Blocks.** All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants and blow-offs shall be designed and constructed with restrained fittings and concrete thrust blocks. See **Standard Drawings W-3 to W-5.**
- **Unknown Soil Strength.** If the soil-bearing strength is unknown, the soil-bearing capacity used in design shall be 2,000 pounds/square foot for waterlines 12” and smaller.
- **Thrust Block Design on Waterlines larger than 12”.** Waterlines larger than 12” must be designed by a Designer and submitted with construction plans for approval.

#### **Meters**

- **Same Size Taps and Meters.** All water taps, service lines and meters connected to the meter will normally be the same size.
- **No Public Water Meters in Buildings.** Public water meter installations inside any buildings are prohibited. Meters shall be located within publicly owned Right-of-Way or easements. If an existing meter in a building and a permit is requested, the Engineering Division shall require the meter to be moved.
- **City Owned Meters.** All water meters connected to the City of Northglenn's utility system shall be the property of the City. Under no circumstances shall anyone other than City personnel remove or install a water meter once the pit or vault has been inspected and approved. No connections shall be made in the meter pit other than those related to the meter and bypass.
- **Sprinkler System Connection.** Sprinkler system connections shall be made downstream from the meter and a minimum of five feet from the meter pit or vault.
- **Unusual Conditions.** For any installation where special or unusual conditions might exist, additional design and review shall be required prior to Engineering Division acceptance.
- **Master Meter System.** Every “Master Metered” system to which fire hydrants or fire protection lines will be connected shall have a UL or FM approved “Fire Service Protection Water Meter” in accordance with AWWA C703.



- **Sizing.** The Designer shall develop the form from AWWA for water line sizing and present it at the Pre-Application/Pre-Design meeting and provide the information in the Utility Report (Refer to **Chapter 5 – Design Report Requirements**).
- **Additional Requirements for meters over 2 inches in size.** For any water meter installation over 2 inches in size, detailed drawings of the proposed installation shall be submitted to the City for review and acceptance prior to construction.
- **No Wiring in Water Meter Pits.** There shall be no electrical wiring allowed in any water meter pit or vault.
- **Installation of Meter Pits.** All meter locations shall be accurately shown on the construction plans for specific review and approval. The City requires that all meter pits and vaults be specifically inspected and approved prior to substantial Completion of the work.

### **Fire Protection Service Line**

- **Valve Locations.** Valves on newly constructed fire lines shall be located on the tee at the main line.
- **Private Ownership.** The owner shall maintain all private fire lines beginning at and including this valve.
- **Backflow Prevention Device.** All fire sprinkler taps shall be installed with an approved backflow prevention device as defined by the Municipal Code and a flow switch which will indicate when water has flowed through the line.
- **Separate Taps.** A property requiring a domestic service line and a fire protection service line will have separate taps for each.

### **Valve Vaults**

- **24” and Larger Valves Installed in a Vault.** All valves larger than 24 inches shall be installed in a vault in accordance with the detail drawings in **Appendix G.6**.
- **H-20 Loading Requirements.** All valve vaults shall be capable of withstanding AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.
- **Design of Vaults.** Vaults shall be made waterproof after construction by use of sealants, epoxies or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves. All vent pipes for vaults shall be installed in conformance with the detail drawings in **Appendix G.6**.

### **Manholes**

Manholes shall be installed on all pressure regulating valves, permanent blow-off installations, and air release valves. See **Standard Drawing W-18**.

### **Backflow Prevention Assemblies**

To prevent backflow contamination of the City of Northglenn’s potable water mains, a backflow prevention assembly shall be installed where any condition might exist that could result in a higher pressure downstream of the water meter than exists in the main line that could allow backflow or back-siphonage of polluted or contaminated water or other substances from the water user’s system.

The City shall have the right to access Backflow Prevention Assemblies for all City of Northglenn residences, businesses, or industries. All non-single family residential shall test assembly and submit testing report to the Engineering Division.

- **Location of the Backflow Prevention Assembly.** The assembly shall be placed downstream of the water meter and installed per Colorado Department of Public Health and Environment guidelines to allow for proper operation and easy access for annual testing and maintenance.
- **Type of Assembly.** Criteria listed in State guidelines will be used to determine the type of assembly required for each installation based on the potential hazards of the intended use. Some typical applications requiring backflow prevention include hospitals, medical and dental clinics, car washes, dry cleaners, mortuaries, manufacturing processes using chemicals, locations with lawn irrigation systems, buildings with fire protection systems, buildings greater than 40 feet high and locations with a service line larger than 4 inches in diameter.

### 8.3 Construction Specifications

#### 8.3.1 Excavation, Trenching & Backfilling

Excavation, trenching and backfilling shall be performed in accordance with **Chapter 14 – Trenching, Backfilling, and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS and comply with Industry Safety Standards.

#### 8.3.2 Bedding

Bedding shall conform and be installed in accordance with **Chapter 14 - Trenching, Backfilling and Compacting - Utilities** of these STANDARDS AND SPECIFICATIONS.

#### 8.3.3 Pipeline Installation

##### General

- **City Required Inspections.** The City shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the City.
- **Construction Staking for Alignment and Grading.** Alignment and grade of the pipe and the location of fittings, valves and hydrants shall be staked under the supervision of a professional surveyor registered in the State of Colorado at the cost of the Designer and/or Developer.
- **Correct Materials and Equipment.** Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe fittings, valves and hydrants shall be carefully lowered into the trench by means of a derrick, ropes or other suitable tools or equipment to prevent damage to water main materials and protective coatings and linings. Chains or cables shall not be used for handling pipe with protective coatings. Under no circumstances shall water main materials be dropped or dumped into the trench.
- **No Defective Pipe or Fittings.** All pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the City. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench and prior to connection.
- **Clean Work Environment.** Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

- **Pipe Joint Installation.** Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. This work shall be completed in accordance with manufacturer's instructions. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. After installation of the polyethylene protective wrap, if required, the pipe shall be secured in place by installation of bedding material and backfill, in accordance with **Chapter 14 - Trenching, Backfilling, and Compacting - Utilities**. See **Standard Drawing W - 1**.
- **Deflection of Pipe.** Deflection from a straight line or grade, as required by horizontal or vertical alignments or offsets, shall not exceed the maximum allowable limits set by the manufacturer's specifications. If the alignment requires deflection in excess of the allowable deflection per joint, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limits set forth and in accordance with the Manufacturer's recommendation.
- **Polyethylene Film Wrap.** All ductile iron pipe fittings and appurtenances shall be protected with minimum 8 mil polyethylene film wrap. Miscellaneous steel or other ferrous pipe for temporary blow-offs, etc., shall be similarly protected. Methods for applying the wrap shall conform to the **Standard Drawing W - 6**.
- **Protection of Pipe during Work Stoppages.** At times when installation is not in progress, the open ends of the pipe shall be closed with a watertight plug. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.
- **Cold Weather Pipe.** Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the City, will not be permitted for installation.
- **Location Tape.** During the backfilling of all waterline trenches, a continuous 2-inch-wide metallic-coated tape labeled "Waterline Buried Below" shall be placed in the trench backfill 2 feet above and directly over the pipe.
- **Tracer Wire.** Additionally, all waterline installations shall include the installation of a single, 12-gauge, insulated copper tracing wire taped to the top of the pipe. The tracing wire shall be one piece and installed in a continuous run between valves. Each end of the tracing wire shall be brought to the surface in an anode box next to the fire hydrant or as applicable in the valve box containing the riser pipe. See **Standard Drawing W - 7**. The tracer wire shall be tested by the City for continuity prior to acceptance.

### **Fittings**

Pipes shall be connected to valves and fittings by mechanical joints unless specified differently in the approved drawings. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe. Both the spigot and bell must be thoroughly clean and free from tar or other coatings and rust.

For mechanical joint pipe, the last 8 inches of the outside of the spigot end of the pipe and the inside of the bell of all fittings and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other

foreign matter from the joint and then a thin film of gasket lubricant shall be applied. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell of the fitting. Gasket lubricant shall be applied to the rubber gasket and placed on the spigot end of the pipe with the thick edge towards the gland.

After the spigot end of the pipe is placed into the bell and fully inserted the gasket shall be pressed into place within the bell so it is even around the entire joint. After the gland is positioned behind the gasket, the contractor shall install all bolts and nuts and tighten them with a torque wrench. Nuts spaced 180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland.

Jointing shall be done, unless specifically excepted above, in accordance with AWWA Specification C-111 for a mechanical joint for ductile iron pressure pipe and fittings.

### 8.3.4 Valve & Valve Box Installations

In addition to the jointing requirements mentioned of these STANDARDS AND SPECIFICATIONS, the additional requirements of this section shall apply. Valves and valve boxes shall be installed where shown on the approved drawings and as directed by the City.

- **Elevation of Valve Box Covers.** Valve boxes shall be firmly supported, centered, and plumbed over the wrench nut of the valve with the box cover at or minus 1/4-inch within the surface of the finished pavement or at such other elevation as may be directed by the City.
- **Extensions.** Extensions to within 4 feet of the finished grade shall be provided for valves installed with more than 5 feet of cover. All extensions shall be pinned to the valve operating nut. Earth fill shall be carefully tamped around each valve box to a minimum distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before and after installation. Screw in extension to right height.

Gear cases shall be tightened, and the valve shall be inspected in opened and closed positions to ensure that all parts are in working condition prior to installation. The cases shall be supported by bricks or other means to prevent any shock or stress being transmitted to the valve.

### 8.3.5 Thrust Blocks

#### **Setting Thrust Blocks**

The contractor shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape required. When it is impossible, because of over excavation or other causes, to pour a thrust block against undisturbed earth, harness rods shall be used to anchor the fittings to the main in addition to the thrust block and as required by the City. After the concrete has been placed and has set, the contractor shall remove all forming materials prior to backfilling around the thrust block. Concrete for the thrust blocks shall comply with provisions set forth in **Chapter 15- Street Construction Standards** of these STANDARDS AND SPECIFICATIONS

#### **Bond Breakers**

The blocking shall be placed so that the pipe and fitting joints will be accessible for repair. A bond breaker shall be placed between the fittings and the thrust block.

#### **Backfill & Tamping**

Backfill may be placed over the thrust blocks 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 for a minimum of 24 hours after

placement. Concrete must set a minimum of 48 hours prior to the initial filling of the line. Ensure that the ground under thrust block location is compacted.

### **8.3.6 Connection to Existing Mains**

At locations where connections to existing water mains are to be installed, the contractor shall locate the existing mains, both vertically and horizontally and shall verify their exact size in advance of the time scheduled for making the connections. The contractor shall notify and schedule the connection with the City.

Prior to connecting to existing water mains, the contractor shall have all labor, materials, and equipment ready to connect the fitting to the existing main to keep the shut-off time to a minimum. As soon as possible after making the connections, the contractor shall flush the connection to prevent any contamination of the existing facilities. The contractor shall take every precaution necessary to prevent dirt or debris from entering the main.

### **8.3.7 Fire Hydrant Installation**

Immediately before installation of a hydrant, the following operations shall be performed.

#### **Inspected & Cleaned**

The hydrant shall be thoroughly inspected for any defects or damage. The hydrant interior shall be thoroughly cleaned before completed.

#### **Ensure Operation**

The hydrant shall be opened and closed as many times as necessary to determine that all parts are in proper working order, valves are seating properly, and the drain valve is operating freely.

#### **Setting Requirements**

Hydrants shall be set so that a minimum of 5 feet of cover is provided for the lateral line and the nozzles are a minimum of 18 inches above finished grade. Each hydrant shall be set on a concrete foundation at least 18 inches by 18-inches and 6 inches thick. Each hydrant shall be blocked against the end of the trench with a concrete thrust block. If the trench is unstable then the hydrant shall be mechanically restrained from the tee at the main to the hydrant in addition to the thrust block.

#### **Washed Rock**

Each hydrant shall have drain holes with a minimum 18-inch-thick layer of 1-1/2-inch (minimum) washed rock beneath them. A sheet of 8-mil polyethylene shall be placed over the washed rock to prevent dirt from filling the rock.

#### **Connection to Main**

All hydrants shall stand plumb and shall be connected to the street main by a minimum 6-inch DIP lateral line.

#### **Maximum Base Adjustment**

The fire hydrant base shall be adjusted to not more than 3 inches nor less than 2 inches above the approved finished grade.

#### **Maximum Height of Extensions**

The maximum allowable height of extensions on hydrants is 12 inches. No hydrant lateral shall be installed any deeper than 6 feet from the top of the approved finished grade.



**Bollards**

Depending upon hydrant location, the use of bollards may be required for protection, as specified by the City.

**Hydrant Gate Valves**

Hydrant gate valves shall have a restrained connection directly to the tee at the main.

**Ground Water**

In areas where the hydrant bottom is installed below ground water, the drain shall be plugged, and the hydrant marked with a metal tag to indicate the requirements to pump the hydrant after use. See **Standard Drawing W - 2** for construction requirements.

**8.3.8 Taps**

The size of tap and the tapping method for a given type and size of waterline shall be as follows:

**Table 8.5: Required Service Tab Sizes Based on the Diameter & Type of Pipe**

Size of Pipe (inches)	Ductile Iron				PVC			
	3/4"	1"	1-1/2"	2"	3/4"	1"	1-1/2"	2"
3"	NO	NO	NO	NO	NO	NO	NO	NO
4"	S	S	NO	NO	S	S	NO	NO
6"	DT	S/DT	S	S	DT	S/DT	S	S
8"	DT	DT	S	S	DT	DT	S	S
12"	DT	DT	S	S	DT	DT	S	S
16"	--	--	--	--	--	--	--	--
20"	--	--	--	--	--	--	--	--

S - Tapping saddle required. All saddles shall have the AWWA taper on its threads.

DT - Direct tap permitted.

NO - No tap permitted with or without a saddle. A tee connection may be permitted if specifically authorized by the City.

S/DT - Either a tapping saddle or a direct tap may be permitted depending on the situation.

**Saddles**

All existing AC waterlines shall be tapped using a saddle.

**Tap Angle**

All taps into the water main shall be at an angle of not more than 45 degrees from the horizontal, and corporation stops shall be installed.

**Release for Service**

Taps shall not be made on a water main until the City has performed and the main has passed the pressure tests and clear water tests and a "Release for Service" letter has been issued by the City. Care shall be taken to properly install water service lines so that a minimum of 12 inches of slack is in the service line at the main to protect against pull out. Tapping mains may require digging out bedding material and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the contractor to protect both the service line and the main.

**Separation**

Service taps shall have a minimum separation of 24 inches and be no closer than 24 inches to a main line joint.

**Service Taps**

All service taps shall be performed by the Contractor. All necessary materials for said taps, including corporations stops, cooper line, meter pits, copper setters, curb stops, etc., shall be supplied by the Contractor. Said materials shall conform to these Standards and Specifications. The City will inspect each tap prior to backfilling.

**Taps on Mainline**

Taps to mains shall be accomplished with the mainline valves either side of the tap in the closed position.

**Temperature Limitations**

Taps to PVC mains shall only be made when the air temperature is 32°F or higher.

**8.3.9 Meter Installation**

No connections shall be made in the meter pit other than those related to the meter and bypass. Sprinkler system connections shall be made no closer than five (5) feet from the meter pit or vault on the downstream side of the meter.

The City will provide all meters after connection fees are paid. Contractor is responsible for the installation of all meter appurtenances. Meter will be set only at the time of approval of all other work done by the Contractor.

**3/4 Inch and 1 Inch Meter Installations**

- **Meter Location.** The meter shall be located a minimum of 1 foot behind the sidewalk. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back edge of the curb. In all cases, the meter shall be installed within Right of Ways or public easements. No meters shall be set in streets, sidewalks, driveway alignments or concrete areas without prior approval of the Engineering Division.
- **Horizontal Grade.** The dome or meter lid shall be level and 2 inches above the approved final grade. The copper setter shall be a minimum of 10 inches below the inner cover. A variance of more than 4 inches (vertically) in installing the copper setter will not be accepted.
- **Meter Pits.** Meter pits shall be constructed of modified hi-density polyethylene and a steel cover.

- **Grade Adjustment.** The size shall be as specified in the detail drawing in **Appendix G.6**. Grade adjustment shall be made using concrete rings. The trench floor under the concrete rings shall be compacted earth. The concrete pit shall not bear on the service pipe.
- **Final Inspection Timing.** Final inspections of the meter pit will be made at the time the meter is actually set. The building permit applicant is responsible for any required adjustments to the copper setter or meter lid at that time.
- See **Standard Drawing W – 8** for specific requirements.

### **1 1/2 Inch and 2 Inch Meter Installations**

The entry hole through the roof of the vault shall be centered over the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade. See **Standard Drawing W – 9** for specific requirements.

### **3 Inch and Larger Meter Installations**

The entry hole through the roof of the vault shall be centered over the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade. See **Standard Drawing W – 10**.

Piping shall be ductile iron, flanged-joint design only. Insulators shall be provided between connections of dissimilar metals.

## **8.3.10 Tests**

### **General**

- **Disinfect and Test Lines.** The Contractor shall disinfect and test all mains and fire lines regardless of existing conditions. This may include repairing existing facilities that must be included in the test and are not capable of holding test pressures.
- **Cure on Thrust Blocks.** All thrust blocks or other bracing facilities shall be in place at least 48 hours before the initial filling of the line for disinfecting and testing.
- **Inspection Requirements.** All tests will be conducted in the presence of the City.

### **Filling and Venting Lines**

- **Operation of Valves.** All existing valves will be operated by the City for this testing procedure. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken so that all available hydrants (including hydrant gate valves), air valves and other vents are open during the filling of the line.
- **Filling Rate.** The rate of filling the line shall not exceed the venting capacity of the vent.
- **Temporary Taps.** Where hydrants or other vents are not available in the line, the contractor shall make whatever taps are required for venting purposes. Once the construction is complete, the taps shall be removed and the main repaired by the use of a stainless-steel repair clamp.

### **Pressure Test**

After the pipe and appurtenances have been laid, the line has been backfilled, and all field-place concrete has cured, each valved section, unless otherwise directed by the CITY, shall be subjected to a hydrostatic pressure of not less than





150 PSI. However, in all cases the test pressure shall be 50 percent over existing main pressure in the test area. The test duration shall be a minimum of one hour.

Water added to maintain the pressure shall be per AWWA C-600. Allowable leakage shall be calculated according to the following formulas:

Ductile Iron Pipe:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Polyvinyl Chlorine Pipe:

$$L = \frac{ND\sqrt{P}}{7,400}$$

L = Testing Allowance (makeup water), in gallons per hour

S = Length of pipe tested, in feet

D = Nominal Diameter of pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

When testing against existing closed valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size may be allowed at the discretion of the City.

Each valved section of pipe shall be slowly filled with water and the specified test pressure (measured at the lowest point of elevation) shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges and all necessary apparatus and labor shall be furnished by the contractor. Gauges and measuring devices shall be approved by the City. Before applying the specified test pressure all air shall be expelled from the pipe. Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the contractor with sound material including any existing pipe or appurtenances that are leaking and were included in the test section. After all visible leaks have been repaired, the pressure test shall be conducted again. Should testing show a leakage rate in excess of the rates above, the pipeline shall not be accepted. The pipeline shall be repaired, re-chlorinated to meet the criteria and retested as described in this section until it meets the test requirements and is accepted by the City.

### **Disinfection**

The contractor will be required to chlorinate every new water main installed. The chlorine must remain in the main for a contact period of not less than 24 hours. The chlorine count must be at least 50 parts per million (PPM) after 24-hours to pass. If the PPM are not a minimum of 50, the contractor shall re-chlorinate the water main. This procedure will continue until the minimum requirements of this section are met.

### **Flushing the Main**

The entire line shall be flushed after the specified contact time, and after passing the disinfection test. Such flushing shall continue until the water is clear and meets the chlorine content of the existing line. The entire line, including hydrant leads, branch lines and dead-end mains shall be flushed. The discharge of flushed water shall be accomplished such that no erosion will occur and with no harm to fish, animals, or plants. Procedures for discharge will be subject to the review of the City.

## **Bacteriological & Turbidity Test**

Water from all new mains must successfully pass a bacteriological and turbidity test in accordance with the requirements of the City before the main is placed in service. A minimum 24 hours is required to receive bacteriological test results and may take as long as 72 hours. No bacteriological tests will be taken on Fridays or Weekends. When unsatisfactory results are obtained from bacteriological tests, the City may direct the contractor to re-chlorinate the main. When re-chlorination is deemed necessary, it will be done by the contractor, at his expense, under the City's supervision. After re-chlorination, the bacteriological test shall be performed again, and the procedure repeated until the test passes.

Testing must be scheduled with the Engineering Division at least one week in advance.

## **8.4 Materials**

### **8.4.1 General**

Only polyvinyl chloride PVC is approved for water main installations. All materials furnished shall be new and undamaged. (Lines 16 inches in diameter and larger may at the discretion of the City, be ductile iron pipe.)

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS. The City reserves the right to direct or deny the use of certain types of materials in specific circumstances. All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality for the work. The presence of any defects in any materials may constitute sufficient cause for rejection of the pipe or appurtenances. Rejected materials shall be removed from the work site unless otherwise permitted by the City.

All references cited in these STANDARDS AND SPECIFICATIONS as the Denver Water Board Specifications shall meet the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

### **8.4.2 Pipe**

#### **Ductile Iron Pipe (DIP)**

- **Class.** All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151. Pipe furnished under this specification shall conform to the following thickness classes: Special Class 50 (6")
- **Joint Type.** The joint type shall be "push-on, single-gasket" type conforming with applicable requirements of AWWA Standard C-111. Joint types other than "push-on, single-gasket" are acceptable only if specifically approved by the City in writing.
- **Length.** Pipe shall have normal laying length of either 18 feet or 20 feet. Random lengths shall not be acceptable.
- **Iron.** Iron used in the manufacture of pipe shall have 60/42/10 physicals in accordance with AWWA C-151.
- **Cement Mortar Linings.** Pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104.
- **Pipe Marking.** The weight, class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, the year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

### **Polyvinyl Chloride Pipe (PVC)**

- **PVC Pipe.** All PVC pipe shall meet the requirements of AWWA Specification C-900 (for 4" - 12" pipe) or C-905 (for 14" - 48" pipe), and shall be Class 305 (DR 14 for 4" -12" pipe), or Class 235(DR 18 for 14"- 24" pipe), or Class 165 (DR25 30" and larger).
- **Rubber Ring.** All pipe shall be suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the requirements of AWWA Specification C-900 and C-905.
- **Lengths.** Standard laying lengths shall be twenty feet (20') for all sizes. Random lengths shall not be acceptable.
- **Manufacturer Information.** Each length of pipe shall bear the date manufactured, type, grade, length, manufacturer's name, and NSF seal of approval.
- **Pipe Joints.** Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.
- **Solvent Cement Joints.** Solvent cement joints are strictly prohibited.
- **Certified Statement.** The manufacturer shall furnish a certified statement that all of the specified tests and inspections have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City upon request.

### **Fittings**

All fittings shall be manufactured in accordance with the following AWWA Standards:

- C-104, "Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings for Water"
- C-111, "Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure for Pipe and Fittings" The following are additional requirements or exceptions to the standards mentioned above:

All fittings shall be furnished with a cement mortar lining of standard thickness as defined in the referenced specifications and given a seal coat of bituminous material. All fittings shall be furnished with mechanical joint or flanged ends conforming to the referenced specifications and in addition, the tee-head mechanical joint bolts and hexagon nuts shall be fabricated from a high strength, low alloy steel known in the industry as "Cor-Ten" or approved equal. Mechanical joint anchoring fittings (swivel) as approved by the City, in writing, may also be used.

Fittings shall have pressure ratings of 250 PSI for pipes larger than 24" diameter and 350 PSI for pipes that are 24" diameter and smaller and shall conform to the dimensions and weights shown in the tables of the referenced specifications. All fittings shall be made from gray iron or ductile iron. The manufacturer shall prepare a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City upon request.

### 8.4.3 Valves

#### **General**

All valves shall open left (counterclockwise). All valves shall have a 2-inch-square operating nut. The extension stem shall be mechanically connected to the operating nut. All valves shall have a mechanical joint end and shall be delivered complete with bolts, glands, and rubber gaskets.

End connections shall be furnished with all necessary joint materials and shall have full opening flow way of equal diameter to the nominal size of the connecting pipe.

#### **Gate Valves**

Gate valves shall be iron body, resilient-seated, gate valves with non-rising bronze stems with design, construction and pressure rating conforming to AWWA Specifications C-509 or C515, with modifications specified herein. Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure and in full open position.

All ferrous internal and external surfaces of the valves shall be coated to a minimum thickness of four mils. The coating shall be a two-part thermosetting epoxy suitable for field overcoating and for touch-up with the same coating material without special surface preparation. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings when requested by the City. The coating shall have a successful record of performance in valves, pipe, or other fittings for a minimum of ten years. The resilient seat gate valves shall have external break-off capabilities for over-torquing and positive stop to prevent over compression.

All bolts and nuts used in conjunction with valves shall be stainless steel, "Cor-Ten" or approved equal. All gate valves shall be installed with a valve box meeting the material specifications of these STANDARDS AND SPECIFICATIONS.

#### **Butterfly Valves**

All butterfly valves shall be installed in a vault in accordance with **Standard Drawing W - 11**. All valves having a nominal diameter greater than 12 inches shall be geared butterfly valves designed for direct burial and shall conform to AWWA Specification C-504, Class 150-B. Valves shall be tight closing rubber seat type with rubber seats which are bonded to the valve body. No metal-to-metal sealing surfaces will be permitted. Valves shall be bubble tight at 150.

PSI-rated pressure with flow in either direction. Valve discs shall rotate 90 degrees from the full open position to the shut-tight position. Valve bearings shall be sleeve-type corrosion-resistant and self-lubricating with the load not to exceed 2,500 PSI. All surfaces of the valve shall be clean, dry, and free from grease before painting. All surfaces, exterior and interior, shall be evenly coated with asphalt varnish in accordance with Federal Specification TT-V-51a or Joint Army-Navy Specification JAN-P-450. The coating shall have a successful record of performance in valves for a minimum of ten years.

#### **Valve Boxes**

- **Manufacturer.** Valve box parts for 3" and larger valves shall be Tyler type, series 6860 or approved equal conforming with ASTM A48 Class 20A and made of gray cast-iron, buffalo-type with No. 160 large, oval base.
- **Adjustment for shaft.** A 5-1/4-inch screw-type shaft shall be adjustable from 45 inches to 60 inches.
- **Vertical Adjustment.** Valve boxes shall be considered integral units and shall have at least 6 inches adjustment above and below the specified depth of cover over the pipe.
- **Valve Box Lids.** Valve box lids shall be marked with the word "WATER" and shall have a lip or flange extending into the valve box shaft.

- **Slip-type Boxes.** No slip-type boxes will be allowed. The valve box shall be of a design which will not transmit shock or stress to the valve.

#### 8.4.4 Fire Hydrants

Hydrants will be Mueller Model Super Centurion 250 or City approved equal with the following options:

- Bronze to bronze seating.
- Oil cup reservoir.
- Bronze "safety sleeve" stem coupling.
- Bronze operating nut.
- Epoxy-coated upper and lower washer assembly.
- **Sizing.** Hydrants shall have a 5-1/4-inch main opening with a 6-inch mechanical joint end. Each hydrant shall be equipped with one 4-1/2-inch pumper nozzle and two 2-1/2-inch hose nozzles with national standard threads.
- **Open.** Fire hydrants shall open right (clockwise).
- **Depth and Flange Height.** Fire hydrants shall be installed so that the traffic flange is at or within 2 inches above finished grade. Fire hydrants shall be designed for 5-foot pipe bury.
- **Finish.** Hydrants shall be thoroughly cleaned and then painted with a prime coat followed by one shop coat of federal safety yellow, #916 or approved equal. Care shall be taken when handling hydrants to protect the paint. Whenever the paint is chipped or scratched, the contractor shall repaint the hydrant. A traffic break-away feature shall be incorporated into the barrel of the hydrant at the ground line.
- **Operating Nut.** The operating nut shall be National Standard pentagon measuring 1-1/2 inches from point to opposite flat. Nozzle covers shall have the same size and shape nut as the operating nut and shall be attached by chain to the hydrant body. Any product that must be modified to meet these STANDARDS AND SPECIFICATIONS shall be accompanied by a certification signed by a company officer that states that these changes have been incorporated into the product furnished and in addition, the hydrant shall be tagged by the manufacturer to assure that all the above options were included.

#### 8.4.5 Blow-Offs

- **Material.** Blow-offs shall be fabricated from 2-inch brass pipe with a 2-inch stop and waste on the connecting pipe.
- **Valve.** The valve shall be iron-bodied bronze mounted with a 2-inch square operating nut complete with valve box.
- **Riser Pipe.** The freeze-proof riser pipe shall be provided with drain pit and well-greased plug. The discharge pipe shall terminate above the vault to prevent a backflow situation.
- **Large Mains.** The standard required blow-off for 16-inch and larger mains shall be a 6-inch or larger pipe with a gate valve meeting the material requirements of these STANDARDS AND SPECIFICATION and a manhole meeting the material requirements of these STANDARDS AND SPECIFICATIONS. See **Standard Drawing W-22**.

#### 8.4.6 Manholes

##### General

- **Material Standards.** Manholes, reducing sections, ladder rungs and traffic lids shall be precast and conform to ASTM Standard Designation C-478.
- **Lid Loading.** All traffic lids shall be designed for AASHTO H-20 traffic loading.
- **Ladder Rungs.** All ladder rungs or manhole steps shall be cast into the manhole barrel when the manhole barrel is poured.
- **Prohibited Sections.** Concentric reducing sections shall not be used.
- **Extension Collars.** Concrete extension collars shall be used to adjust the manhole ring and cover to approved street or ground surface elevation.
- **Locking Lids.** All manholes not within the Right of Way shall have locking lids. All valves in manholes shall be operable from above ground.
- **Concrete.** Concrete used in the manufacturing or construction of manholes shall be a minimum of 4,000 psi concrete in accordance with **Chapter 15 – Street Construction Standards** of these STANDARDS AND SPECIFICATIONS.

##### Requirements

All cast iron manhole rings and covers and other iron castings shall conform to the requirements of AASHTO M105/ASTM A48 Class 35B. Ductile Iron castings shall conform to the requirements of ASTM A536. All castings shall conform to Federal Specification RR-F-621E, for shape and dimension required. Castings shall be free from sand, blowholes, shrinkage, cracks, and other cold shuts and be well cleaned by shot blasting. Runners, risers, fins and other cast-on pieces shall be removed from the castings and ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.

- **Size.** Manhole frame or ring dimensions shall be 24” diameter for manholes and 36” diameter for valve vaults, 8” tall or as otherwise approved.
- **Weight.** Cast iron ring and covers shall have a combined weight of not less than 365 pounds.
- **Fittings.** Fittings shall be hot dipped, factory applied, water base, asphalt paint to form a firm and tenacious coating.
- Acceptable product is East Jordan Iron Works #2405A, Product #240568 (water vault only) or approved equal.

##### Manhole Base Slabs and Base Beams

When required, manhole base beams shall be precast, reinforced concrete.

- **Base Beam Size.** The beams shall be 12 inches wide by 9 inches deep by 8 feet long.
- **Reinforcement.** The reinforcement shall consist of three No. 5 bars longitudinally and No. 4 bars at 12-inch centers transversely.

- **Manhole Base Slabs.** Manhole base slabs may be poured in place or precast. The slab shall be designed to uniformly support AASHTO H-20 traffic loading and any earth loading. The minimum slab thickness shall be 8 inches. The minimum reinforcement in the base slab shall conform to the **Standard Drawing ST - 1**.

### **Joint Material**

Joint material used to set barrel sections shall be a flexible butyl resin joint sealing compound meeting Federal specifications SS-S-00210(210-A) and AASHTO M 198-B.

### **Mortar**

- **Mortar Design.** Mortar used in repair of precast sections and for grouting joints shall be composed of one-part Portland cement and not more than three nor less than two parts of fine aggregate.
- **Unacceptable Materials.** Hydrated lime or masonry cement shall not be used.
- **Portland Cement.** Portland cement shall meet the requirements of ASTM C-250, Type II.
- **Aggregate.** Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a No. 4 sieve and a maximum of 7 percent passing a No. 100 sieve.

### **8.4.7 Vaults**

- **Vaults with Electricity.** All vaults requiring electricity shall have 110/120 volt, watertight outlets and light fixtures. All outlets shall be GFI and conform to National Electrical Code.
- **Light Switch Location.** The light switch shall also be connected to the ventilation fan and be located such that it can be operated without entering the vault. Vaults shall also be equipped with a sump pump, ventilation fan, sump hole and dehumidifier meeting the following specifications, when required by the City.
- **Sump Pumps.** Sump pumps shall be bronze mounted with built-in automatic float controls with a 1/3-horsepower motor designed to operate on 115 volts. A union shall be installed in the discharge line between the pump and the check valve to aid in the removal of the pump for repair or replacement.
- **Ventilation Fans.** Ventilation fans shall be Dayton Model Number 2C889 or City approved equal with a 9-inch wheel. The discharge of the vent fan shall be totally enclosed and attached to the opening of the exhaust vent pipe.
- **De-Humidifiers.** De-humidifiers shall be EBCO Model 00-200-1 or approved equal rated at 13 pints per 24 hours and designed to run on 115 volts. Concrete floors shall have 12-inch diameter by 18-inch-deep sump holes in the opposite corner from the manhole opening.

The Engineer shall submit construction drawings along with design calculations, which include the electric layout of the vault, to the City for written approval prior to the installation.

### **8.4.8 Vent Pipes**

Above-ground vent pipe shall be 4-inch nominal diameter galvanized steel pipe, Grade 40, which conforms to ASTM Standard Designation A-53. The vent screen shall be a 3/4-inch, No. 9-11 flattened, expanded galvanized metal screen. Below-ground vent pipes shall be 6-inch diameter, Scheduled 40 PVC with glued joints. A PVC glued joint by standard

pipe thread female adapter shall be used to connect the steel pipe to the PVC pipe at ground level. The vent pipe shall be prime coated and painted Fox Valley Systems “Electric Blue” with a louvered top.

#### 8.4.9 Service Connections

##### Pipe

Acceptable materials for a service line are seamless copper tube or ductile iron pipe. All service pipes shall conform to one of the following specifications. Plastic pipe is not an acceptable service pipe material.

- Seamless copper tube designated as "Type K" (soft) in the industry shall be used for service lines 3/4-inch through 2 inches.
- PVC C-900 pipe conforming to these STANDARDS AND SPECIFICATIONS shall be used for 3-inch service lines and all service lines larger than 4 inches.

##### Saddles

For all taps requiring saddles, the saddles shall be CC thread in accordance with AWWA C-800, epoxy coated body with stainless steel double straps. Saddles for PVC pipe shall be full-support, wide-bearing type.

##### Curb Stops

Curb stops shall be **Mueller Company Mark II Oriseal, Jones, Ford ball valves McDonald ball valves** or approved equal. 1-1/2 inch and 2-inch curb stops shall have compression fittings.

Curb Stop Boxes shall be **Tyler, 6870 series**, 5-foot (5') extension, size 145R with 4 1/4" shaft and bolt down lid.

##### Tapping Sleeve and Valve

ALL TAPPING SLEEVES shall be approved by the Public Works Department on a “case by case” basis. General Guidelines include:

- Cast or Ductile Iron
  - Full body Mechanical Joint (MJ) cast or Ductile Iron Tapping Sleeves
  - Acceptable models include Mueller H-615, Waterous Series 1004 or 2800, US Pipe T-9, Tyler/Union Compact (up to 12")
- PVC or AC
  - Fabricated Stainless Steel with Stainless flange.
  - A flange insulator kit between the valve and tee is required.
  - Stainless Steel bolts on the tapping sleeve side.
  - Triangular sidebar style only. No repair clamp style will be allowed.
  - Rated for 250 PSI minimum (4"-12")
  - 200 PSI for larger sizes.



- Acceptable models include JCM 432 or 452, Romac SST III or STS 400, Mueller H-304, Smith Blair 665, Ford FTSS
- Tapping Valves
  - Re-sealant seat, cast iron body, fully bronze mounted with non-rising stem and materials shall be in conformance with the Safe Drinking Water Act and shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with ANSI/NSF Standard 61. Tapping valve materials not specifically specified in this section shall meet the requirements of AWWA C509.

**Corporation Stops**

All corporation stops and threaded brass fittings shall be in accordance with ASTM-B62-63 (common trade name 85-5-5-5). All threads shall conform to AWWA C-800-66.

Acceptable corporation stops are:

**Table 8.6: Acceptable Corporation Stops**

3/4"	1"	1-1/2"	2"
Ford: F-1000-3-G	Ford: F-1000-4-G	Ford: FB-1000-6-G	Ford: FB-1000-7-G
McDonald: 4701BQ	McDonald: 4701BQ	McDonald: 4701BQ	McDonald: 4701BQ
Mueller: H-15008	Mueller: H-15008	Mueller: H-15013	Mueller: H-15013
Jones: J3401SG	Jones: J3401SG	Jones: J1937SG	Jones: J1937SG
McDonald - Q series compression end	Mueller - 110 compression end	Ford - Quick Joint compression end	

**Stop & Waste**

Stop and wastes for use in blow off assemblies shall be either Mueller Company Mark II ORISEAL H-10284 with A#B-20299 2-inch square nut adapter or FORD B11 777SW with a QT67 2-inch square nut adapter.

**Compression Couplings**

Compression couplings where allowed shall be either:

**Table 8.7: Compression Couplings**

Compression Couplings
Mueller: H-15403
Ford: C44
McDonald: 4758-Q
Jones: J2609SG

**8.4.10 Encasement**

**Concrete**

All concrete shall be a minimum of Class B and shall conform to City standards for Portland cement concrete work as specified in **Chapter 14 – Trenching, Backfilling and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS. All concrete encasements shall be a minimum of 6 inches thick from outside of pipe to outside of encasement.

**Polyethylene Wrap**

- **Manufacturer.** Polyethylene encasement material shall be a minimum of 8 mils thick and shall be Scotchrap No. 50 (polyvinyl) or approved equal.
- **Standard.** All polyethylene encasement material shall be manufactured in accordance with ANSI/AWWA Standard C-105/A21.5. The raw materials used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designations D-1250.

**8.4.11 Meters**

**General**

All water meters shall be Badger or City approved equal. Approval of the meter by size, type and brand shall be obtained from the City prior to purchasing the meter. All meters shall be pre-tested by the Public Works Department prior to installing the meter in the meter setting to assure compliance with current “Remote Read” systems in use by the City.

**Magnetic Drive Displacement Type Water Meters**

All magnetic drive displacement-type meters shall conform to AWWA C700 and C710.

**Compound & Turbine Meters**

Compound meters shall conform to AWWA 702, AWWA 701 for Turbine meters, and C703 for Fire service meters.

**Meter Bypass Line**

Bypass lines shall contain an independent control valve and shall contain no tees, plugs, or other outlets through which water could be withdrawn.



**Meter Check Valves**

- **Conformance.** Swing-check valves shall be manufactured in accordance with AWWA Standard C-508, "Swing-check Valves for Ordinary Waterworks Service".
- **Valves.** Valves shall be iron body and the disc shall be swing type.
- **Working Pressure.** The working pressure for all sizes shall be 150 psig.

Bolts and hex nuts used for attaching top cap to the body shall be the manufacturer's standard, fabricated from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

Check valves shall be furnished with flanged ends. The size and drilling shall be in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. Ferrous surfaces except machined or bearing surfaces shall be prepared in accordance with SSPC-SP-10. These surfaces shall then be coated with liquid epoxy in two or more uniform coats or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils in accordance with AWWA C550.

A copy of the Certification including compliance with NSF/ANSI 61 shall be provided to the City.

**Valves for Use with 1-1/2 Inch and 2 Inch Meters**

Ball valves 2 inches and smaller to be used with copper service pipe shall be brass with non-rising stems and solid wedge disc, manufactured in accordance with ASTM Specification B-62 and Federal Specification W.W.-V54 Class A 125 PSI W.S.P., 200 PSI, W.O.G.

All other gate valves shall conform to these STANDARDS AND SPECIFICATIONS.

**Meter Yokes (Line Setters)**

Meter yokes shall conform to the Denver Water Board Material Specifications. Copper setters 12" x 3/4" with locking nut, 3/4" conductor compression connection ends. See **Standard Drawings W-8 to W-10**.

Acceptable Setters are:

**Table 8.8: Acceptable Setters**

3/4"	1"
Ford – VH83-09W-44- 33-G	Ford – VH84-12W-44- 44-G
McDonald – 31-309- WCTT33	McDonald – 31-312- WCTT44
Mueller – B-2474-6A	Mueller – B-2474-6A

**Valve and Meter Supports**

Meter supports shall be in conformance with **Standard Drawing W-12**.

### **Meter Pits**

- **Residential Meter Pit.** Residential meter pits shall be constructed of modified high-density polyethylene with a nominal wall thickness of (minimum) .50", shall have protected UV degradation with a low temperature brittleness which exceeds -76° F, a thermal transfer rate of .40, smooth walled (inside and out) and shall have a vertical crush rating which exceeds 20,000 pounds. The meter pit covers shall be airtight, shall have a cast iron, cap-type, top lid with a locking screw forged pentagon bolt. The body of the meter pit lid shall be aluminum.
- **Commercial Meter Pit.** Commercial meter pits shall be constructed of modified high-density polyethylene with a nominal wall thickness of (minimum) .50", shall have protected UV degradation with a low temperature brittleness which exceeds -76° F, a thermal transfer rate of .40, smooth walled (inside and out) and shall have a vertical crush rating which exceeds 20,000 pounds. The meter pit covers shall be airtight, shall have a cast iron, cap-type, top lid with a locking screw forged pentagon bolt. The body of the meter pit lid shall be aluminum.

### **8.4.12 Pressure Reducing Valve**

- **Manufacturer.** All pressure reducing valves shall be Singer approved equal. The valve shall be designed to reduce a high upstream pressure to a constant downstream pressure by way of a pilot control system. The pilot system shall control the main valve which shall be single-seated, hydraulically-operated, diaphragm, globe-valve type. The valve seats shall be bronze except when subjected to sustained high velocities through the valve, the manufacturer recommends stainless steel seats. An indicator rod or flow tube shall be furnished as an integral part of the valve to show the position of the valve.
- **Standard.** The valve shall be cast-iron body. Flanges and covers shall conform to ASTM Standard Designation A-50. Bronze castings or parts of internal trim shall conform to ASTM Standard B-61. All valves shall be furnished with flanged ends and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA Standard C-115.
- **Pilot Valve.** The pilot valve for controlling operation of the main valve shall be single-seated, diaphragm-operated, and spring-loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is under pressure. The pilot control system shall be cast bronzed ASTM B-62 with 303 stainless steel trim.
- **Needle Valve.** The needle valve shall be all bronze and included with the main valve to control the speed of piston travel.

### **8.4.13 Combination Air Vacuum /Release Valves**

Air vacuum release valves shall be in conformance with AWWA C512.

### **8.4.14 Restraining System**

#### **Harness Rods**

Harness rods shall be mild steel, ASTM Standard Designation A-36. Hex nuts shall be ASTM Standard Designation A-307, Grade A or B, hexagon heavy series.

#### **Mechanical Joint Restraint**

Mechanical joint restraint can be accomplished by the use of a Megalug restraining system, Uniflange joint restraints or approved equal.

- **Glands.** Glands shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53, latest revision. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure that the proper torque is applied to the bolts. In no case shall the twist-off bolts be torqued beyond 90 ft. lbs.
- **Joint Restraint Device.** The mechanical joint restraint device shall have a working pressure of at least 250 PSI, with a minimum safety factor of 2:1.

### **Concrete Reinforcement**

All deformed reinforcing in concrete shall be steel bars and conform to ASTM Standards A-615, Grade 60 or ASTM Standard A-671, Grade 60 or welded wire steel fabric shall conform to ASTM Standard A-185.

### **Backflow Prevention Device**

Backflow prevention devices shall conform to the requirements of AWWA C511.

### **Repair Clamps**

Repair clamps shall be made of stainless-steel bands, lugs, nuts, and bolts. Gaskets shall be gridded virgin GPR compounded for water service and meeting the requirements of ASTM D 2000-90M 4AA607. Prior to construction, a submittal to the City is required showing repair clamp design and make for specific approval prior to installation.