

**SECTION 400**  
**WATER SYSTEMS**

(revised 12.13.2021 to include Cross Connection details)

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## SECTION 400 WATER SUPPLY FACILITIES

### 401.0 GENERAL CONDITIONS

Refer to Section 100 TITLE, SCOPE AND GENERAL CONDITIONS of these CONSTRUCTION STANDARDS & SPECIFICATIONS for additional requirements that apply to all projects within the Independence Water & Sanitation District (the “District”).

#### 401.1 Cross Connections – Cross Connections Shall Not Be Allowed

##### Purpose

The purpose of this Section is to protect the public water system from contaminants or pollutants that could enter the distribution system by backflow from a customer’s water supply system through the service connection.

##### Authority

The authority to implement this program is contained in the following statute, legislation and regulations and acts:

- a. Article 1-114 and Article 1-114.1 of Title 25 of the Colorado Revised Statutes (CRS)
- b. Section 39 of 5 CCR 1002-11, Colorado Primary Drinking Water Regulations
- c. Colorado Plumbing Code

The public water system shall have the authority to survey all service connections within the distribution system to determine if the connection is a cross-connection.

The public water system shall have the authority to control all service connections within the distribution system if the connection is a cross-connection.

The public water system may control any service connections within the distribution system in lieu of a survey as long as the service connection is controlled with an air gap or reduced pressure zone backflow prevention assembly.

The public water system may collect fees for the administration of this program.

The public water system shall maintain records of cross-connection surveys and the installation, testing and repair of all backflow prevention assemblies installed for containment and containment by isolation purposes.

Except as otherwise provided herein, the public water system shall administer, implement and enforce the provisions of this Ordinance.

##### Applicability

This Section applies to all commercial, industrial and multi-family residential service connections within the public water system and to any persons outside the Independence Community who are, by contract or agreement with the public water system, users of the public water system. This Section does not apply to single-family-residential service connections unless the public water system becomes aware of a cross connection at the single-family connection.

## Definitions

- a. “ACTIVE DATE” means the first day that a backflow prevention assembly or backflow prevention method is used to control a cross-connection in each calendar year.
- b. “AIR GAP” is a physical separation between the free flowing discharge end of a potable water supply pipeline and an open or non-pressure receiving vessel installed in accordance with standard ASME A112.1.2.
- c. “BACKFLOW” means the undesirable reversal of flow of water or mixtures of water and other liquids, gases or other substances into the public water systems distribution system from any source or sources other than its intended source.
- d. “BACKFLOW CONTAMINATION EVENT” means backflow into a public water system from an uncontrolled cross connection such that the water quality no longer meets the Colorado Primary Drinking Water Regulations or presents an immediate health and/or safety risk to the public.
- e. “BACKFLOW PREVENTION ASSEMBLY” means any mechanical assembly installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the mechanical assembly is appropriate for the identified contaminant at the cross connection and is an in-line field-testable assembly.
- f. “BACKFLOW PREVENTION METHOD” means any method and/or non-testable device installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the method or non-testable device is appropriate for the identified contaminant at the cross connection.
- g. “CERTIFIED CROSS-CONNECTION CONTROL TECHNICIAN” means a person who possesses a valid Backflow Prevention Assembly Tester certification from one of the following approved organizations: American Society of Sanitary Engineering (ASSE) or the American Backflow Prevention Association (ABPA). If a certification has expired, the certification is invalid.
- h. “CONTAINMENT” means the installation of a backflow prevention assembly or a backflow prevention method at any connection to the public water system that supplies an auxiliary water system, location, facility, or area such that backflow from a cross connection into the public water system is prevented.
- i. “CONTAINMENT BY ISOLATION” means the installation of backflow prevention assemblies or backflow prevention methods at all cross connections identified within a customer’s water system such that backflow from a cross connection into the public water system is prevented.
- j. “CONTROLLED” means having a properly installed, maintained, and tested or inspected backflow prevention assembly or backflow prevention method that prevents backflow through a cross connection.
- k. “CROSS CONNECTION” means any connection that could allow any water, fluid, or gas such that the water quality could present an unacceptable health and/or safety risk to the public, to flow from any pipe, plumbing fixture, or a customer’s water system into a public water system’s distribution system or any other part of the public water system through backflow.

- l. “MULTI-FAMILY” means a single residential connection to the public water system’s distribution system from which two or more separate dwelling units are supplied water.
- m. “SINGLE-FAMILY” means:
  - i. A single dwelling which is occupied by a single family and is supplied by a separate service line; or
  - ii. A single dwelling comprised of multiple living units where each living unit is supplied by a separate service line.
- n. “UNCONTROLLED” means not having a properly installed and maintained and tested or inspected backflow prevention assembly or backflow prevention method, or the backflow prevention assembly or backflow prevention method does not prevent backflow through a cross connection.
- o. “WATER SUPPLY SYSTEM” means a water distribution system, piping, connection fittings, valves and appurtenances within a building, structure, or premises. Water supply systems are also referred to commonly as premise plumbing systems.

#### Requirements

- a. Commercial, industrial and multi-family service connections shall be subject to a survey for cross connections. If a cross connection has been identified an appropriate backflow prevention assembly and or method shall be installed at the customer’s water service connection within 120 days of its discovery. The assembly shall be installed downstream of the water meter or as close to that location as deemed practical by the public water system. If the assembly or method cannot be installed within 120 days the public water system must take action to control or remove the cross connection, suspended service to the cross connection or receive an alternative compliance schedule from the Colorado Department of Public Health and Environment.
- b. In no case shall it be permissible to have connections or tees between the meter and the containment backflow prevention assembly.
  - i. In instances where a reduced pressure principle backflow preventer cannot be installed, the owner must install approved backflow prevention devices or methods at all cross-connections within the owner’s plumbing system.
- c. Backflow prevention assemblies and methods shall be installed in a location which provides access for maintenance, testing and repair.
- d. Reduced pressure principle backflow preventers shall not be installed in a manner subject to flooding.
- e. Provisions shall be made to provide adequate drainage from the discharge of water from reduced pressure principle backflow prevention assemblies. Such discharge shall be conveyed in a manner which does not impact waters of the state.

- f. All assemblies and methods shall be protected to prevent freezing. Those assemblies and methods used for seasonal services may be removed in lieu of being protected from freezing. The assemblies and methods must be reinstalled and then tested by a certified cross-connection control technician upon reinstallation.
- g. Where a backflow prevention assembly or method is installed on a water supply system using storage water heating equipment such that thermal expansion causes an increase in pressure, a device for controlling pressure shall be installed.
- h. All backflow prevention assemblies shall be tested at the time of installation and on an annual schedule thereafter. Such tests must be conducted by a Certified Cross-Connection Control Technician.
- i. The public water system shall require inspection, testing, maintenance and as needed repairs and replacement of all backflow prevention assemblies and methods, and of all required installations within the owner's plumbing system in the cases where containment assemblies and or methods cannot be installed.
- j. All costs for design, installation, maintenance, testing and as needed repair and replacement are to be borne by the customer.
- k. No grandfather clauses exist except for fire sprinkler systems where the installation of a backflow prevention assembly or method will compromise the integrity of the fire sprinkler system.
- l. For new buildings, all building plans must be submitted to the public water system and approved prior to the issuance of water service. Building plans must show:
  - i. Water service type, size and location
  - ii. Meter size and location
  - iii. Backflow prevention assembly size, type and location
  - iv. Fire sprinkler system(s) service line, size and type of backflow prevention assembly.
    - 1. All fire sprinkling lines shall have a minimum protection of an approved double check valve assembly for containment of the system.
    - 2. All glycol (ethylene or propylene), or antifreeze systems shall have an approved reduced pressure principle backflow preventer for containment.
    - 3. Dry fire systems shall have an approved double check valve assembly installed upstream of the air pressure valve.
    - 4. In cases where the installation of a backflow prevention assembly or method will compromise the integrity of the fire sprinkler system the public water system can chose to not require the backflow protection. The public water system will measure chlorine residual at location representative of the service connection once a month and perform periodic bacteriological testing at the site. If the public water system suspects water

quality issues the public water system will evaluate the practicability of requiring that the fire sprinkler system be flushed periodically.

#### Inspection, Testing and Repair

- a. Backflow prevention assemblies or methods shall be tested by a Certified Cross-Connection Control Technician upon installation and tested at least annually, thereafter. The tests shall be made at the expense of the customer.
  - i. Any backflow prevention assemblies or methods that are non-testable, shall be inspected at least once annually by a certified cross-connection control technician. The inspections shall be made at the expense of the customer.
- b. As necessary, backflow prevention assemblies or methods shall be repaired and retested or replaced and tested at the expense of the customer whenever the assemblies or methods are found to be defective.
- c. Testing gauges shall be tested and calibrated for accuracy at least once annually.

#### Reporting and Recordkeeping

- a. Copies of records of test reports, repairs and retests, or replacements shall be kept by the customer for a minimum of three (3) years.
- b. Copies of records of test reports, repairs and retests shall be submitted to the public water system by mail, facsimile or e-mail by the testing company or testing technician.
- c. Information on test reports shall include, but may not be limited to,
  - i. Assembly or method type
  - ii. Assembly or method location
  - iii. Assembly make, model and serial number
  - iv. Assembly size
  - v. Test date; and
  - vi. Test results including all results that would justify a pass or fail outcome
  - vii. Certified cross-connection control technician certification agency
  - viii. Technician's certification number
  - ix. Technician's certification expiration date
  - x. Test kit manufacturer, model and serial number
  - xi. Test kit calibration date



#### Right of entry

- a. A properly credentialed representative of the public water system shall have the right of entry to survey any and all buildings and premises for the presence of cross-connections for possible contamination risk and for determining compliance with this section. This right of entry shall be a condition of water service in order to protect the health, safety and welfare of customers throughout the public water system's distribution system.

#### Compliance

- a. Customers shall cooperate with the installation, inspection, testing, maintenance, and as needed repair and replacement of backflow prevention assemblies and with the survey process. For any identified uncontrolled cross-connections, the public water system shall complete one of the following actions within 120 days of its discovery:
  - i. Control the cross connection
  - ii. Remove the cross connection
  - iii. Suspend service to the cross connection
- b. The public water system shall give notice in writing to any owner whose plumbing system has been found to present a risk to the public water system's distribution system through an uncontrolled cross connection. The notice and order shall state that the owner must install a backflow prevention assembly or method at each service connection to the owner's premises to contain the water service. The notice and order will give a date by which the owner must comply.
  - i. In instances where a backflow prevention assembly or method cannot be installed, the owner must install approved backflow prevention assemblies or methods at all cross-connections within the owner's water supply system. The notice and order will give a date by which the owner must comply.

#### Violations and Penalties.

- a. Any violation of the provisions of this ordinance, shall, upon conviction be punishable as provided in all applicable statutes, laws, and regulations.

#### Conflict with other codes.

- a. If a dispute or conflict arises between the Colorado Plumbing Code as adopted herein, and any plumbing, mechanical, building, electrical, fire or other code adopted by the State, then the most stringent provisions of each respective code shall prevail.

## 410.0 DESIGN CRITERIA

### 410.1 General

All potable water distribution systems shall comply with the requirements of the CONSTRUCTION STANDARDS & SPECIFICATIONS for water main and service line construction and may include special criteria established by the District for the overall hydraulics of the water utility system. Special criteria shall be outlined at pre-design meetings, as determined necessary by the District. The requirements set forth in the latest edition of the *Denver Water Board Specifications* shall apply for information omitted in these CONSTRUCTION STANDARDS & SPECIFICATIONS.

These CONSTRUCTION STANDARDS & SPECIFICATIONS also cover design and construction of waterlines for the transmission and distribution of reuse water (tertiary treated effluent) and for the supply of raw water (water in its natural state, prior to any treatment and taken from a natural or impounded body of water) to maintain ponds as visual amenities. The area wetted with reuse water shall be designed to avoid picnic tables, drinking fountains and playground equipment. Reuse and raw water are intended for non-potable uses such as landscape irrigation, and are not intended for use on residential property and other areas with a potable water supply.

These CONSTRUCTION STANDARDS & SPECIFICATIONS shall apply to all reuse waterlines from the connection to the District's tertiary treated effluent transmission main or existing reuse lateral to the points of use or application. Design of irrigation systems connected to the reuse water distribution system shall be in accordance with the applicable sub-sections of Section 1000 LANDSCAPING STANDARDS FOR DEVELOPMENT PROJECTS of these CONSTRUCTION STANDARDS & SPECIFICATIONS and shall include backflow prevention. Unless otherwise specified, the provisions of Section 370.00 RESTORATION AND CLEANUP of these CONSTRUCTION

STANDARDS & SPECIFICATIONS shall apply to reuse and raw waterline installation.

**411.0 Design Flow Requirements**

**411.1 Potable Water Distribution System**

The design of the potable water distribution system shall be based on the following:

**UNIT WATER DEMANDS FOR FUTURE LAND USE**

<b>Land Type</b>	<b>Avg. Demand</b>	<b>Max. Day/Avg. Day</b>	<b>Max. Hr./Max. Day</b>
Residential	145 GPCD*	3.05	1.9
Commercial	1651 GPD/Acre	2.00	1.9
Industrial	1651 GPD/Acre	1.32	1.9
Park	3060 GPD/Acre	3.90	1.9

*\*Gallons Per Capita/Day*

Minimum residential population density, household density and land usage shall be as noted on the approved PUD and/or Plat, or as determined by the Elbert County Director of Planning. Fire flows may be calculated from more than one hydrant, providing the hydrants used are directly accessible to all possible fire locations in the area served and not at the end of cul-de-sacs. Fire flows required shall be in accordance with the appropriate fire district:

**411.2 Non-Potable Water Distribution System**

Where reuse water is to be supplied at the necessary peak application rate, under system pressure, directly to the sprinkler heads, the following design criteria shall apply:

- A. Annual Irrigation Volume: Not less than 1.0 ac-ft/yr. or more than 2.5 ac-ft/yr. times total acres irrigated.
- B. Maximum Daily Irrigation Volume: 0.07 ac-ft per acre times total acres irrigated
- C. Maximum Peak Flow Rate: 23.5 gpm per acre times total acres irrigated.

Where reuse water shall first be discharged to storage prior to irrigation application, the following design criteria shall apply:

- A. Annual Irrigation Volume: Not less than 1.0 ac-ft/yr. or more than 2.5 ac-ft/yr. per irrigated acre.
- B. Maximum Monthly Irrigated Volume: 0.65 ac-ft per acre times total acres irrigated.

- C. Maximum Peak Flow Rate: 5.9 gpm per acre, times total acres irrigated.

For non-irrigation use (storage), maximum daily, maximum peak flow and annual volume rates shall be determined on a case by case basis.

#### **412.00 Operating Pressure Requirements**

##### **412.1 Potable Water System Pressure Requirements**

All areas shall be designed to provide a maximum static head of two-hundred ninety (290) feet or one-hundred twenty-five (125) psi and a minimum static head of one-hundred (100) feet or forty-three (43) psi. Distribution systems shall also be designed to maintain a twenty (20) psi residual pressure during the required fire flow and a forty (40) psi residential residual during peak residential flows. The maximum pressure-drop from static head to either fire flow or peak residential flow shall not exceed thirty (30) psi.

##### **412.2 Non-Potable Water System Pressure Requirements**

All areas shall be designed to provide a maximum static head of two-hundred ninety (290) feet or one-hundred twenty-five (125) psi and a minimum static head of one-hundred (100) feet or forty-three (43) psi. Distribution systems shall also be designed to maintain a forty (40) psi residential residual during peak irrigation flows. The maximum pressure-drop from static head to peak irrigation flow shall not exceed thirty (30) psi.

#### **413.00 Fire Hydrant Spacing**

In single-family residential areas, fire hydrants shall be spaced a maximum of five-hundred (500) feet apart as measured along street curb line, and at an overall spacing that shall average not less than one hydrant to two-hundred thousand (200,000) square feet accessible to the fire hydrant throughout an individual subdivision. A hydrant shall be placed in the end of each cul-de-sac. Fire hydrants at the end of cul-de-sacs shall not be considered available for firefighting purposes.

In business, industrial, and high-density residential areas, hydrants shall be spaced not greater than three-hundred (300) feet apart or as approved by the applicable fire district.

Hydrants shall be spaced not greater than one-thousand (1,000) feet along connector and arterial roadways without domestic water service lines.

All fire hydrant locations and spacing shall be reviewed and approved by the applicable Fire District in addition to being consistent with NFPA.

#### **414.00 Fire Lines**

The property owner shall maintain all fire lines extending from the valve on the

District's water main. Valves on newly constructed fire lines shall be located on the tee at the main line. Fire lines are to be used exclusively for fire protection. Domestic water taps and irrigation taps shall not be allowed on the fire line.

#### **415.00 Distribution System Layout**

Distribution mains and lateral lines shall be located as shown on the approved plans, and shall be a minimum of eight (8) inch diameter pipe.

Dead ends shall be minimized by looping whenever possible. Lines at ends of long cul-de-sacs shall be looped along lot lines to adjacent streets or in out-lots whenever possible. If a utility easement is required, it shall be a minimum of thirty (30) feet wide. Dead ends shall be provided with a fire hydrant. Mains and laterals shall be extended to the boundaries of Filings or Phases and completely across the frontage of individual lots. **Dead ends shall not exceed 500' in length.**

#### **416.00 Valve Spacing and Marking**

Valves shall be placed with a maximum spacing of six-hundred (600) feet in all distribution mains and lateral lines. Spacing of valves in transmission mains may be greater than six-hundred (600) feet with the approval of the District. Valves shall also be placed at each fire hydrant.

All waterline tees shall have a minimum of two (2) valves. All waterline crosses shall have a minimum of three (3) valves. For a succession of short blocks perpendicular to the direction of the distribution main and without residential or commercial services between them, one or more intersection(s) may have the valve in that direction omitted, but the six hundred (600) foot maximum spacing requirement shall be maintained.

Valves shall also be placed at each end of a waterline running through an easement on private property, on each side of a major creek or channel crossing, and on each side (at property lines extended) of a distribution line that provides service to a hospital, school or large industrial user.

#### **417.00 Air Release and Vacuum Relief Valves**

Combination air and vacuum relief valves shall be installed at each high point in all distribution mains and at high points of lateral lines, as required by the District.

Air and vacuum relief valves shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere and in accordance with the Detail Drawings.

#### **418.0 Blow-off Valves and Drains**

##### **418.1 Blow-off Valves**

Provisions shall be included in the design to allow for the flushing of distribution mains and lateral lines at any low point in the system. Fire hydrants may be used for permanent blow-offs.

For temporary dead-end waterlines, a temporary blow-off valve may be permitted. The blow-off assembly shall be installed perpendicular to and on the downhill side of the waterline and shall drain to the nearest street gutter line or drainage channel. The blow-off assembly standpipe shall have a threaded end to accept a fire hose coupling. The top of the standpipe shall be between four (4) and six (6) inches below grade.

**418.2 Drains**

Provisions shall be included in the design to allow for the draining of transmission lines.

**419.0 Pipe**

All pipe used for distribution mains and lateral lines having a diameter of twelve (12) inches or less shall be PVC pipe unless otherwise approved in writing by the District. Distribution mains in excess of twelve (12) inches in diameter shall be subject to approval and as directed by the District. The design engineer shall specify the pipe class as required for specific project conditions.

**419.1 Hydraulic Design**

All pipes shall be designed to provide a maximum velocity of ten (10) feet per second. Distribution mains and lateral lines shall be designed using the Hazen-Williams friction coefficients and maximum head losses noted below:

<b>Pipe Size</b>	<b>Hazen-Williams Friction Coeff.</b>	<b>Max. Head Loss</b>
8" - 12"	C-100	2' per 1,000'
14" - 16"	C-110	2' per 1,000'
20"	C-130	1.5' per 1,000'
Over 20"	As directed by the District	

**419.2 Location (Typical)**

Water mains shall typically be located twelve (12) feet north or east of the centerline of the street unless otherwise approved by the District.

At street intersections, valves shall be located at the extension of property lines. Fire hydrant gate valves shall be placed near the main. All fire hydrants shall have a restrained connection directly to the tee off the main.

In all instances, water mains shall extend to the boundary line of the property or subdivision served, to the center of boundary streets or to the outside of paved areas, as noted on the approved plans. A water main serving one lot shall extend the entire length across the frontage of that lot.

#### **419.3** Horizontal and Vertical Alignment

Methods of deflection of PVC and ductile iron pipe joints shall be in accordance with manufacturers' recommendations only. Pipe shall not be bent. For horizontal alignment changes, pipe may be deflected at pipe joints up to a maximum of one degree (1°). Fittings are required for deflections to cross under utilities, but the contractor may request a variance from the District to vertically deflect pipe joints a maximum of one degree (1°).

#### **419.4** Pipe Depths

All water main pipe shall be installed with a minimum of four (4) feet – six (6) inches of cover from finished grade of street to the top of the pipe barrel. Proposed installations greater than ten (10) feet from finished grade require District approval.

#### **419.5** Relation to Sanitary Sewer Lines

Refer to Section 516.00 Relation to Waterlines for additional requirements.

### **420.00 GENERAL PROVISIONS**

#### **421.00 General**

Construction of all water mains within the District and all water service lines that connect to water mains within the District shall be in accordance with these CONSTRUCTION STANDARDS & SPECIFICATIONS and the approved plans. These CONSTRUCTION STANDARDS & SPECIFICATIONS shall apply to new water system construction as well as to repairs to existing facilities.

When special conditions are encountered or deviations from these CONSTRUCTION STANDARDS & SPECIFICATIONS are required by the District, and such changes are in the best interests of the District, the decision of the District shall be final.

#### **422.00 Permits Required**

A Public/Private Improvement Permit (PIIP) shall not be issued until the District has approved the water system plans. A pre-construction meeting with District inspection staff and the project

engineer shall be scheduled and completed prior to the commencement of any construction.

#### **423.00 Maintenance of Traffic**

When street cuts are required for water system construction or repairs to existing facilities, the following conditions shall be met to avoid interference with traffic:

Street service cuts shall only be open between 9:00 a.m. and 4:00 p.m. Two-way traffic shall be maintained at all times around the construction area. A Traffic Control Plan (TCP) shall be prepared in accordance with Section 141.12 Traffic Control, Barricades and Warning Signs of these CONSTRUCTION STANDARDS & SPECIFICATIONS, and submitted to the Elbert County Road & Bridge Superintendent for approval prior to the commencement of construction.

### **430.00 POTABLE RAW AND REUSE WATER MAIN CONSTRUCTION**

#### **431.0 Site Work and Earthwork**

Refer to Section 340.00 EARTHWORK of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

##### **431.1 Trenching, Backfilling and Compacting**

Refer to Section 350.00 TRENCHING, BACKFILLING AND COMPACTING of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

##### **431.2 Preservation of Monuments**

Refer to Section 141.00 Protection of Public, Private and Utility Interests of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

#### **432.0 Materials**

##### **432.1 General**

All references to the *Denver Water Board Specifications* cited in these CONSTRUCTION STANDARDS & SPECIFICATIONS shall mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

Pressure classes or ratings specified for materials in this section are minimums. The pressure class or rating for all materials used in a water supply system design shall be adequate for the water system pressure requirements.



**432.2** Pipe

All pipe for water main construction shall be as described in Section 419.00 Pipe of these CONSTRUCTION STANDARDS & SPECIFICATIONS. Each pipe shall be marked with the class designation and size. A six (6) inch wide detectable warning tape shall be installed above all pipe for the purpose of warning of location of buried pipeline, in accordance with the Detail Drawings. A No. 6 AWG solid, uninsulated copper wire shall be attached to all pipe for the purpose of future location, in accordance with the Detail Drawings. Installation of all pipe shall be in accordance with the manufacturers' recommendations and these CONSTRUCTION STANDARDS & SPECIFICATIONS.

PVC Pipe: All PVC pressure pipe for potable waterlines in sizes up through twelve (12) inch diameter shall comply with AWWA C900, pressure class 235 psi and wall thickness dimension ratio fourteen (DR-18) minimum.

PVC pipe for non-potable waterlines in sizes up through twelve (12) inches in diameter shall comply with AWWA C900, pressure class 200 psi (DR-14) and shall be purple in color. The purple color shall be a factory pigment of the PVC material, and painting of the pipe material is not acceptable.

PVC pressure pipe for potable waterlines in fourteen (14) inch through thirty-six (36) inch diameter shall comply with AWWA C905, pressure rating 165 psi (DR-25) minimum. For PVC pipe designed for a maximum safe operating pressure of 125 psi, or when required by the District, the minimum pressure rating shall be 235 psi (DR-18), or as determined by the design conditions.

PVC pressure pipe for non-potable waterlines in fourteen (14) inch through thirty-six (36) inch diameter shall comply with AWWA C905, pressure rating 165 psi (DR-25) or 235 psi (DR-18).

PVCO Pipe: Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe for potable waterlines in sizes up through twelve (12) inch diameter shall comply with AWWA C909, pressure class 200 psi minimum.

Ductile Iron Pipe: All ductile iron pipe shall comply with AWWA C151. Class designation shall be as shown on the approved plans or as designated by the District for each individual project. Joints shall be mechanical or push-on and shall comply with AWWA C111. Ductile iron pipe shall have a standard cement mortar lining that complies with AWWA C104 and a bituminous outside coating approximately one (1) mil thick.

Ductile iron pipe used in construction of hydrant laterals and fire lines shall be thickness Class 52.

Ductile iron pipe used in construction of non-potable waterlines shall be Class 350. Ductile iron pipe (DIP) may be required for non-potable waterlines that have higher pressures and that are twelve (12) inches in diameter or less.

Ductile iron, copper, steel or other non-potable pipe material not readily available in a purple color shall be encased in purple polyethylene (poly-wrapped).

#### 432.3 Polyethylene Wrap for Ductile Iron Pipe and Fittings

The polyethylene encasement material shall be in accordance with the Detail Drawings.

#### 432.4 Fittings

Ductile iron fittings shall comply with AWWA C110 and/or C153. Class designation shall be compatible with the pipe class designated for the project. Joints shall be mechanically restrained. Integral restrained joints that comply with AWWA C111 may be used with approval of the District. Rubber gasket joints shall comply with AWWA C111. A standard thickness cement mortar lining shall be applied to comply with AWWA C104. All fittings shall receive a bituminous outside coating approximately one (1) mil thick or be lined and coated with fusion bonded epoxy coating to comply with AWWA C116.

Mechanical joint restraint shall be wedge action, self-actuating, such as Megalugs. Restraints shall be protected in accordance with Section 432.18 Corrosion Protection Systems of these CONSTRUCTION STANDARDS & SPECIFICATIONS. **NO ALL-THREAD SHALL BE USED.**

#### 432.5 Gate Valves

**ALL GATE VALVES FOR POTABLE AND RAW WATERLINES SHALL OPEN LEFT (COUNTER-CLOCKWISE), AND ALL GATE VALVES FOR REUSE WATERLINES SHALL OPEN RIGHT (CLOCKWISE).**

Gate valves in sizes four (4) inches to twelve (12) inches shall be of the ductile iron body, non-rising bronze stem, resilient-seated type manufactured in accordance with AWWA C509 or AWWA C515. Class designation shall be compatible with the pipe class designated for the project.

Valves shall provide zero leakage at operating pressures up through one hundred fifty (150) psi in both directions. They shall be furnished with a two (2) inch square operating nut or hand wheel. End connections shall be furnished with all necessary joint materials and shall have a full opening flow way of equal diameter to the nominal size of the connecting pipe.

The disc shall have an integrally cast ductile iron stem nut to prevent twisting or angling of the stem. The disc casting shall be open on one side so as to form no

cavities for the accumulation of solids, and to permit the application of the protective coating. The sealing mechanism shall consist of a replaceable, contoured natural rubber disc seat ring, internally reinforced by a steel ring and molded separately from the disc. The seat ring shall be secured to the disc with self-locking stainless-steel screws and shaped so that it cannot be installed improperly. The seat ring shall seal against an accurately formed machined surface in the valve body.

Valves shall be provided with three (3) O-ring stem seals, with two (2) placed above and one (1) below the thrust collar. The two (2) upper O-rings shall be replaceable with the valve fully open and under pressure. The area between the O-rings shall be filled with a lubricant to reduce friction and to lubricate the O-ring each time the valve is operated. An anti-friction washer shall be placed above the thrust collar to further minimize operating torque. Structural design of the valve shall be such that if excessive torque is applied to the stem, failure of the pressure retaining parts shall not occur. Stem failure under such conditions shall occur externally at such a point as to enable the stem to be safely turned by use of a pipe wrench or other such readily available tool after exposure of the valve. The stem shall then be replaceable through removal of the two-bolt stuffing box.

Coatings shall be equal to or exceed AWWA C550. All internal ferrous metal surfaces shall be fully coated and holiday free to a minimum thickness of four (4) mils. The coating shall be a two-part thermosetting epoxy suitable for field over-coating and for touchup without special surface preparation or extreme heat. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings. Coatings shall have a successful record of performance in valves, pipe or other allied equipment for a minimum of ten (10) years.

#### 432.6 Butterfly Valves

**ALL BUTTERFLY VALVES FOR POTABLE AND RAW WATERLINES SHALL OPEN LEFT (COUNTER-CLOCKWISE), AND ALL BUTTERFLY VALVES FOR REUSE WATERLINES SHALL OPEN RIGHT (CLOCKWISE).** All valves having a nominal diameter of fourteen (14) inches or greater shall be geared butterfly valves designed for direct burial and shall comply with AWWA C504, Class 150-B. Class designation shall be compatible with the pipe class designated for the project.

Valves shall be of the tight-closing, rubber seat type with rubber seats which are bonded to the valve body. No metal-to-metal sealing surfaces shall be permitted. Valves shall provide zero leakage at the pressure rating of the pipe in either direction. Valve discs shall rotate ninety (90) degrees from the full-open position to the tight shut position. Coatings shall be equal to or exceed AWWA C550. Valve bearings shall be sleeve-type, corrosion-resistant and self-lubricating with the load not to exceed twenty-five hundred (2,500) psi.

Valve operators shall be the traveling nut type designed to withstand three-hundred (300) foot-pounds of input torque at full-open or closed positions without damage to the valve or operator. Valve operators shall be fully gasketed, grease packed, designed to withstand submersion in water to ten (10) psi and operate with a two (2) inch square nut.

#### **432.7** Pressure Reducing Valves

All pressure reducing valves shall be 150 Class suitable for a working pressure of 250 psi. Distribution main and lateral line pressure reducing valves shall be installed in a vault and contain parallel valves for high and low flow ranges. Piping shall be ductile iron through the vault walls and extend three (3) feet past the vault walls in accordance with the Detail Drawings. Oil filled differential gauges shall be installed with brass or stainless-steel ball valves.

Pressure reducing valves shall be installed at location(s) noted on the approved plans. The valve shall be capable of maintaining a constant downstream pressure regardless of varying inlet pressure and shall be hydraulically operated and diaphragm-actuated with a globe or angle pattern. It shall contain a resilient, synthetic rubber disc having a rectangular cross-section contained on three and one-half (3-½) sides by a disc retainer, forming a tight seal against a single removable seat insert. The diaphragm assembly, containing a valve stem, shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing the valve from the line. The valve shall be furnished with an indicator rod to show valve position.

The pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The control system shall include a fixed orifice.

This valve shall be similar in all aspects to a Clayton 90-91AB and/or a Clayton 90-01AS Pressure Reducing Valve (PRV) as manufactured by Cla-Val Co., or an approved equal.

#### **432.8** Fire Hydrants

Fire hydrants shall comply with ANSI/AWWA C502 for dry-barrel fire hydrants, and shall be listed by Underwriters Laboratories and Factory Mutual Research Corporation. Casting or other permanent marks shall be used to confirm that fire hydrants comply with these standards.

Fire hydrants shall also comply with the following supplementary specifications:

- A. Fire hydrants shall be Kennedy Guardian K-81DD, or approved equal. Equal must be approved by the Elizabeth Fire Protection District.
- B. Hydrants shall be rated at 250 psi operating pressure and tested at 500 psi per Section 5.1 of AWWA C502. Production testing of each hydrant shall be performed at 500 psi to assure proper assembly and operation and detection of any imperfections. All iron parts as designated in Section 3.1.2 of AWWA C502 shall be ductile iron.
- C. Hydrants shall be designed for five (5) feet pipe bury and shall not be buried below the first flange. The first flange shall be two (2) to four (4) inches above grade. A maximum of one riser shall be used, and if a riser is required, a break-away coupling shall be installed two (2) to four (4) inches above grade. **INSTALLATION OF A HYDRANT RISER REQUIRES A SEPARATE, SPECIFIC INSPECTION.**
- D. Nozzles shall be two 2-½” hose connections 180 degrees apart and one 4-½” pumper connection. All nozzles shall be at the same elevation. Nozzle threads shall be National Standard Fire Hose coupling screw threads as described in Appendix A of AWWA C502, unless otherwise specified. Nozzles caps shall be provided with chains and gaskets. Nozzles caps shall have the same nut configuration as the hydrant-operating nut. Nozzle shall be reverse threaded into the upper barrel and mechanically locked in place.
- E. Hydrant main valves shall be 5-¼” minimum and shall be of the full compression design, opening against and closing with the pressure. The main valve seat ring shall thread into a bronze sub-seat, and all gaskets sealing the seat ring shall be on a bronze-to-bronze seating surface. The seat ring threads shall not serve as pressure seal. The entire valve and rod assembly shall be removable by use of a small lightweight seat removal wrench.
- F. The drain valves shall allow complete drainage of all residual water in the hydrant. The circumferential drain passage inside the hydrant shall be bronze on all surfaces. The draining system of the hydrant shall be bronze with a sliding bronze drain valve. Sliding drain valves made of rubber, plastic or leather shall not be allowed.
- G. Hydrants shall be the breakaway types with a frangible groundline and rod coupling designed to break upon traffic impact to prevent further damage to the hydrant and connecting pipe. The frangible coupling shall allow the upper section to be rotated to any desired position. Couplings which employ lug devices or a breakaway barrel are not acceptable. Frangible bolts are not allowed.
- H. Hydrant operating nuts shall be ductile iron and shall be pentagonal in shape, 1½” point to flat. The operating nut shall also

function as a weather shield. **HYDRANTS SHALL OPEN LEFT (COUNTER-CLOCKWISE).**

- I. The operating mechanism shall utilize two (2) O-ring seals between the revolving nut and bronze-sheathed upper section of the valve rod. The top of the rod shall also be fitted with a travel stop nut to limit downward travel on the rod. All-weather grease shall be used to provide permanent lubrication. A thermoplastic or Teflon thrust ring shall be used to reduce friction while opening the hydrant.
- J. The hydrant inlet shall have mechanical joint restraint which shall be accomplished by use of wedge action, self-actuating fittings.
- K. The buried portion of the hydrant shall have a bituminous coating to comply with AWWA C116. All ferrous metal parts shall be coated to comply with AWWA C500. The bonnet and nozzle cap shall be given one shop coat of yellow color heavy duty alkyd enamel paint that complies with Federal Color No. 13538 Specifications. The remaining above ground portion of the fire hydrant shall also be shop painted chrome yellow.

#### **432.9**            Valve Boxes

All buried valves shall be provided with a valve box. Valve boxes shall be gray cast iron, ASTM A48, three (3) piece adjustable screw boxes with a round or oval base and a five and one-fourth (5-¼) inch screw-type shaft suitable for depth of cover as required. Box lids shall be marked "Water".

All valves set at greater than normal depth shall have an extension stem provided and installed with the valve box so that the valve may be operated with a standard seven (7) foot valve key. A valve operating nut at six (6) feet or greater below final grade shall have an extension stem provided to bring the operating nut to a depth of four (4) feet below final grade. Coatings shall comply with AWWA C116. Boxes shall be Tyler Pipe screw-type cast iron valve box assembly Series 6860, or an approved equal.

Reuse valve boxes shall be model number 3TCIDEN by Castings Inc., or an equal approved by the District. The lid shall be triangular with a purple finish and shall be marked "NON-POTABLE WATER".

#### **432.10**            Air Release and Vacuum Relief Valves

All combination air release and vacuum relief valves shall comply with AWWA C512. The large orifice of combination air valves shall allow air to escape during pipeline filling and to enter during drainage of the pipeline.

The valve shall consist of a body, cover, baffle, float and seat. The float shall be stainless steel designed to withstand a maximum pressure of 1,000 psi. All materials shall comply with ASTM A126 and ASTM A240.

Air release and vacuum relief valves shall be installed in a vault in accordance with the Detail Drawings. Galvanized piping or fittings shall not be allowed.

#### **432.11**            Irrigation Flow Control Valves

Reuse water service lines shall be equipped with a flow control valve to limit flow to the maximum rate approved by the District. Flow control valves shall be OCV Control Valves, “Rate of Flow Valve Series 120 G” or “Cla-Val Co Model 49-01”. If the design rate of flow exceeds a maximum ratio of 4:1, an OCV Series 120 G-4 flow control valve shall be used.

Upon the Developer’s payment to the District for the actual cost of the valve, the flow control valve shall be ordered and purchased by the District and factory pre-set to the approved maximum flow rate. The pre-set flow rate shall not be field adjusted.

The flow control valve shall be installed with the meter in a common vault in accordance with the Detail Drawings.

#### **432.12**            Blow-off and Drain Assemblies

The temporary blow-off shall be through a two-inch (2) ball valve with a two-inch (2) gate valve operating nut, box, piping and cover. Unless otherwise approved in writing by the District, all piping shall be threaded copper and valves shall be brass. Galvanized piping and fittings are not allowed. Refer to the Detail Drawings.

Permanent six (6) inch drains for potable waterlines shall be approved in writing by the District and shall be constructed in accordance with the Detail Drawings. Six (6) inch blow-offs for non-potable waterline flushing shall be constructed at all dead-ends and at other points deemed necessary by the District.

#### **432.13**            Vaults

Vaults may be precast or cast-in-place and shall be constructed in accordance with these CONSTRUCTION STANDARDS & SPECIFICATIONS. Precast vaults shall be designed so that all joints and corners are waterproof. Precast and cast-in-place vaults shall be made waterproof after construction by use of sealants, epoxies, or other approved methods.

The vault roof shall be designed to support the overhead fill, any surcharge and an H-20 traffic loading. Where the cover over the roof is less than two and one-half (2-½) feet or more than five (5) feet, a cast-in-place vault is required.

Cast-in-place meter vaults shall be in accordance with the Detail Drawings and shall be constructed of CDOT Class B concrete with steel reinforcement in accordance with the CDOT M&S STANDARDS.

#### **432.14** Manholes

Refer to Section 532.04 Manholes and Section 532.07 Cast and Ductile Iron Fittings of these CONSTRUCTION STANDARDS & SPECIFICATIONS. Lids shall be furnished with the word "WATER" cast on top.

#### **432.15** Manhole Base Slabs and Base Beams

Refer to Section 532.05 Manhole Bases and Base Beams of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

#### **432.16** Sump Pits for Vaults and Manholes

Sumps with a gravity drain line or sump pump are required for vaults or manholes in areas where there is groundwater present and in all telemetry equipment and pressure regulating valve manholes and vault installations. Refer to the Detail Drawings.

#### **432.17** Vent Pipes

Vent pipes shall be used in all vaults and manholes to allow gases to escape. Installations that contain electrical equipment shall have a blower attached to the vent system. Vent pipes shall be field located at the nearest intersection of the street property line and the side lot line. Refer to the Detail Drawings.

Above ground vent pipe shall be six and five-eighths (6-5/8) inch O.D. galvanized steel pipe, Grade 40 that complies with ASTM A53. The vent screen shall be three-fourths (¾) inch No. 9-11 flattened, expanded galvanized metal screen. Below ground vent pipe shall be six (6) inch, schedule 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.

#### **432.18** Corrosion Protection Systems

When soil resistivity is less than two thousand five hundred (2,500) ohm-centimeters (OHM-CM), but greater than one thousand (1,000) OHM-CM, ductile iron pipe and fittings may be used but the ductile iron materials shall be protected against corrosion.



Methods to provide corrosion protection of integral metallic parts of the water transmission system are as follows:

- A. Corrosion Resistant T-head Bolts and Nuts shall be 45,000 psi minimum steel with a fluoropolymer coating and shall be either “Cor-Blue” by NSS Industries or “Blue Bolt” by Birmingham Fasteners.
- B. Ductile Iron Pipe shall be furnished from manufacturer with cement mortar lining and bituminous coating. Pipe shall be double wrapped with polyethylene wrap and taped at each end.
- C. Butterfly and Gate Valves shall be furnished from manufacturer with a coating equal to or exceeding AWWA C550. Bolts and nuts shall either be epoxy or fluoropolymer coated. Valves shall be double wrapped with polyethylene and taped at each end.
- D. Mechanical Joint Tees, Bends, Caps, Plugs and all other fittings shall be furnished from manufacturer with cement mortar lining and bituminous coating. T-head bolts and nuts shall be corrosion resistant. Fittings shall be double wrapped with polyethylene and taped at each end.
- E. Mechanical Joint Restraint (Wedge action, self-actuating, such as Megalugs) for ductile iron pipe shall be furnished from manufacturer with a bituminous coating. Mechanical joint restraint for PVC pipe shall be furnished from the manufacturer with red primer coat. T-head bolts and nuts shall be corrosion resistant. Mechanical joint restraint shall be double wrapped with polyethylene and taped at each end.
- F. Polyethylene Wrap shall be eight (8)-mil minimum, close-laminated wrap and shall comply with the Denver Water Board Specifications Section MS-13.
- G. Damage to Epoxy and/or Other Material Coatings shall be repaired and inspected prior to installation.
- H. Polyethylene Wrapping and Taping shall be inspected by a District representative prior to backfilling.
- I. Record Documents shall provide coordinate locations of all metallic items, including but not limited to pipe, valves and fittings to “GPS backpack” accuracy. Refer to Section 200.00 Acceptance Procedures of these CONSTRUCTION STANDARDS & SPECIFICATIONS for more information.
- J. Cathodic Protection for Steel Casings shall be protected from corrosion by a galvanic anode cathodic protection system when directed by the District. The galvanic anode cathodic protection system shall be comprised of two test stations placed at each end of each steel sleeve that shall connect galvanic anodes to the sleeve.

The cathodic protection system shall be designed by a Colorado Licensed Professional Engineer, accredited by the National Association of Corrosion Engineers. Installation shall be performed under the direction of a licensed Professional Engineer who is accredited by the National Association of Corrosion Engineers. Each cathodic protection system shall be tested under the direction of a Colorado Licensed Professional Engineer who is accredited by the National Association of Corrosion Engineers. A final, colored report on the installation and testing/monitoring procedures shall be prepared by a Colorado Licensed Professional Engineer who is accredited by the National Association of Corrosion Engineers and submitted to the District.

Metallic reuse pipe shall be electrically insulated at its connection to the transmission main. New runs of metallic pipe shall be designed for electrical continuity throughout the run, but shall be electrically insulated at connections with other pipelines. Bonding of joints shall be required. Ductile iron and steel pipelines shall be cathodically protected using the passive anode system.

Cathodic protection test stations shall be provided and shall be shown on the approved construction drawings.

#### 432.18.1 Insulators

For metallic pipe, insulators shall be installed at the outlet end of the corporation stop. Insulators shall be Ford Service Insulators or an approved equal for water service lines and shall be installed in accordance with the Detail Drawings.

Refer to Denver Water Board Specifications Sections MS-21 and MS-22 for other insulators that may be required. Refer to Sections MS-27 and DD-9 for insulators for mechanical joint systems. Refer to the Detail Drawings.

#### 432.18.2 Tape

The polyethylene seams and overlaps shall be wrapped and held in place by means of two-inch wide plastic-backed adhesive tape. The tape shall be Polyken #900 (polyethylene), Scotchrap #50 (polyvinyl) or equal. The tape shall have adhesive that shall bond securely to both metal surfaces and polyethylene film.

#### 432.19 Tracer Wire and Warning Tape

A No. 6 AWG solid, uninsulated copper wire shall be attached to all pipes, including at least one carrier pipe inside a casing pipe, for the purpose of future location. If tracer wire is not attached to a carrier pipe, it may be cad-welded to both ends of a casing pipe and terminated in test stations within ten (10)

horizontal feet from the ends of the casing pipe. Bundy KS17 copper split connectors, or equal, shall be used. Tracer wire shall be run along each fire hydrant assembly and brought to the surface in a test station located behind the fire hydrant. No tracer wire shall be allowed in valve boxes. Test stations shall be CP Test Services, Glenn Series Glenn-4 with locking lid, 3 ½" x 4", or approved equal. A qualified tester shall verify continuity of tracer wire and a report shall be submitted to the District with other Record Documents.

**UNINTERRUPTED CONTINUITY IS A REQUIREMENT FOR CONSTRUCTION ACCEPTANCE.**

All pipelines shall have a six (6) inch wide, detectable, magnetic warning tape installed twelve (12) to eighteen (18) inches above all pipe, on top of the bedding, for the purpose of warning of location of buried pipeline. For potable and raw waterlines, the marker tape shall be blue in color with black lettering in a continuously repeating pattern with the words "CAUTION WATER LINE BELOW". For non-potable (reuse) waterlines, the marker tape shall be purple in color with black lettering in a continuously repeating pattern with the words "CAUTION RECLAIMED WATER LINE BELOW".

432.20 Bedding Materials

Bedding materials shall comply with Section 353.00 Bedding for Pipelines and Service Lines of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

432.21 Concrete

All concrete shall comply with Section 800 CONCRETE MIX DESIGN AND CONSTRUCTION of these CONSTRUCTION STANDARDS & SPECIFICATIONS for Portland cement concrete construction.

432.22 Plastic Liner Pipe (Sliplining)

Water main sliplining materials shall comply with Section 532.09 In-Place Rehabilitation of Existing Pipelines of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

432.23 Steel Casings for Bores

Steel casing pipe shall comply with Section 532.10 Steel Casings for Bores of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

**433.0 Installation**

**433.1 General**

All work shall comply with AWWA C600, AWWA C605, and to the pipe manufacturer's installation instructions, except as modified by these specifications.

#### **433.2** Alignment and Grade

Field parties, under the supervision of a Colorado Licensed Professional Land Surveyor or Professional Engineer, shall determine alignment and grade of the pipe and the location of fittings, valves, and hydrants. The required minimum depth of cover between the top of the pipe barrel and the finished street grade is four (4) feet - six (6) inches. The waterline shall be installed to the required lines and grades with fittings, valves, and hydrants at the required locations. Record Documents of waterline alignment, verified by a Professional Licensed Surveyor or a Professional Engineer, shall be furnished to the District to comply with Section 200.00 ACCEPTANCE PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS. Refer to Section 516.00 Relation to Waterlines for additional requirements.

#### **433.3** Protection of Existing Underground Utilities

The Contractor shall be held responsible for the protection of public improvements as stated in Section 141.00 Protection of Public, Private and Utility Interests of these CONSTRUCTION STANDARDS & SPECIFICATIONS. It shall be the Contractor's responsibility to replace all damaged public improvements at his own expense.

#### **433.4** Interruption of Services

Interruption of services shall comply with Section 141.04 Interruption of Services of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

#### **433.5** Pipe Installation

Proper equipment, tools and facilities shall be provided and used by the Contractor for safe and efficient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and to protect coatings and linings. Under no circumstances shall pipe or fittings be dropped or dumped into the trench. Any pipe or fittings that are dropped or dumped shall be removed from the work site and shall not be used.

When buried, all ductile iron pipe fittings and appurtenances shall be protected with thick polyethylene wrap. Miscellaneous steel or other ferrous pipe for blow-offs, etc., shall be similarly protected. Refer to Section 200.00 ACCEPTANCE

PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS for survey requirements for Record Documents of waterlines.

The District shall be notified at least one working day (twenty-four [24] hours) in advance of when pipe is to be installed in any trench. No pipe shall be covered until a District Operator has inspected the installation.

Refer to Section 516.00 Relation to Waterlines for additional requirements.

#### **433.6** Thrust Blocking, Restrained Joints and Fittings

Thrust blocks and mechanical joint restraints shall be used at all valves, bends, fittings with mechanical connections and dead ends in accordance with the Detail Drawings. For high pressure or special circumstances, alternative restraint systems may be considered. Alternative restraint systems shall be approved by the District.

The length of restrained pipe (L) in the table shown in the Length of Restrained Pipe Detail Drawing is measured from the centerline of the fitting or valve and refers to the amount of pipe which shall be restrained. Mechanical joint restraint (wedge action, self-actuating, such as Megalugs) shall be used at all valves, bends, fittings with mechanical connections and dead ends. Tie rods shall not be used. The table shall also be used for the length of mechanical joint restraint. Restraints shall be protected to comply with Section 432.18 Corrosion Protection Systems of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

Crosses shall be restrained in all applicable directions, and twelve (12) inch and smaller in-line valves and tees shall have mechanical joint restraint on each side of the fitting or valve.

Thrust blocking shall be in accordance with the Detail Drawings. Care shall be taken to not block outlets, cover bolts, nuts, clamps or other fittings, and to ensure they are accessible. A bond breaker shall be placed between the pipe and the thrust block to aid in future removal. The thrust block shall bear against undisturbed earth.

Forming for thrust blocks and anchors may be bulk-heading around the shape of the thrust block or anchor with wood, burlap, or reinforced paper sacks filled with sand or earth. Wood forms shall be removed before backfilling. Newly placed thrust blocks shall be allowed to set undisturbed for a minimum of twenty-four (24) hours prior to any backfilling, tamping or compaction, unless otherwise approved by the District.

#### **433.7** Setting Valves and Fire Hydrants

Hydrant runs shall not contain bends unless approved by the District. Valve boxes shall not be installed in curb and gutter, sidewalk or crosspans.

Each hydrant shall have a six (6) inch gate valve on the hydrant run and shall be connected to the main by a six (6) inch ductile iron, polyethylene wrapped pipe. The valve shall be anchored to the swivel tee.

Hydrants shall be set with the bury line at the established finished grade. Hose nozzles shall be set parallel to the curb with the pumper nozzle facing the curb. Hydrants shall be located at least eighteen (18) inches from center of hydrant to back of curb or sidewalk. If a riser is required, a break-away coupling shall be installed two (2) to four (4) inches above grade.

Valves shall be provided with valve boxes centered and plumb over the operating nut of the valve. The boxes shall be supported to prevent any shock or stress from being transmitted to the valve. All valves shall be installed using a valve box adaptor to ensure proper centering of the valve box during backfill and to maintain valve box location. Valve boxes shall be maintained in this position during backfill. Valve box covers shall be set below the subgrade level to prevent damage during street construction and later adjusted to grade at the time of paving. If the top of the valve-operating nut is greater than six (6) feet below finished grade, a valve nut extension shall be installed to bring the operating nut up to four (4) feet below finished grade.

Hydrants shall include a drainage pit with nine (9) square feet of surface area and two (2) feet of depth below the barrel of the inlet. Pits shall be backfilled with one and one-half (1-½) inch, washed, crushed rock to a level six (6) inches above the barrel drain hole. A concrete thrust block shall be placed at the bowl of each hydrant in accordance with the Detail Drawings to prevent obstruction of the barrel drain hole.

#### **433.8** Plastic Liner Pipe (Sliplining)

Installation of plastic liner pipe shall comply with Section 533.09 In-Place Rehabilitation of Existing Pipelines of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

#### **433.9** Steel Casing and Carrier Pipe Installation

Installation of steel casing and carrier pipe shall comply with Section 533.10 Steel Casing and Carrier Pipe Installation of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

Tracer wire shall be taped to the carrier pipe before installation of carrier pipe supports and installed in the steel casing along with the carrier pipe. A test

station, similar to those required at fire hydrants, shall be installed for the tracer wire in Elbert County R.O.W. near each end of the steel casing pipe. If tracer wire becomes discontinuous during installation of carrier pipe into casing pipe, tracer wire shall be welded to each end of the casing, with written approval of the District. Uninterrupted continuity shall be tested in accordance with the requirements of Section 432.19 Tracer Wire and Warning Tape of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

#### **433.10** Cathodic Protection Test Stations

Underground pipeline test stations shall be installed at locations shown on the approved plans and in accordance with the Detail Drawings.

#### **433.11** Plugging of Dead Ends

Temporary dead ends shall be installed with standard plugs or caps. Temporary dead ends shall be provided with blow-offs or fire hydrants, as required by the District. Permanent dead ends shall be provided with fire hydrants and valves. All temporary dead ends in undeveloped lots and open lands shall be marked with a blue post.

#### **433.12** Filling and Venting the Line

The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all available hydrants (including hydrant gate valves), air relief valves, and other vents are open during the filling of the line. Where hydrants or other vents are not available in the line, the Contractor shall use a temporary two (2) inch blow-off for venting purposes. The rate of filling the line shall not exceed the venting capacity.

#### **433.13** Disinfection and Flushing of Water Lines

Disinfection and flushing shall be performed in accordance with the requirements of the Colorado Department of Public Health and Environment and shall comply with AWWA C651.

The chlorine solution shall be retained in the water line for at least twenty-four (24) hours. A free chlorine residual at all hydrants and blow-offs shall be at least twenty-five (25) parts per million (ppm) at the end of the twenty-four (24) hour period. If the test is unsatisfactory, disinfection shall be repeated until a twenty-five (25) ppm free chlorine residual is obtained.

When cutting into or repairing an existing water line, disinfection and flushing shall comply with AWWA C651.

Following chlorination, the water line shall be flushed through all hydrants and blow-offs until the water runs clear with no chlorine residual in excess of that

carried in the existing system. As a minimum, the total volume of the water line being tested shall be flushed. **THE CONTRACTOR SHALL BE RESPONSIBLE FOR METERING AND PAYING THE DISTRICT FOR WATER USED FOR FLUSHING.**

The Contractor shall take all necessary precautions to prevent the flow of strong chlorine solution into existing water facilities and shall be responsible for damages done by heavily chlorinated water. No water lines shall be placed in service or tapped until a written release is obtained from the District. Sodium thiosulfate shall be used when flushing water on the ground and to waterways that do not contain fish. Vita-D- Chlor Neutral, or approved equal, shall be used when flushing to waterways with fish

The line shall be visually inspected for turbidity. If the inspection is unsatisfactory, the line shall be flushed again. If the turbidity test fails a second time, the line shall be re-chlorinated and then re-flushed.

A twenty-four (24) hour bacteriological test for total coliform bacteria shall be performed by the District. If the test is unsatisfactory, the line shall be flushed again. If the bacteriological test fails a second time, the line shall be re-chlorinated, re-flushed and re-tested.

#### **433.14**            Leakage

Pressure and leakage tests shall be conducted to comply with AWWA C600 to a pressure of one hundred and fifty (150) pounds per square inch (psi) at the low point of the section being tested for the duration of two (2) hours. The maximum length of line to be tested shall be one thousand (1,000) feet. All joints shall be watertight within tolerances allowed by AWWA C600. Leakage in excess of tolerances shall be located and made watertight by the Contractor. Pressure and leakage tests shall not be conducted until the line has passed all required disinfection and bacteriological tests.

Reuse water systems with pressures greater than one hundred and fifty (150) pounds per square inch (psi) shall be tested to a pressure of two-hundred (200) pounds per square inch (psi) at the low point of the section being tested for the duration of two (2) hours.

#### **433.15**            Concrete Vaults

Refer to Denver Water Board Specifications Section MS-26.

### **434.0**            Inspections



Refer to Section 154.00 Inspections of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

Adequate inspections assure compliance to District requirements and are the basis for the District's recommendation that said improvements be accepted for maintenance and for release of performance guarantees. It is the responsibility of the Contractor to contact the District a minimum of one (1) full working day (twenty-four [24] hours) in advance of the required inspections. Required inspections shall include:

- A. Stockpiled Materials – Verify that materials meet CONSTRUCTION STANDARDS & SPECIFICATIONS and approved submittals, including but not limited to: bedding material, pipe, fittings, valves, valve boxes and fire hydrants.
- B. Excavation – Verify proper trench depths, shoring, spoil pile location, dewatering, and location and protection of existing utilities.
- C. Installation – Verify proper bedding depth, alignment and grade, clean pipe and lubricants. Check that chlorine tablets are affixed to the inside of pipe, and verify “slicing in” of bedding at haunches. Tracer wire is securely attached to the TOP of pipe, metallic fittings are wrapped with polyethylene, fittings have corrosion resistant bolts and nuts, and fire hydrants have proper drainage rock. Reuse waterlines shall be purple in color or have purple plastic wrap and warning tape.
- D. Thrust Blocks and Restraints – Verify proper size of concrete thrust blocks and adequate bond breaker, and proper torque of bolts for mechanical restraints.
- E. Backfill and Compaction – Verify proper methods of backfill and compaction, depths of lifts, moisture control, and backfill material free of large rock, organic or frozen material.
- F. Loading and Testing – Verify that loading and testing methods adhere to these CONSTRUCTION STANDARDS & SPECIFICATIONS. Load line, wait at least twenty-four (24) hours, test for high chlorine residual, flush, test for reduced chlorine residual and wait at least twenty-four (24) hours. The bacteriological (“clear water”) sample shall pass prior to pressure testing in accordance with these CONSTRUCTION STANDARDS & SPECIFICATIONS.
- G. Tie In – After successful testing, tie in dead end to loop the system.
- H. Service Taps – Verify proper tapping procedures. For direct taps, line is under pressure. For saddle taps, torque on the saddle is checked. Verify that there are no leaks at the corporation stop and the coupon has been removed. Verify copper service line has

proper goose neck, the service line runs correctly to the yoke at the meter pit, and the water is on at the meter pit.

- I. Construction Acceptance – Refer to Section 200 ACCEPTANCE PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS. General items include:
  1. All temporary structures, debris, mud and waste materials shall be removed from public property.
  2. All relative testing certifications and documentation shall be submitted to the District. Include all compaction tests. Copies of originals are acceptable.
  3. All curb stop boxes are raised to grade and checked for valve accessibility.
  4. All water services shall be marked with a “V” by saw cutting into the face of the curb where the service extends into the property.
  5. All water valve boxes are at construction grade, straight and cleaned out to check for access to valve nut and ability to get a valve key on the nut and operate the valve. Verify that all valves that should be open are open. Tracer wire test stations shall be accessible.
  6. All fire hydrants shall be checked for ability to be pressurized.
- J. Final Acceptance – Refer to Section 200 ACCEPTANCE PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS. General items include:
  1. Each water valve box shall be cleaned out to check for access to valve nut and the ability to get a valve key on the nut and operate the valve. All valves that should be open are open. Tracer wire test stations shall be accessible.
  2. All fire hydrants shall be checked for ability to be pressurized.

## **440.00 WATER SERVICE LINE CONSTRUCTION**

### **441.0 General**

All water service line locations shall be marked on the face of the curb by saw cutting a “V” symbol where services cross under the curb. Water service lines shall be in a separate trench, except as approved by the District, and shall be a minimum of ten (10) horizontal feet from sewer service lines. Water service lines shall be a minimum of eighteen (18) vertical inches above any sanitary sewer crossing. All water service lines shall be stubbed into the lot either ten (10) feet beyond the back of the sidewalk or curb or five (5) feet beyond any utility easement, whichever is greater, and shall be marked at the end of the water service with a wood 2x4 painted blue.

The water service line at the curb stop shall be no deeper than five (5) feet - six (6) inches. Water service lines shall be a minimum of two (2) feet inside the property line and shall not be located under a driveway unless approved by the District.

#### 441.1 Excavation

All excavation shall comply with Section 342.00 Excavation of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

### 442.0 Equipment and Materials

#### 442.1 Water Service Lines

Water service lines shall be sized to adequately supply the requirements of the property being served. The minimum size line shall be three-fourths ( $\frac{3}{4}$ ) inch. The acceptable material for a three-quarter ( $\frac{3}{4}$ ) inch to two (2) inch service line is seamless copper tube. Three (3) inch and greater diameter service lines may be ductile iron pipe or PVC pressure pipe. High density polyethylene pipe may be an acceptable material for water service lines installed between water meters and private structures, at the discretion of the District. All service pipes shall conform to one of the following specifications:

- A. Seamless copper tube designated as “Type K” (soft) shall be used for service lines three-fourths ( $\frac{3}{4}$ ) inch through three (3) inches.
- B. Ductile Iron Pipe or PVC pressure pipe complying with Denver Water Board Specifications may be used for three (3) inch service lines, and shall be used for all service lines larger than three (3) inches.
- C. High Density Polyethylene Pipe shall be PE 3408 (DR-11) with a minimum pressure rating of one hundred sixty (160) psi. PE 3408 may be used for service lines that are three-fourths ( $\frac{3}{4}$ ) inch through three (3) inches in diameter and between a water meter and a private structure, as approved by the District. All pipe, fittings and joints shall comply with sections 605 and 605.20 of the International Plumbing Code.

Water service lines shall be of the same type material from beginning to end, unless the appropriate insulator is installed at the junctions of dissimilar metals and unless approved by the District.

#### 442.2 Water Service Saddles

Water service saddles shall be required for all AWWA C909 PVC waterlines for water service taps and may be required on other PVC piping as determined by the District. Service saddles shall be brass or bronze and shall comply with AWWA C800.

#### 442.3 Meters

All meters shall be purchased from the District and shall be installed, owned and maintained by the District. All single family residential meters shall be size 5/8" x 3/4", unless otherwise approved by the District. No meter shall be installed until the District has approved the proposed installation. Permanent water meters shall be installed prior to issue of the Certificate of Occupancy.

#### 442.4 (Left Blank Intentionally)

#### 442.5 (Left Blank Intentionally)

#### 442.6 Outside Meter Settings

All outside meters shall be installed in a horizontal position and housed in a manhole or vault in accordance with the Detail Drawings. The installation of the water meter shall comply with the following unless otherwise approved by the District:

- A. All meters not installed within the right-of-way shall require an easement dedication ten (10) feet wide and extending three (3) feet behind the meter.
- B. The meter shall be installed in a pit, manhole or vault which shall allow free and easy access and adequate room for installation, inspection and maintenance, and shall provide protection from freezing.
- C. All fittings shall be brass or copper.
- D. A pressure regulator (Watts 25 AUB or equivalent) shall be installed on all water services before the meter is installed.
- E. A ball or gate valve shall be installed where the water service line enters the building and the meter is installed.

#### 442.7 Inside Meter Setting and Remote Readers

All inside meter settings shall be installed in a manner which shall

allow free and easy access and adequate room for installation, inspection and maintenance, and shall provide protection from freezing. Meters installed inside buildings shall not be more than eighteen (18) inches from the wall through which the water service line enters the building, unless otherwise approved in writing by the District.

Inside meter settings shall not be allowed in crawlspaces, closets or other places where free and easy access is not provided. Meter sizes one and one-half (1½) inch and two (2) inch installed inside buildings shall be provided with a floor drain. Refer to the Detail Drawings. Installation shall conform to the following:

- A. The meter setting shall be installed in the basement which shall allow free and easy access and adequate room for installation, inspection, and maintenance.
- B. The meter yoke shall be a minimum of twelve (12) inches and a maximum of four (4) feet above floor level in a horizontal position and have a minimum of twelve (12) inches clearance from all surrounding obstructions.
- C. A ball or gate valve shall be installed on both the upstream and downstream side of the water meter.
- D. A pressure regulator, adjustable from twenty-five (25) to seventy-five (75) psi shall be installed between the meter yoke and downstream valve. The regulator shall be a Watts Model 25AUB or equivalent unless otherwise approved in writing by the District.
- E. All fittings shall be brass or copper.

#### **442.8** Meter Check Valves

Check valves shall be required on meters where any condition exists that could cause water to flow from the property to the main.

#### **442.9** Valves for Use with Meters

1. Gate valves three (3) inches and smaller for copper water service lines shall be brass, with non-rising stems and solid wedge disc,

manufactured in accordance with ASTM B62, 125 WSP, 200 PSI WOG. Gate valves shall comply with AWWA C800 and shall be in accordance with the Detail Drawings.

Valves larger than three (3) inches for use with ductile iron water service lines shall be gate valves with cast iron bodies. All gate valves larger than three (3) inches shall be supported by adjustable steel valve supports.

#### **442.10** Meter Couplings

All meters shall be installed with a coupling to allow for the removal of the meter without disturbing the pipe. Couplings shall comply with Denver Water Board Specifications Section MS-22.

#### **442.11** Meter Yokes (Copper Setters)

Meter Yokes (Copper Setters) shall be Ford Series 80, McDonald Series 31, Cambridge Series 6040 or Mueller Series P-2474 with an angle ball valve and a padlock wing on the inlet side of meter. Water service connections shall be compression fittings, with a “110”, “Cam Pack”, or “Mac Pack” type fitting and shall be vertical.

#### **442.12** (Left Blank Intentionally)

#### **442.13** (Left Blank Intentionally)

#### **442.14** Meter Pits and Covers

Meter pits for five-eighths (5/8) inch meters shall be twenty (20) inches in diameter and forty-eight (48) inches deep and shall comply with ASTM D1505 and D746 and Denver Water Board Specifications. Meter pit covers shall be tight fitting with double lids for frost protection. Meter pit covers and domes shall have non-metallic, cap-type top lids, and the inner lids shall be plastic, aluminum or rubber. Aluminum shall have a polymer coating such as an epoxy. Meter pits and covers shall comply with Denver Water Board Specifications Section MS-23 and shall be in accordance with the Detail Drawings. Placement of meter pits shall be a maximum of five (5) feet from the front property line. Meters not located in the right-of-way shall require an easement dedication ten (10) feet wide and extending three (3) feet behind the meter.

#### **442.15** Corporation Stops

Corporation stops provide the connection for the water service line to the waterline. Services shall be a minimum of eighteen (18) inches from all pipe joints, fittings and valves. Corporation stops are also required in air and vacuum valve and large butterfly valve installations. Corporation stops are available in

standard sizes  $\frac{3}{4}$ ", 1", 1½" and 2". Refer to the Detail Drawings and Denver Water Board Specifications Section MS-21. Tapered threads other than the inlet thread of corporation valves shall comply with ANSI/ASME B1.20.1. Two spiral wraps of three (3) mil PTFE (Teflon) tape shall be wrapped clockwise around the inlet threads on the closed corporation stops. Liquid sealants or other lubricants shall not be used.

#### **442.16** Curb Stops

Curb stops are required on all water service lines., are to set on the service line on the inlet side of the meter pit to provide a means to shut off the service line. Placement of the curb stop and stop box can vary from a maximum of five (5) feet outside the front property line to a maximum of five (5) feet inside the front property line. Curb stops shall be buried a minimum of four (4) feet – six (6) inches and a maximum of five (5) feet – six (6) inches. Placement of the curb stop and stop box outside the front property line is preferred. Refer to the Detail Drawings and Denver Water Board Specifications Sections MS-21 and MS-23. Curb stops shall not be installed under concrete or asphalt unless approved by the District and shall have a traffic approved curb box.

#### **442.17** Curb Stop Service Boxes

Curb stop service boxes shall be cast iron, Buffalo type. The bottom part shaped like an inverted "U" straddling the service line, shall have a flanged bottom so as to support itself. Curb stop service boxes shall comply with Denver Water Board Specifications Section MS-22. Curb stop boxes shall be to grade and be accessible at the time of meter installation.

#### **442.18** Brass Fitting Couplings

Couplings for brass fittings may be flared or compression.

#### **442.19** Backflow Preventers

Backflow preventers shall be installed on all commercial water service lines and on all residential water service lines that serve more than two units.

### **443.00** Tapping the Main

ALL TAPS SHALL BE WET TAPS. SHUT DOWN OF ANY PORTION OF THE WATER SYSTEM SHALL ONLY BE ALLOWED WHEN UNCONTROLLED CIRCUMSTANCES DO NOT PERMIT A WET TAP. ANY SHUT DOWN OF THE WATER SYSTEM MUST BE APPROVED IN WRITING BY THE DISTRICT.

**TAPPING OF AWWA C905 PIPE SHALL BE MADE WITH A TAPPING SADDLE.**

The District's Operator shall complete tapping of all waterlines up to and including two (2) inch diameter taps. Notification shall be given to the District two working days (forty-eight [48] hours) in advance of the tap in order to provide ample time to schedule the work. In those instances where District crews are not available to complete taps in a timely manner or when the tap is over two (2) inches in diameter, the tap may be installed by a contractor or plumber approved by the District who specializes in the installation of water taps.

**450.00 TRENCHING, BACKFILLING AND COMPACTING**

Trenching, backfilling and compacting shall comply with Section 350.00 TRENCHING, BACKFILLING AND COMPACTING of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

**460.00 HEALTH AND SAFETY SIGNAGE**

A sign reading "NON-POTABLE RECLAIMED WATER—NOT FOR DRINKING" shall be posted at all points where consumption of the water may be attractive to the public (yard hydrants, hose bibs, etc.), in areas of public use which receive reclaimed water and at all valves, control boxes and similar features. This requirement shall not apply to sprinkler heads. Signs reading "ATTENTION: IRRIGATED WITH RECLAIMED WASTEWATER. DO NOT DRINK FROM SPRINKLERS" shall be purchased and posted by the Developer at conspicuous locations in areas irrigated with reuse water. Where signage is not feasible (such as a valve box in a street), the above wording shall be engraved on brass tags riveted to the outside and inside of the component. A signage plan shall be submitted to the District and approval for it obtained before connecting to the District's reuse or raw water system. These signage provisions apply to both new construction and cases where an existing irrigation waterline is connected to the District's reuse or raw water system.

To the extent possible, reuse components such as valve box lids, valves, valve operators, control boxes, etc. shall be painted purple. Warning signs shall be not less than one-eighth (1/8) inch thick, two (2) inches high and four (4) inches wide. "WARNING" shall be in red letters and other lettering shall be in black. Letter size and font shall be as approved by the District. Signs shall be attached by stainless steel chain.

Hose bibs and yard hydrant connections shall be coupling-type, (not threaded) to prevent use of common "garden" hose and possible cross-connections.



**470.00 RESTORATION AND CLEANUP**

Restoration and cleanup shall be completed in accordance with Section 370.00 RESTORATION AND CLEANUP of these CONSTRUCTION STANDARDS & SPECIFICATIONS.