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## STANDARD SPECIFICATIONS – WATER LINE CONSTRUCTION

### PART I – GENERAL

The water lines and appurtenances shall be constructed according to standard accepted practices and as specified herein. Reference to standard specifications, e.g., AWWA, ASTM, etc., made a portion of these specifications by reference shall be the latest edition and revision thereof. All water line improvements and additions must also comply with the Minimum Standards portion of this document, and all applicable Colorado Department of Health and EPA regulations.

#### Description

This section covers the furnishing, installation, and testing of water distribution lines and appurtenances. Contractor shall furnish all equipment necessary for said work and testing.

Contractor shall follow manufacturer's recommended procedures in all handling and installation operations. All water line improvement must also comply with the City's Minimum Standards and all applicable codes, laws, and regulations.

The City will work with the Contractor to establish in the field the final location for new lines, fittings, valves, hydrants, etc. The Contractor shall make such excavations as are necessary to determine the exact location of existing utilities which affect new construction. Where practical, new lines shall be routed to facilitate installation and to minimize construction problems.

#### Related Work Specified Elsewhere

Minimum Standards – Water Line Construction  
Excavation, Backfill, and Compaction Specifications  
Water Service Connections Specifications

#### Proximity Statement

Water lines shall not be laid closer horizontally than ten (10) feet edge-to-edge from any existing or proposed sewer lines, and the water lines shall be at a higher elevation than the sewer. If this is not possible, installation shall be in accordance with the requirements of the City Minimum Standards for Water and Colorado Department of Health and Uniform Plumbing Code requirements.

Force main sewers require a separation from the water main of at least ten (10) feet measured horizontally. There shall be a two (2) foot vertical separation at crossings as is required above. There shall be a casing pipe around the sewer pipe, and the ends of the casing shall have a water-tight seal and have adequate structural support. No water pipe shall pass through or come within ten (10) feet of

a sewer manhole unless absolutely unavoidable, in which case adequate protection as determined by the City Engineer must be provided. Water lines shall have at least five (5) foot horizontal separation from wire utilities.

PART II – PRODUCTS

All materials shall be new, unused, and of the best standard quality available for the purpose intended. Where materials are specified by brand names, materials of equal quality may be substituted if the Contractor submits adequate technical and descriptive data and secures the approval of the City. The City or its designated representative shall be the sole judge of the suitability and acceptance of materials. The City, in some instances, may insist on a particular brand or model (to match materials in use) to minimize the parts inventory and/or O&M requirements.

Ductile Iron Pipe

Conformance	AWWA C151
Thickness	Class 52
Pressure Rating	250 psi
Joints	Rubber Gasket AWWA C11 with Conductivity Straps
Fittings	ANSI/AWWA C153 when available or C110

Gate Valves

Conformance	AWWA C500
Material	Iron Body, bronze mounted
Type	Resilient seat, non-rising stem
Pressure Rating	150 psi, minimum
Joints	Flange or Mechanical Joint end as required, typically flanged to fitting, mechanical joint to pipe
Operating Nut	2” Square, open counter-clockwise
Acceptable Models	Mueller (only these products will be accepted by City)

Valve Box

Type	Slip type, two or three piece 5 1/4" as required, traffic-rated
Base	Suitable for valve size, depth, and operating mechanism
Material	Cast Iron, 1/4” minimum wall thickness

Cover	Cast Iron, traffic type, marked "WATER"
Location	All buried gate valves

Fire Hydrants

Conformance	AWWA C502
Material	Cast Iron Body, fully bronze mounted
Pressure Rating	150 psi, minimum
Type	Breakaway traffic w/easily replaced flange
Size	6" w/6" mechanical joint inlet, 5' minimum bury
Joints	Megalug O.A.E. restraints on mechanical joints
Outlets	2 – 2 1/2" hose nozzles, 1 – 4 1/2" pumper nozzle, all w/National Standard Thread
Operating Nut	1 1/2" National Standard hex, open counter-clockwise
Main Shutoff	Gate valve per spec. above
Acceptable Models	Mueller Modern Centurion (only this model will be accepted by City)

Air Valves

At high points in water mains where air can accumulate, provisions shall be made to remove air by means of air relief valves or other means approved by the City. Air relief valves shall be placed in vaults which allow convenient service of the valve and provide for adequate drainage.

Material	Cast Iron Body, ASTM-approved materials
Pressure Rating	150 psi
Size	3/4" minimum, sized by air flow requirements
Connection	3/4" tapping saddle, tap at high point in line
Main Shutoff	Corporation stop
Support	Support weight so not transferred to water line
Vent	12" above ground, pointed downward, covered with #24 mesh
Acceptable Models	APCO or Valmatic automatic valves

Cross Connection Control Valves

Where there is a potential of backflow, either backpressure or back-siphonage, of a hazardous liquid into the potable water supply, the hazardous liquid shall be isolated from the potable supply by a backflow prevention device such as a reduced pressure principal device (RP), pressure or atmospheric vacuum breaker depending on the location and nature of the hazard. The City shall approve the type of

device to be installed. All cross connection control devices shall meet the standards of the Foundation for Cross Connection Control and Hydraulic Research. The valve shall be used only as recommended by the Foundation, and installation shall be in accordance with its recommendations. A list of currently approved devices and valves is available from the Colorado Department of Health. Valves shall be installed in vaults which allow for convenient testing and maintenance of the valves.

### Miscellaneous Valves

Plans for all large valves, pressure reducing valves, and other specialized valves shall be submitted to the City for review and approval. In all cases, such valves shall be installed in vaults or pits that are sufficiently large to accommodate all operation and maintenance required. Bypass lines are required.

## PART III – EXECUTION

### FIELD LOCATIONS

The City will work with the Contractor to establish in the field the final location for new lines, fittings, valves, hydrants, etc. The Contractor shall make such excavations as are necessary to determine the exact location of existing utilities which affect new construction. Where practical, new lines shall be routed to facilitate installation and to minimize construction problems.

### SERVICE DISRUPTION

Service disruption shall conform to the requirements in the General Requirements. When possible, any construction operations which will result in disruption of services to residential consumers shall be done between the hours of 10 a.m. and 4 p.m. or 11 p.m. and 4 a.m. Notice of the time and day of the shutoff and the estimated length of the time the utility will be out of service should be given to affected consumers 24 hours in advance in accordance with General Requirements. When unexpected disruptions in service occur, Contractor shall notify consumers as expeditiously as possible as to when service will be restored.

### RECEIVING, HANDLING, AND STORAGE

Upon receipt, make overall inspection that pipe has been received in good condition. Pipe should be inspected for any damage or imperfections, and problem joints should be set aside. City reserves the right to inspect all materials received and reject any which does not meet the requirements of City specifications and standards.

Pipe should be unloaded, handled, and stored in accordance with manufacturer's recommendations. Pipe shall be handled during all phases of construction in a manner that will provide the maximum protection of the pipe and any coating or lining and will prevent the intrusion of dirt or other foreign

materials into the pipe. All slings, hooks, and other lifting or handling equipment which comes in contact with pipe and appurtenances shall be padded. Dropping the pipe during unloading or placing in the trench is prohibited and will be cause for rejecting that material.

Only the amount of pipe and fittings necessary to insure efficient installation progress shall be strung along the trenches. All other pipe and fittings shall be stored in the Contractor's yard. Piping strung or stored shall be protected at all times from damage by traffic, workmen, construction operations, and other hazards.

### ALIGNMENT AND GRADE

Pipe shall be laid and maintained to the required line and/or grade shown on the approved plans with fittings, valves, and hydrants at the required locations with spigots centered in the bells. Changes in horizontal or vertical alignment of the pipe at a joint shall not exceed the manufacturer's recommended deflection for the type and size pipe being laid. When the change required is more than that recommended, a fitting or several short joints of pipe shall be used. All changes in direction in excess of eight (8) degrees shall require a fitting unless otherwise approved by the City.

When new pipe is to be connected to an existing pipe or when crossing existing pipeline, the Contractor shall excavate the existing lines well in advance of the laying of the new line to enable the City's representative to verify their elevation and placement and to make any adjustments in grade and/or alignment of the new pipe line that may be required.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged. Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other structures encountered in the progress of the Work shall be furnished by the Contractor at his expense.

Whenever obstructions are encountered during the progress of the Work and interfere to such an extent that an alteration in the approved plans is required, the Contractor shall notify the City and the City shall have the authority to change the plans and order a deviation from the line and/or grade or arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions.

All pipe shall be laid to the depth shown on the approved plans or pipeline typical drawing. The depth of cover shall be measured from the top of the barrel of the pipe to the established finished grade of the street unless changes in street grade are proposed, in which case the cover shall be measured to the proposed depth.

## EXCAVATION AND TRENCH PREPARATION

Excavation shall be in accordance with Excavation, Compaction, and Backfilling Standard Specifications except as more stringent requirements are outlined herein.

### PIPE LAYING

Lowering pipe into trench – Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and convenient performance of the Work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench.

Inspection before installation – The pipe and accessories shall be carefully inspected for cracks and other damage before installation in the final position. Defective or unsound material shall be set aside for inspection by the City who will determine if the material shall be repaired or rejected. Rejected materials shall be removed by the Contractor from the job.

Keeping pipe clean – Every effort shall be made to keep the interior of pipe and fittings clean during all phases of construction. This is especially important if the tablet method of disinfection is to be allowed. The interior of the pipe shall be thoroughly cleaned of foreign material before being lowered into the trench and shall be kept clean during operations by plugging or other approved means. Fittings shall be thoroughly cleaned with a wire brush if necessary. If the pipe laying crew cannot keep pipe clean while placing the pipe in the trench, City may require that the ends of the pipe be covered before placing it in the trench and that the covers only be removed as the joints are assembled. Swabbing may be required by the City if cleanliness is in question.

Laying of Pipe – The full length of each section of pipe shall rest solidly upon the bed, with recesses excavated to accommodate bells and joints. Pipe shall be laid with bell ends facing the direction of laying unless directed otherwise by the City. Pipe laid on slopes 10% and steeper shall be laid from the bottom and proceed upward and have restraints approved by the City. Pipe shall not be laid in water or when trench or weather conditions are unsuitable for the Work unless expressly permitted by the City.

The sub-grade upon which the pipe is placed shall consist of materials suitable for supporting the pipe without excessive settlement or stress development. Fine earthen materials shall be carefully placed and compacted around the pipe and up to a depth of six (6) inches over the top of the pipe. Care shall be taken in backfilling to see that the pipe is not displaced, crushed, cracked, or otherwise injured. In the event that rock or excessively spongy materials are encountered, they shall be removed to a depth of not less than six (6) inches below the bottom of the proposed lines and replaced with an approved



material and mechanically compacted to grade. If no suitable sub-grade material is available from the upper portion of the excavation, approved material shall be imported to the job site.

The sealing surface of the pipe, the bell to be joined, and the elastomeric gaskets shall be cleaned immediately before assembly. Assembly shall be made as recommended by the manufacturer. Unless otherwise directed, the gasket and the bell or the plain end of the pipe to be jointed shall both be lubricated with a suitable soft vegetable soap compound. The spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Care shall be taken to insure that no damage is done to the pipe, collar, gasket, or bell when the pipe is being homed. Any pipe that has had the grade or joint disturbed during or after laying shall be taken out and re-layed.

Any section of pipe, fittings, valves, or hydrants already laid and found to be defective shall be taken up and replaced without additional expense to the City. Flange and mechanical joints shall be made with properly sized machine bolts and nuts. All nuts and bolts utilized in underground connections shall be stainless steel, coated high strength cast iron, or coated high strength wrought iron, depending on soil conditions. All components of these types of joints shall be cleaned before jointing. Only one (1) gasket will be permitted in a flange joint. In a mechanical joint, the plain end pipe shall be fully seated before the gland and gasket is slipped up the bell; care shall be taken to locate the gasket evenly around the entire joint. All nuts on both types of joints shall be tightened by hand first, then by alternating nuts 180 degrees apart. Deflection at a mechanical joint shall not exceed either the manufacturer's recommendation or Table 1 in AWWA C600. Buried bolts and nuts on mechanical and flanged joints shall be covered with double layer of 4 mil plastic and taped closed.

When work is not in progress, open ends of pipe and fittings shall be securely closed by a watertight plug to prevent entry of foreign materials and/or water. If there is water in the trench, the seal shall remain in place until the trench is pumped completely dry. Whenever water is in the trench, enough backfill shall be placed on the pipe to prevent floating. Should any foreign material be allowed to enter the line or to remain in the line after installation, the Contractor shall remove such accumulation with a pipeline scraper or other approved means. Should the Contractor repeatedly fail to prevent dirt or other material from entering the line, he will be required to clean each section of pipe with a pipeline scraper or swab as it is installed. If pipeline cleanliness is in question, the tablet method of disinfection will not be permitted.

Sequencing – Pipeline installation shall follow trench excavation within 100 lineal feet. Trench backfill shall follow pipe installation within 100 lineal feet. Approved cleanup shall follow trench excavation within 100 lineal feet. The City may allow changes in these requirements if field conditions warrant.

Cutting of Pipe – The pipe shall be cut in a neat and workmanlike manner in accordance with manufacturer recommendations. No damage shall be done to the pipe or any lining or coating, and the cut shall leave a smooth end at right angles to the axis of the pipe. Flame cutting of iron pipe by means of an oxyacetylene torch shall not be allowed.

Connection to and Crossing of Existing Lines – When new pipe is to be connected to or cross existing pipe, the Contractor shall excavate the existing lines well in advance of the laying of the new line to enable the City’s representative to verify elevation and placement and to make any changes in grade and/or alignment of the new pipeline that may be required. Connections to existing lines shall be made at the locations shown on the approved plans unless changes are approved by the City. Coordinate timing of the cut with the City, and provide required notice to affected customers. In cutting the existing pipe, take great care to minimize contamination of existing line. Keep water level in the trench below the level of the pipes. Make connection using required fittings and restrain the joint. Disinfect the line as called for below for a repaired line. Cut off and seal abandoned section.

Crossings – Details for crossing roadways, canals, ditches, and arroyos (draws) are covered in a separate specification entitled “Crossings.” All river crossings shall be submitted to the City for specific review and approval.

Setting of Fittings, Valves, and Hydrants – All hydrants, valves, plugs, caps, and fittings shall be provided as shown on the approved plans and set and joined to the pipe in the manner specified herein for cleaning, laying, and joining pipe.

Dead Ends – All unconnected ends of pipe shall have a valve, plug, or cap installed on it with appropriate restraint. In general, plugs shall be inserted into the bells of all dead-end fittings. Spigot ends of accessories, fittings and plain ends of plastic pipe shall be capped. A reaction or thrust block shall be provided at all dead-ends of pipe.

Thrust Blocks – A reaction or thrust block shall be provided at each bend, tee, valve, hydrant, or plug, and at reducers or fittings where changes in pipe diameter or direction occur. The size and shape of the thrust blocking shall be as shown on the typical drawing. Concrete shall be a 5-1/2 sack, 3000 psi at 28 days mix approved by the City. Maximum water in concrete shall be 5-1/2 gallons per sack of concrete. The concrete shall be poured between the pipe and the undisturbed wall of the trench. The concrete shall be placed in such a manner that no concrete is in contact with any bolts or nuts on the fitting, etc., so that the pipe and fitting joints will be accessible for repair. Typically, the joints shall be wrapped with plastic and taped closed. If the connection is to be pressurized before the concrete has time to achieve adequate strength, a joint restraint system such as Megalugs shall also be provided.

Valves and Valve Boxes – Gate valves shall be installed as shown on the City typical drawing and in accordance with the Minimum Standards adopted by the City. In general, a valve shall be provided on each branch of a tee or cross. Care shall be taken to assure that the valve and box are plumb and that

the valve box is properly supported on a concrete base and adjusted for the correct finished grade. A box shall be provided for each buried valve, and the box shall not transmit shock or stress to the valve and shall be centered over the valve nut.

Hydrants – Hydrants shall be located as shown on the approved plans. Final location will be approved by the City in the field and should provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. Hydrants shall be accurately set to the proper bury lines so that bolts are accessible and shall be securely anchored when it is plumb. A gravel fill shall be placed around the hydrant barrel drain port as shown on the typical drawings. Each hydrant shall be connected to the main with a six (6) inch minimum diameter branch controlled by an independent six (6) inch gate valve, installed in accordance with the typical drawings for hydrant and gate valve installation adopted by the City. The Contractor, in the presence of the City, shall test each hydrant by operating it through several open and close cycles.

Air Valves – Air valves shall be installed in all locations where air is likely to accumulate in the water line, most often at high spots in the line. A tap shall be made in the top of the line and a corporation stop installed in the tap. The line shall then be connected to an air valve installed in a manhole or vault that meets the requirements of the material specifications above and shall be installed in accordance with the standard drawing adopted by the City. The valve shall be installed at four (4) feet below finished grade. A frost-free lid shall be provided. Adequate insulation shall be installed around the valve to protect it from freezing.

Cross Connection Control Valves – Cross connection control valves shall be installed in a manner which conforms to the recommendations of the Foundation for Cross Connection Control and Hydraulic Research and shall have sufficient space around and access to the valve to allow for proper testing.

Vaults – Vaults, where required, shall be of concrete with minimum wall thickness of six (6) inches or the minimum required to properly encase the reinforcing steel required by the structure. The vault shall be of such size as to allow easy operation and maintenance of the equipment contained therein. A twenty-four (24) inch minimum access hatch shall be provided over the manway steps to allow access to the vault. Vaults shall include either a floor drain or sump, depending on groundwater conditions.

Concrete Encasements – Concrete shall be the same as for thrust blocks. Prior to placing the concrete for cradles or encasement, temporary supports consisting of concrete blocks or bricks shall be used to support the pipe in place. Size and frequency of such support shall be the minimum which will support the pipe. No encasement shall be poured until the City has inspected and approved the pipe to be encased and its support.

## BEDDING AND COMPACTION

Bedding, backfilling, and compaction shall be in accordance with Excavation, Backfill and Compaction Standard Specifications of the City and pipe manufacturer's specification. Special attention shall be given to placing and compacting select bedding material in the pipe zone. The haunching on PVC pipe shall be compacted to 95% Standard Proctor. Backfill shall not be wheel compacted until there is a minimum of thirty-six (36) inches of compacted cover over the top of the pipe.

## HYDROSTATIC TESTING

The Contractor shall be required to perform hydrostatic tests on all water mains, laterals, deadends, and service lines in accordance with AWWA specifications C600. Prior to making the test, the Contractor shall advise the City of the time and place of the test so that adequate inspection can be provided. Prior to performance of the test, the pipeline shall be completely filled with water for a period of twenty-four (24) hours.

The test shall be conducted in the presence of the City or its authorized representative. The testing of the lines shall be done without being connected to existing lines unless approved by the City. All necessary apparatus for pressure testing, including the pump, pipe connection, gauges, and measuring devices, shall be furnished by the Contractor at no cost to the City. If connections to the existing lines are allowed by the City, it is with the understanding that the Contractor assumes any and all responsibility in case of damage or failure of the existing system. Leakage through connections to the existing system, leaks in the existing lines, or leaking valves under the test pressure will invalidate the test and require the Contractor to find another means to test the line.

Prior to testing, all air shall be bled from the lines. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such high points so the air can be expelled as the line is filled, then the corps closed. The lines shall be tested at 150 psi or 1.5 times the normal working pressure of the lines, whichever is greater, for not less than two (2) hours when performing the combined pressure and leakage test. Test pressure shall be measured at the high point in the line. All taps, gauges, and necessary equipment shall be provided by the Contractor as approved by the City; however, the City may utilize its own gauges if it so elects. Each section of the new line, between valves, shall be tested to demonstrate that each valve will hold the test pressure. No pipe installed will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{N * D * \sqrt{P}}{7400}$$

where L = allowable leakage (gal/hr)  
N = number of joints in the line  
D = nominal pipe diameter (in.)  
P = test pressure (psi)

During the test, the test pressure shall not lose more than 10 psig without being pumped back up to the test pressure. The total gallons of water required to return the line to the test pressure at the end of the test period is the total leakage. If the total leakage is less than the allowable, the line can be given preliminary acceptance. All visible leaks will be repaired regardless of the amount of leakage. If leakage exceeds that allowed based on the above formula, Contractor shall identify problems, make repairs, and repeat the test until the leakage is less than or equal to the allowable leakage.

When separate pressure and leakage tests are to be performed, test procedures shall conform to the procedures detailed in AWWA C600. The duration of the pressure test shall be a minimum of one (1) hour and the duration of the leakage test shall be a minimum of four (4) hours.

Each gate valve shall be tested to insure that it operates properly and provides watertight seal under 1-1/2 times operating pressure in the closed position.

#### DISINFECTION OF POTABLE WATERLINES

General – Flushing and disinfection of potable water lines shall be done in accordance with the procedure set forth in AWWA C601 - Disinfecting Water Mains. All water lines and sections of water line which have been exposed, including lines owned by other parties, must be disinfected. The Contractor shall provide all temporary blowoffs, pumps, chlorination equipment, chlorine and all other necessary apparatus required. The placement of powder chlorine, in each joint of pipe will not be allowed.

Pipe Cleaning – If the pipe contains dirt or heavy encrusted matter that, in the opinion of the City Public Works Director, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a 5% chlorine solution.

Preliminary Flushing – The pipeline shall be flushed prior to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 5 ft./sec. for five minutes minimum through the length of the pipe. If dirt cannot, in the opinion of City Engineer, be removed by flushing, the pipe shall be cleaned and swabbed with a 5% hypochlorite disinfecting solution.

Chlorine Application – In general, chlorine shall be applied using the continuous feed method. The tablet method may be used on short extensions (up to 2500 ft.) of small diameter mains (12-inch and smaller).

Continuous Feed Method – Introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 50 mg/l. Maintain the chlorinated water in the pipeline for a minimum of 24 hours, after which period the treated water shall contain no less than 25 mg/l of chlorine throughout

the entire length. Repeat the above procedure if the residual at the end of the 24 hours fails to meet the minimum concentration.

Tablet Method – This method shall not be used if trench water or foreign material has entered the line or if the water is below 5 degrees C (41 degrees F). Because preliminary flushing cannot be used with this method, tablet method shall only be used when scrupulous cleanliness has been exercised. Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/l. Refer to Table 3 of AWWA C601 for the required minimum number of tablets (2 tablets for 6” and 3 for 8” pipe in 20’ joints). All tablets within the main must be attached at the top of the pipe with an adhesive appropriate for potable water. Tablets shall also be placed on all hydrants. Introduce water into the pipeline at a rate no greater than 1 ft./sec. and retain the water in the pipeline for a period of 24 hours. The minimum residual shall be 5 mg/l throughout the line.

Disinfecting Existing Mains – The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and may not require disinfection.

When an old line is opened, either by accident or by design, the excavation is likely to be wet and could be contaminated. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

The following procedure is considered as a minimum that may be used.

Swabbing with Hypochlorite Solution – The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a 5% hypochlorite solution before they are installed.

Flushing – Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated. Lines shall be flushed in a manner which will not cause any environmental harm or any damage to property.

Where practicable, in addition to the above procedures, a section of main in which the break is located shall be isolated, all service connection shut off, and the section flushed and chlorinated as described for new lines, except that the dose may be increased to as much as 500 mg/l and the contact time reduced to as little as 1/2 hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated, and chlorine concentration is equal to that in the system.

Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

Final Flushing – After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system, or less than 1 mg/l. When the tablet method has been used, provide a flushing velocity equal to that of the preliminary flushing specified above.

Bacteriologic Tests – After completion of the final flushing and prior to placing the pipeline in service, collect samples from the end of the line and test for bacteriologic quality to show the absence of coliform organisms. The number and frequency of samples shall conform to the requirements of the public health authority having jurisdiction, but in no case shall the number be less than one for chlorinated supplies and two collected 24 hours apart for unchlorinated supplies. Collect samples in sterile bottles from a standard corporation stop installed in the main. Do not collect samples using a hose or fire hydrant. Sterilize the corp stop prior to sampling.

Repetition of Procedure – If the original disinfection fails to produce satisfactory samples, repeat the disinfection procedure until satisfactory results are obtained.

## WATER DISTRIBUTION SYSTEM

### MINIMUM DESIGN STANDARDS

#### MATERIALS

Pipe, fittings, valves and fire hydrants shall conform to the latest standards issued by the AWWA, Colorado Department of Health, and shall comply with City's detailed standard specifications. In the absence of such standards, materials meeting applicable Product Standards may be submitted to the City for review and approval. Jointing material used in joining pipe shall meet pipe manufacturer's specifications and AWWA Standards as well as the City's Standards.

#### Ductile Iron Pipe(DIP) – Water

Conformance	AWWA C151/A21.51
Thickness	Class 52
Pressure Rating	350 psi, unless greater required by field conditions
Joints	Bell and Spigot/Mechanical
Fittings	Ductile Iron AWWA C153
Marking	Metallic marking tape, placed 12" above pipe

#### Gate Valves

Conformance	AWWA C500
Material	Iron Body, bronze mounted
Type	Resilient seat, non-rising stem
Pressure Rating	250 psi
Joints	Flange or Mechanical Joint end as required Typically flanged to fitting, mechanical joint to pipe
Operating Nut	2" Square, open counter-clockwise
Acceptable Models	Mueller (only this products will be accepted by City)

#### Valve Box

Type	Slip or screw type, two piece 5 1/4", traffic rated
Base	Suitable for valve size and operating mechanism
Material	Cast Iron, 1/4" minimum wall thickness
Cover	Cast Iron, traffic type, marked "WATER"
Location	All buried gate valves



### **Water Meters**

Conformance	AWWA C700
Material	Brass
Pressure Rating	150 psi
Type	Register, EnviroBrass II maincase, mutating disc Measuring chamber
Size	¾ or 1-inch
Acceptable Model	Neptune T-10

### **Fire Hydrants**

Conformance	AWWA C502
Material	Cast Iron Body, fully bronze mounted
Pressure Rating	150 psi
Type	Breakaway traffic w/easily replaced flange
Size	6" w/6" mechanical joint inlet, 5' minimum bury
Joints	Megalug O.A.E. restraints on mechanical joints
Outlets	2 – 2 1/2" hose nozzles, 1 – 4 1/2" pumper Nozzle, all w/National Standard Thread
Operating Nut	1 1/2" National Standard hex, open counter-clockwise
Main Shutoff	Gate valve per spec. above
Acceptable Models	Mueller Modern Centurion (Only this model will be accepted by City)

### **MINIMUM FLOW**

Design shall be based on an average peak flow of four (4) gallons per minute (gpm) per tap and 8 gpm per dead end for lines servicing five or more taps. Instantaneous residential flow shall be assumed to be 15 gpm. Fire flow in residential areas shall be at least 1000 gpm, unless agreed upon by the City. The required flow may be from more than one hydrant, provided the additional hydrants are accessible to all possible fire locations.

Commercial and industrial flows shall be designed based on the nature of the business, using such references as Department of Health guidelines for sizing lines. The City will have final review authority on all such lines. Fire flow in commercial and industrial areas shall be at least 1000 gpm and, if the business has an above average hazard, the fire flow will be determined by the City with assistance from the State Fire Marshall's office to insure no detrimental impact on the fire rating of the City.

All areas shall be designed to have a maximum static head of 140 psi with City mains designed to have 90 psi or less except for short distances. A minimum static head of 60 psi. Distribution systems shall

be designed to maintain a 35 psi residual pressure during required fire flow and peak residential flows. Pressure zones shall conform to existing City zones as approved by the City.

### LINE SIZE

Size and location of all water lines shall be designed by a competent, licensed engineer and must be approved by the City. The City may, at its option, waive the requirement for an engineered design when the line is less than one hundred (100) feet and will serve less than five (5) residential taps. The minimum line size shall be six (6) inches, except that four (4) inch mains may be installed on permanent deadends less than one hundred fifty (150) feet long which serve three (3) or less houses and when a permanent flushing hydrant is provided. Any lines that temporarily deadend and that will be tapped for service before being extended shall be provided with a temporary flushing hydrant.

If the City anticipates future expansion from the area which would require a larger main than that required by the proposed development, the City will work with the applicant in determining an equitable breakdown for the additional cost, in most cases only the price difference for the increase in materials costs.

### WATER LINE LOOPING

Water mains shall be designed through a subdivision so that a continuous loop is provided for an alternate source of water, better circulation, and more even pressure. A variance of the alternate source looping requirement may be considered when the amount of pipe required to complete the loop will exceed 70% of the line required to serve the subdivision in accordance with City specifications and the total cost of the water system extension will exceed \$3,000 per tap plus inflation (based on 1992).

### VALVE SPACING

A sufficient number of valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. The water system for residential areas shall be designed so that only one block need be closed off in the event of a water line break. Gate valves shall be placed at all pipeline intersections so that each segment of line can be isolated while minimizing the number of customers out of water. Where the line runs as a single segment for long distances, valves should be placed at least at quarter-mile intervals with more frequent intervals being required on larger lines and in densely populated areas.

Valves shall be placed at each fire hydrant and permanent flush hydrant. Air vacuum valves shall be installed at high points on primary feeders and where venting high points through a fire hydrant is not feasible on other mains.

### HYDRANTS

Fire hydrants shall be placed at the intervals recommended by the State Insurance Services Office, generally at four hundred (400) foot intervals. Hydrants shall also be located to facilitate flushing and draining, even if that necessitates reducing the spacing. Hydrant leads shall be a minimum of six (6) inches in diameter. Auxiliary valves shall be installed on all hydrant leads in conformance with typical drawings. Fire hydrant bottom valve size shall be at least five (5) inches. Nozzle size and threads shall be confirmed with the requirements of the Ouray Fire District.

Hydrant weep hole and leach area shall not be connected to or located within ten (10) feet of sanitary sewers or storm drains. In cases where an existing sewer conflicts with a proposed hydrant leach area, the City may allow concrete encasement of the sewer or other solution on a case-by-case basis.

Propylene glycol shall be the only antifreeze utilized for freeze protection of hydrants.

#### Cross Connections

There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the City potable water system. Any interconnections between potable water supplies shall have prior written approval of the City.

#### Service Connections

The installation of service lines and taps will be performed by the City public works staff, or with City approval, under City supervision. Residential lots shall be served by a three-quarter (3/4) inch or 1-inch tap. Materials shall conform to materials specified in the Standard Specifications and installation according to typical water tap and meter installation drawing.

Service lines shall be installed perpendicular to the main and shall be located ten (10) feet inside the uphill property line. Any variance of this layout will require justification and approval of the City. Meter cans shall be set in the public right-of-way at property line or just to the street side of the sidewalk. Service lines shall be stubbed across the property line through the width of the utility easement with the end sealed with a watertight seal and marked full depth with a 2x4 painted blue and brought to grade.

#### Proximity Statement

Water lines shall not be laid closer horizontally than ten (10) feet edge-to-edge from any existing or proposed sewer or other non-potable pipelines and the water lines shall be at a higher elevation than the sewer. If this is not possible, separate trenches will be required and the water line shall be at least eighteen (18) inches above the sewer. When water and sewer lines cross each other, the water line

shall be at least eighteen (18) inches above the sewer. If this distance is less than three (3) feet, the sewer shall be of ductile iron for a distance of ten (10) feet each side of the crossing with no point closer than eight (8) feet from the crossing. If the sewer pipe is of concrete, clay, or PVC, it shall be encased in concrete for a distance of ten feet each side of the crossing or replaced with ductile iron pipe.

Force main sewers require a separation from the water main of at least ten (10) feet measured horizontally. There shall be a two (2) foot vertical separation at crossings as is required above. There shall be a casing pipe around the sewer pipe, and the ends of the casing shall have a water-tight seal and have adequate structural support. No water pipe shall pass through or come within ten (10) feet of a sewer manhole unless absolutely unavoidable, in which case adequate protection as determined by the City Public Works Director must be provided.

### Testing

Testing of water lines, services, and appurtenances shall conform to the requirements of AWWA and the applicable Standard Specifications of the City.

## WATER SERVICE CONNECTIONS

### PART I – GENERAL

- Work Included
- Related Work Specified Elsewhere

### PART II – PRODUCTS

### PART III – EXECUTION

- General
- Depth of Bury
- Meter Lid Elevation
- Installation

## STANDARD SPECIFICATIONS – WATER SERVICE CONNECTIONS

### PART I – GENERAL

Work Included – Water service connections shall be installed as designated on the approved plans. These shall be served off the water line parallel to their property line unless otherwise indicated. Service lines shall be perpendicular to the main unless otherwise approved by the City. Installations shall be in accordance with details shown on the standard drawing.

Service connections for all pipe diameters and classes shall be made by means of a saddle with corporation stop. There shall be no direct taps.

#### Related Work Specified Elsewhere

Excavation and Backfilling  
Water Line Construction

### PART II – PRODUCTS

The City has, based on experience, selected the specific products listed below for the quality of the specific products and models. These are the same products that are used by the City in City-constructed installations. Unless specifically stated for a particular product, alternate products will not be accepted.

**Direct Taps – Direct taps are the preferred method for connecting a service line to the water main.**

Corporation Stops – Corporation ball stops shall be of all bronze with individually lapped ground keys. Inlet shall be Mueller CC thread. Outlet shall be for use with copper tubing, flared joint. Stops shall be Mueller H-15002.

Service Saddles – If a direct tap is not possible, then service saddles shall be bronze, double strap, with O-Ring gasket seal on main. Gaskets shall be neoprene. Saddles shall be Mueller BR 2 B Series or approved equal.

Meter Cans – 20” diameter plastic sections 36 tall with a 12” aluminum top ring section. The inner lid shall be aluminum and the outer lid will be cast iron.

Service Pipe – Pipe for water service shall be type “K” copper tubing conforming to ASTM B-88-62 to ASTM and NSF standards for potable water service. The couplings shall be brass whenever brass is available for the configuration required.

Reduced Pressure Backflow Preventive – Backflow device for three-quarter (3/4) inch and one (1) inch service shall be Mueller M-98 ASSE approved top entry vertical check valve, and shall be installed in the main water service meter can. For services greater than one (1) inch, the reduced pressure device and its installation will be subject to review and approval by the City.

Meter – Residential meters shall be Neptune Proread Model T-10 5/8” by 3/4”.

NOTE: Corporation stops, service lines, curb stops, water meter and pit will be installed by the City’s Public Works crew unless the City approves a subcontractor to do the installations. The property owner will be responsible for all time and material charges associated with the installations.

**Pressure Regulating Valves-PRVs – Pressure regulating valves will be required on the service line side of the meters. These valves shall be placed on the service lines where they enter the structure. They will be placed where there is adequate room to service these valves. The recommended PRV is Wilkens Model 600 and will be available through the City at cost.**

### PART III – EXECUTION

General – All water services shall be stubbed out to through the utility easement. Generally, meters shall be set at property line. When sidewalks are set close to property line, meters shall be set in the green belt near the sidewalk. In all cases, owner responsibility for the service line shall begin at the meter.

Installation of service lines shall be by open cut with bedding, backfill, and compaction in conformance with Standard Water Line Specifications and Standard specifications for Excavation, Backfill and Compaction.

Depth of Bury – All water services shall have a minimum of five (5) feet of bury.

Meter Lid Elevation – The lid for the meter can boxes shall be sufficiently high to be readily visible, but shall be adjusted to blend to finished grade of the surrounding property and landscape.

Installation – Care shall be taken in laying the service line to prohibit kinks in the line. In placing backfill around pipe, use only select materials which will bed and support the pipe and not cause injury to it.

Copper tubing shall only be cut and flared with tools especially designed for those purposes.