

SECTION 02512

SITE WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings for site water lines including domestic water lines.
 - 2. Valves.
 - 3. Hydrants.
 - 4. Pipe markers.
 - 5. Precast concrete vault.
 - 6. Bedding and cover materials.
 - 7. Water System Accessories.

- B. Related Sections:
 - 1. Section 02060 - Aggregate: Aggregate for backfill in trenches.
 - 2. Section 02324 - Trenching: Execution requirements for trenching required by this section.

1.2 REFERENCES

- A. Colorado Department of Transportation:
 - 1. 2005 CDOT Standard Specifications for Road and Bridge Construction.

- B. American Society for Testing and Materials:
 - 1. ASTM A536 – Standard Specification for Ductile Iron Castings.
 - 2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 3. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
 - 4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 5. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

- C. American Water Works Association:
 - 1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch for Water and Other Liquids.
 - 4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C153 – Ductile-Iron Compact Fittings, 3-inch Through 16-inch, for Water and Other Liquids.
7. AWWA C205 – Cement-Mortar Protective Lining and Coating for Steel Water Pipe- 4-inch and larger- shop applied.
8. AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4-inch Through 144-inch.
9. AWWA C502 - Dry-Barrel Fire Hydrants.
10. AWWA C504 - Rubber-Sealed Butterfly Valves.
11. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
12. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
13. AWWA C605 – Underground installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
14. AWWA C651 – Disinfecting Water Mains.
15. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
16. AWWA C905 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch.

- D. Underwriters Laboratories Inc.:
1. UL 246 - Hydrants for Fire - Protection Service.

1.3 SUBMITTALS

- A. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents “AS BUILTS”: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Cañon City standards.
- B. Maintain one copy of each document on site.
- C. Valves: Manufacturer's name and pressure rating marked on valve body.
- D. Pipe: Acceptance of DI pipe that has cracks within the cement lining or PVC pipe that is “sunburned” shall be accepted at the Engineer’s discretion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Pipes, fittings, valves, and accessories shall be loaded and unloaded or otherwise handled in such a manner as to minimize the possibility of damage prior to installation. All materials shall be stored at the construction site in such a way as to prevent damage and to assure they are kept as clean as possible prior to installation.

PART 2 PRODUCTS

2.1 WATER PIPING

- A. Ductile Iron Pipe: AWWA C151 and C104, Pressure Class 350, exceptions by Engineer may include Class 51 or 52.
 - 1. Fittings: Ductile iron, compact, AWWA C153, manufactured/cast in U.S.A.
 - 2. Joints: AWWA C110, C111, and C153, rubber gasket, mechanical joint restraints (“Mega-lug”, retainer gland) for all connections to valves and fittings.
 - 3. Jackets: AWWA C105 polyethylene jacket, half lapped, 8 mil (0.008 inch), polyethylene tape.
 - 4. Coatings & Linings: AWWA C205, cement-mortar lining, bituminous seal coating.
 - 5. Size:
 - a. Except for permanent cul-de-sacs of less than 500 feet in length, the minimum size of any new water main within the distribution system shall be eight (8) inches in diameter.
 - b. In streets that have a permanent cul-de-sac less than 500 feet in length, the Engineer may authorize a water main that is six (6) inches in diameter.
 - c. In location where the Engineer determines that a water main must be larger than eight (8) inches in diameter, the water main shall be of such size as specified by the Engineer or according to the City’s Master Plan.
 - d. Larger sizes shall be required as needed to provide proper distribution flow, pressure, and fire protection.
 - 6. Use/Location: Allowed for use in entire system. Shall be polyethylene encased to AWWA C105 at all locations north of Arkansas River and south of Arkansas River only when aggressive or “hot” soils are shown to exist.
- B. Copper Tubing: ASTM B88, Type K, annealed
 - 1. Fittings: Flared.
 - 2. Joints: Flared.
 - 3. Size: ¾ inch minimum.
 - 4. 1 ½ inch – 2 inch service lines can be rigid copper w/ silver solder connections.

- C. PVC Pipe: AWWA C900 (~~PC-150 & 200~~) and C905 (~~PR-165 & 235~~),
1. Fittings: AWWA C111, cast iron, wrapped, manufactured/cast in U.S.A.
 2. Joints: ASTM D3139 compression gasket ring, AWWA C153 and C900, mechanical joint restraints (“Mega-lug”) for all connections to valves and fittings.
 3. Jackets: Fittings and valves only, AWWA C105 polyethylene jacket, half lapped, 8 mil (0.008 inch), polyethylene tape.
 4. Size:
 - a. Except for permanent cul-de-sacs of less than 500 feet in length, the minimum size of any new water main within the distribution system shall be eight (8) inches in diameter.
 - b. In streets that have a permanent cul-de-sac less than 500 feet in length, the Engineer may authorize a water main that is six (6) inches in diameter.
 - c. In location where the Engineer determines that a water main must be larger than eight (8) inches in diameter, the water main shall be of such size as specified by the Engineer or according to the City’s Master Plan.
 - d. Larger sizes shall be required as needed to provide proper distribution flow, pressure, and fire protection.
 5. Thickness: DR-18 for sizes 6 inch – 12 inch or DR-14 when static pressure exceeds 100 psi, DR-25 for sizes greater than 12 inch or DR-18 when static pressure exceeds 100 psi.
 6. Use/Location: Allowed for use in entire system.

2.2 VALVES

A. GATE VALVES

1. Valves: Manufactured/cast in U.S.A.
2. Smaller than 12 inch: AWWA C509, iron body, resilient seat, open left, non-rising stem with 2 inch square nut, single wedge.
3. Accessories: Manufactured/cast in U.S.A.

B. BUTTERFLY VALVES

1. Valves: Manufactured/cast in U.S.A.
2. 12 inches or larger: AWWA C504, iron body, bronze disc, resilient replaceable seat, open left, non-rising stem with 2 inch square nut.
3. Accessories: Manufactured/cast in U.S.A.

2.3 HYDRANT

- A. Manufacturers:
 - 1. Mueller Company Model Centurion A423.
 - 2. Waterous Company Model WB-67 (Pacer).
- B. Hydrant: AWWA C502, UL 246, dry barrel type, traffic “break away” type, safety stem coupling, frangible bolts or safety flange allowing full rotation of nozzle section, main valve opening 5 ¼ inch minimum, 6 inch mechanical joint inlet, 1 ½ inch pentagon operating nut, open left.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- D. Hose and Steamer Connection: 2 hose nozzles, 1 pumper nozzle, national standard threads, mechanical lock-in device on nozzles, 1 ½ inch pentagon nut on caps.
- E. Finish: Red in color to match existing hydrants in system.

2.4 PIPE MARKERS

- A. UNDERGROUND- Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, continuous No. 12 TH HN coated wire, silicon filled waterproof connectors/nuts.
- B. AT SURFACE- Marking Posts: Marking posts shall be installed per manufacturer’s instructions above the water main, in rural unpaved areas to be determined by Engineer, every 200 feet and at every valve and bend. The posts shall be “Rhino 3-Rail” or approved equal. The posts shall be blue in color and have UV stable, all-weather decals affixed that are marked with the international “No-Dig” symbol and have a highly visible white and blue warning that reads “WARNING WATER PIPELINE, BEFORE DIGGING IN THIS AREA CALL CITY OF CANON CITY WATER 719-269-9022”. Decals shall measure 2-7/8” X 14”.

2.5 PRECAST CONCRETE VAULT

- A. Furnish materials in accordance with City of Cañon City standards.
- B. Product Description: Pre-cast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories per City of Cañon City Standard Detail W-5C.

2.6 BEDDING AND COVER MATERIALS

- A. Road Base: Type Class 6 as specified in Section 02060.
- B. Flow-Fill: Structural Backfill that meets the requirements of 2005 CDOT Standard Specifications for Road and Bridge Construction, Section 206.02; within the following limits:
 - 1. Components per cubic yard

Fine Aggregates (Type A2 as specified in Section 02060)	1,845 lbs.
Coarse Aggregates (Type A1 as specified in Section 02060)	1,700 lbs.
Cement	50 lbs.
Water	325 lbs.
 - 2. Slump – 6 inch minimum, 8 inch maximum
 - 3. Strength – 10 psi minimum in 1 day, 60 psi maximum in 18 days.

2.7 ACCESSORIES

- A. Concrete for Thrust Restraints, Cradles, Valve Blocking, and Encasements:
 - 1. Refer to City of Cañon City Standard Detail W-4 for restraint sizing.
 - 2. Concrete: compressive strength of 3000 psi in 28 days.
- B. Air & Vacuum Valve Vault: Refer to City of Cañon City Standard Detail W-7.
- C. Bell Joint Restraint: ductile iron, ASTM A536, split ring for sizes greater than 12 inch.
 - 1. PVC pipe: restraint mechanism shall consist of a plurality of individually activated gripping surfaces to maximize restraint capability, EBAA Iron series 1600 or 2800 respectively.
 - 2. DI pipe: restraint mechanism shall consist of a wedge action restraint ring on the spigot joint to a ductile iron follower gland behind the bell, EBAA Iron series 1700.
- D. Bolts: Cor-ten steel by U.S. Steel Company or approved equal.
- E. Tapping Sleeves: 304 stainless steel including bolts and nuts with full circle gasket, AWWA C207 Class D ANSI 150# flange drilling pattern with gasket, Romac “SST3” Stainless Steel, drilling size on size taps requires a ½ inch undersize shell cutter.
- F. Valve boxes: 5 ¼ inch diameter screw type, No. 564S recommended or others for varying depth, “WATER” shall be cast in valve box covers, bonnet required for valves 12 inches or larger.
- G. Tapping Saddles: Nylon coated, ductile iron, double stainless steel straps, Smith Blair 317.
- H. Corporations: Ball type, CC threaded X flared, Ford FB600.
- I. Curb Stops: Ford B22-333, flared connections.

- J. Valve Blocking: solid concrete blocks, 4-inch x 8-inch x 16-inch minimum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify connections and municipal utility water main size, location, and invert as indicated on Drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BORING

- A. A qualified contractor shall perform boring with proper boring equipment.
- B. Water pipe shall be installed through a steel sleeve under irrigation canals, railroads, creeks, waterways, and other structures designated by the Engineer.
- C. Steel sleeve shall be of Standard Weight, Schedule 30 steel, with a diameter adequate to receive the pipe bells and insulators.
- D. Corrosion resistant coated casing insulators with steel bands and glass reinforced plastic runners shall be installed and centered within the sleeve according to the manufacturer's instructions at the maximum allowed spacing.
- E. Rubber end seals with stainless steel bands, clamps, and screws shall be installed on both ends of the sleeve

3.4 BEDDING

- A. Excavate pipe trench in accordance with Section 02324 for Work of this Section.
- B. Minimum support for the pipe shall be directed by the Engineer to meet conditions in the field. No pipe shall be installed when the Engineer has determined that the trench conditions are unsuitable.
- C. Prior to placing concrete for cradles or encasements, temporary supports consisting of concrete blocks shall be used to support the pipe in place. Not more than two supports shall be used for each pipe length, one on either end. Inspection by Engineer is required prior to placement of concrete.

- D. Place bedding material at trench bottom per City of Cañon City Standard Detail W-3, level fill materials under pipe in one continuous layer not less than 4 inches compacted depth up to 6 inches above the top of the pipe; compact to 92 percent, maximum dry density, ASTM D698, Standard Proctor.
- E. Place fill material in accordance with Section 02324.

3.5 INSTALLATION - PIPE

- A. Carefully lower pipe and fittings into trench in such a manner as to prevent damage to the water main materials and protective coatings and linings.
- B. Prevent foreign material from entering pipe or joint space while it is installed. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe. At times when installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or as directed by the Engineer. If water is in trench, the plug shall remain in place until the trench is pumped completely dry.
- C. Maintain separation of water main from sewer piping a minimum of 10 feet. At no time shall a bell or spigot PVC pipe joint be located within 5 feet of the centerline of a sanitary sewer pipe trench.
- D. When water pipeline crosses a sanitary service, perform work in accordance with City of Cañon City Standard Detail W-6. The Contractor shall physically locate the centerline of the existing sewer main and center of a full pipe joint (nominal joint length of 20 linear feet) across the sewer main (+/- 1-foot from the center of the joint). Crossings shall likely require the Contractor to cut and re-bevel the end of the previously laid pipe joint to fit. New water main shall be installed a minimum of 6-inches above the top of the existing sewer main pipe. The water main shall be blocked on both sides of the sewer pipe with concrete blocks resting on undisturbed native soil. Bedding and backfill materials within 3-feet either side of the intersection of water and sewer pipe shall be lightly compacted (less than 95% Standard Proctor density) until the water main is backfilled to approximately 6-inches above the top of the pipe, at which point normal compaction shall begin.
- E. Water mains shall be installed so that a continuous loop is provided for an alternate source of supply where deemed practical by the City.
- F. Water mains shall be placed under traveled portion of roadway if possible. Provide staking for alignment and elevation of water mains a minimum of 50 feet apart and for location of hydrants.
- G. Install pipe with a minimum of 3 ½ feet and a maximum of 7 feet of cover from top of the pipe to the final finished grade of street. Maintain a minimum of 3 feet of cover over pipe at all times during construction.
- H. If for any reason, minimum and maximum cover cannot be maintained over existing installed water mains or water service lines; the mains and service lines so affected shall be relocated at the expense of the developer/owner.

I. Mechanical Joint Fittings:

1. Install ductile iron piping and fittings per AWWA C600 and PVC piping and fittings per AWWA 605.
2. All fittings and valves used north of the Arkansas River shall be wrapped/encased with polyethylene jacket per AWWA C105.
3. There shall be a minimum of 18 inches of pipe between all valves and fittings.
4. Remove all oil, grit, excess coating, and foreign material from inside the fitting. Slip the follower gland on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. Place the rubber gasket on the spigot end with the thick edges toward the gland. Push the entire section of pipe forward to seat the spigot in the socket end of the fitting. Press the gasket into place within the socket. Move the follower gland along the pipe into position for bolting. Insert all the bolts and “finger” tighten nuts. Tighten nuts spaced 180 degrees apart alternately in order to produce an equal pressure on all parts of the gland. Tighten all nuts with a torque limiting wrench according to the following torques:

<u>Bolt Size (inch)</u>	<u>Torque (ft-lb)</u>
5/8	40-60
3/4	60-90
1	70-100
1 ½	90-120

J. Push-On Joint Pipe:

1. Remove all oil, grit, excess coating, and foreign material from inside of bell and outside of spigot.
2. Flex the circular rubber gasket inward and insert in the recess of the bell. Apply a thin film of gasket lubricant to the inside surface of the gasket and the spigot end of the pipe.
3. Install the spigot end of pipe in bell without letting it contact the ground. Push the joint together. Pipe that is not furnished with a depth mark shall be marked prior to assembly to assure that spigot is installed to the proper depth.
4. Field cut spigot ends shall be filed and ground smooth and angled to resemble the original manufactured end.

K. Water mains shall be designed to be restrained mechanically without the use of thrust blocks when at all possible:

1. Design of number and placement of mechanical joint restraints shall be by a licensed professional engineer.

2. Install “Mega-Lug” fittings or retainer glands on all fittings and valves. Form and place concrete for thrust restraints at elbow or change of direction of pipe main in addition to mechanical restraints only at the Engineer’s direction or as shown on Drawings.
 3. At a minimum, install a bell joint restraint when a bell end is within 14 feet of a fitting or valve. Also, the last section of pipe at a dead end shall have a bell joint restraint, in addition to adequate blocking, if the section is less than 14 feet. Pipe sizes larger than 8 inch diameter will have different requirements.
 4. A closed valve that will be pressure tested against shall be considered as a dead end. Payment for Bell joint restraints shall be incidental to the cost of the sleeve or pipe installed.
 5. Locking gaskets (if available) may be substituted for bell joint restraints where applicable with the Engineer’s approval.
- L. Route pipe in straight line at a constant depth. When pipe is laid on a grade of 10 percent or greater, the laying shall start at the lower elevation and shall proceed uphill with the bell ends of the pipe uphill.
- M. Install pipe to allow for expansion and contraction without stressing pipe or joints per pipe specifications.
- N. Concrete Thrust Restraints (when applicable):
1. Concrete thrust restraints shall be necessary when connecting to existing water mains.
 2. Form and place concrete for pipe thrust restraints at change of pipe direction when required by Engineer or not otherwise restrained.
 3. Place concrete to permit full access to pipe and pipe accessories against undisturbed trench wall.
 4. Use plastic “bond breaker” between concrete restraint and pipe or fitting.
 5. Allow concrete restraint to cure for 12 hours before continuing backfill operations.
 6. Per City of Cañon City Standard Detail W-4.
- O. Install trace wire continuously to the top of PVC pipe taped at intervals to keep it on top of pipe during backfill operations; coordinate with Section 02324. Bring trace wire to surface at every hydrant location or at locations indicated by Engineer.
- P. Backfill trench in accordance with Section 02324 and per City of Cañon City Standard Detail W-3.

3.6 INSTALLATION - VALVES AND HYDRANTS

- A. Install valves at locations indicated on Drawings. Install a minimum of one valve every two blocks in residential areas and every block in business or high-density areas.
- B. Set valves on blocking placed on subsoil.
 1. Valves up to and including 8 inch: install solid concrete blocks, 4-inch x 8-inch x 16-inch minimum.

2. Valves 10 & 12 inch: blocks under 10-inch and 12-inch butterfly valves shall be pre-cast concrete 3-foot wide X 3-foot wide and 6-inches thick. The blocks shall be constructed with concrete of a compressive strength of 3500 psi at 28 days and reinforcement of #4, grade 40 deformed bar at 12-inch o.c. each way. Smaller blocks will be stacked tightly onto the pre-cast block up to the bottom of the valve operator nut of all butterfly valves. Flow-fill in addition to blocking shall be installed a minimum of 8 inches under valve up to the spring line of the pipe.
 3. Valves greater than 12 inch: blocks under valves shall be pre-cast concrete 4-foot wide X 4-foot wide and 6-inches thick. The blocks shall be constructed with concrete of a compressive strength of 3500 psi at 28 days and reinforcement of #4, grade 40 deformed bar at 12-inch o.c. each way. Flow-fill in addition to blocking shall be installed a minimum of 8 inches under valve up to the spring line of the pipe.
 4. The Engineer may specify for valves of all sizes cast-in-place concrete blocking.
- C. Center and plumb valve box over valve. Set box cover flush with finished grade.
 - D. Install hydrants at locations indicated on Plans and as required by the Fire District.
 - E. When a drainage ditch deeper than 2 feet exists between a hydrant and the roadway, a culvert of appropriate size of at least 10 feet in length shall be installed centered on the hydrant per Specifications.
 - F. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
 - G. Set hydrants to grade, with nozzles at least 16 inches above ground.
 - H. Connect hydrant to water main with a 6-inch branch line (using the least amount of joints possible) controlled by an independent 6-inch gate valve. Locate control valve per Detail.
 - I. Provide drainage pit 12 inches square by 12 inches deep (in clay or other impervious soil, pit shall be 36 inches square by 36 inches deep) filled with 1 ½ inch washed gravel with a waterproof barrier on top between pit and backfill. Encase elbow of hydrant in gravel to 12 inches above drain opening.
 - J. Install hydrant and blow-off assemblies in accordance with City of Cañon City Standard Details W-1 and W-2. A hydrant or blow-off assembly must be installed at all dead ends on water mains.

3.7 INSTALLATION - METERS

- A. Install Work in accordance with City of Cañon City standards and Standard Details W-5A, W-5B, and W-5C.

3.8 SERVICE CONNECTIONS

- A. City of Cañon City Water Department personnel will perform the installation of taps on the water main. All required shoring and safety measures shall be in place prior to City personnel entering the trench to make the taps. The Contractor shall perform excavation, backfill, compaction, and maintenance of trenches for the water main taps and service lines.
- B. Where it is required to reconnect the existing tap to the new water main, the Contractor shall extend the existing service line to the new main. Where the Contractor encounters existing galvanized steel or lead pipe water service lines, the Contractor shall completely replace such lines with type K copper tubing of equal diameter or larger (3/4 inch minimum). This work shall include miscellaneous fittings for connection to the existing curb stop or water meter, or coupling connection at the edge of the street R-O-W, as approved by the Engineer.
- C. No service line splices are be allowed to be installed under a newly constructed, reconstructed, or over-layed street.
- D. Service lines shall be placed with a minimum of 3 ½ feet and a maximum of 7 feet of cover from the top of line to the final finished grade of street.
- E. If for any reason, minimum and maximum cover cannot be maintained over existing installed water mains or water service lines; the mains and service lines so affected shall be relocated at the expense of the developer/owner.
- F. The Contractor is encouraged to use small diameter boring equipment wherever practical for installation of service lines.
- G. Taps will never be made on PVC water mains until such lines have been isolated and depressurized.
- H. Tapping saddles are not required on ductile iron water mains.
- I. Taps will not be made until the water main has been tested and accepted.
- J. Taps will be placed in the top quadrant of the water main at a 45 degree angle no closer than 18 inches to another tap, fitting, valve, or a spigot/bell end of pipe.
- K. A minimum of 1 foot of new pipe must be installed on the outside of a new pit on the customer side.
- L. Saddle nuts shall be tightened evenly with the following torque:

<u>Bolt Size (inch)</u>	<u>Torque (ft-lb)</u>
5/16	10-12
1/2	25-30
5/8	50-60

3.9 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system per AWWA C651 before placing new water main in service.
- B. Chlorine residual shall not be less than 50 ppm in the water after 24 hours standing in the pipe. The line shall be re-chlorinated and re-tested until the residual requirement is met.
- C. All valves or other appurtenances shall be operated while the line is filled with the chlorination agent.

3.10 FILLING AND FLUSHING DOMESTIC WATER PIPING SYSTEM

- A. It may be necessary to install temporary blow-offs to facilitate blowing off and disinfecting the new water mains before the mains can be tied into the City water system. The Contractor shall furnish all materials, labor, and equipment to install and remove the temporary blow-offs. For each blow-off, the Contractor shall install the required assembly per Standard Detail W-2 or an approved method and assembly approved by the Engineer (as the blow-off is temporary).
- B. Taps shall be made to expel air in locations at high points where no hydrant or blow-off is installed. The Engineer shall specify the size and number of taps. Such taps shall be plugged when testing is complete. Permanent high points in the water main shall have air and vacuum valves and vaults installed.
- C. All dead end portions of the main that are to be tied into existing mains after completion shall be fitted with temporary blocking of sufficient strength to withstand required test pressures.
- D. Filling and flushing of mains shall be performed by City of Cañon City Water Department personnel.
- E. All backfill operations shall be complete and all permanent concrete thrust blocks in place for a minimum of 24 hours prior to any filling or flushing operations.
- F. Following chlorination, all treated water shall be flushed from the pipeline until, upon test by City personnel, the water is proved comparable in quality to the water served to the public from the existing system.

3.11 EXISTING MAIN ABANDONMENT

- A. Existing water mains indicated by the Engineer shall be abandoned as directed.
- B. Existing water valves shall be removed if necessary to install the new main or can be left in place. Valves left in place shall have their valve boxes removed and the resulting void filled with flow fill.

- C. Existing fire hydrants to be abandoned shall be removed as a whole assembly by disconnecting it at the lateral without damage to the assembly or surrounding structures and landscape. The hydrant shall be salvaged by delivering it to the Water Department yard if directed, otherwise shall be disposed of at Contractor's expense.

3.12 FIELD QUALITY CONTROL

- A. Engineer and City personnel will perform Field inspecting and testing unless otherwise indicated. Contractor shall have a Certified Class 3 Water Distribution Technician on site any time any existing water main is cut open. The Contractor shall be billed for this service if provided by City personnel.
- B. A coliform bacteria sample shall be taken by City personnel after flushing is complete and delivered by the Contractor to a certified laboratory. Pressure testing shall be scheduled upon receipt of a negative coliform bacteria test result.
- C. Pressure test system:
 - 1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, the City will conduct, in presence of Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600 & AWWA C605.
 - 2. The Contractor shall accept full responsibility for testing against any existing valves, fire hydrants, or other appurtenances.
 - 3. The City will provide equipment required to perform leakage and hydrostatic pressure tests.
 - 4. Test Pressure: Not less than 150 psi or 1.5 times in excess of maximum static pressure, whichever is greater.
 - 5. Conduct hydrostatic test for at least two-hour duration.
 - 6. Pressure shall not vary by more than 5 psi during the hydrostatic pressure test.
 - 7. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks installed and plug pipe openings.
 - 8. The City personnel will slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
 - 9. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.

10. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$$L = \frac{NDV \cdot P}{7,400}$$

- L = allowable, in gallons per hour
N = number of joints in section to be tested
D = nominal diameter of pipe, in inches
P = average test pressure during leakage test, in pounds per square inch (gauge)

11. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

- D. Compaction testing for bedding and backfill in accordance with Section 02324.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- F. The pipeline may be placed in operation after all required cleaning, testing, and inspection have been completed and written permission has been granted by the Engineer. Final acceptance of the pipeline system shall take place a period of 2 years from the date written permission is given. During this 2 year period, any defects in the system resulting from defective materials, poor workmanship, or any other cause attributable to the Contractor shall be corrected at his expense and to the satisfaction of the Engineer. Should the Contractor fail to respond within 48 hours after written notification of any deficiency, the City may complete the work and bill the Contractor. In emergency situations, the City shall take whatever steps necessary to correct the problem.

END OF SECTION