

## 7-09 WATER MAINS

### 7-09.1 Description

This Work consists of constructing water mains 16-inches in diameter and smaller in accordance with the Plans, these Standard Specifications, the Special Provisions and the Standard Plans, at the location shown on the Plans.

#### 7-09.1(1) Definitions

##### 7-09.1(1)A Trench Widths

Trench width is from trench wall to trench wall, outside of shoring.

##### 7-09.1(1)B Unsuitable Material

Material removed because it is unsatisfactory for foundations is defined as unsuitable foundation material.

Material removed in trenching which is unsuitable for replacement in the backfill is defined as unsuitable backfill material.

##### 7-09.1(1)C Gravel Backfill for Pipe Zone Bedding

Gravel backfill for pipe zone bedding is the method or material used to transmit load from the pipe into the foundation or into the sidewall support.

##### 7-09.1(1)D Pipe Zone Backfill

Pipe zone backfill includes material placed above the gravel backfill for pipe zone bedding up to the depths shown on the Standard Plans.

##### 7-09.1(1)E Trench Backfill

Trench backfill includes materials placed above the pipe zone backfill. Trench backfill within the Roadway prism shall extend up to the underside of the pavement or surfacing materials. Trench backfill outside the Roadway prism shall extend up to original ground or finished grade.

### 7-09.2 Materials

Materials shall meet the requirements of the following sections:

Pipe for main line:	9-30.1
Ductile Iron Pipe	9-30.1(1)
Steel Pipe (6-inches and over)	9-30.1(4)A
Polyvinyl Chloride (PVC) Pressure Pipe (4-inches and over)	9-30.1(5)A
Polyvinyl Chloride (PVC) Pressure Pipe (under 4-inches)	9-30.1(5)B
Polyethylene (PE) Pressure Pipe (4-inches and over)	9-30.1(6)
Fittings for Main Lines:	9-30.2
Ductile Iron Pipe	9-30.2(1)
Steel Pipe (6-inches and over)	9-30.2(4)A
Polyvinyl Chloride (PVC) Pipe (4-inches and over)	9-30.2(5)A
Polyvinyl Chloride (PVC) Pipe (under 4-inches)	9-30.2(5)B
Restrained Joints	9-30.2(6)
Bolted, Sleeve – Type Couplings for Plain End Pipe	9-30.2(7)
Restrained Flexible Couplings	9-30.2(8)

Grooved and Shouldered Joints	9-30.2(9)
Polyethylene (PE) Pipe (4-inches and over)	9-30.2(10)
Fabricated Steel Mechanical Slip – Type Expansion Joints	9-30.2(11)
<b>Appurtenances:</b>	
Concrete Blocking	6-02.3(2)B
Detectable Marking Tape	9-15.18
Blow Off Assemblies	9-30.1, 9-30.2, 9-30.3, 9-30.6
<b>Polyethylene Encasement</b>	
Steel Pipe (4-inches and under)	9-30.1(2)
Fittings for Steel Pipe (4-inches and under)	9-30.1(4)B 9-30.2(4)B
<b>Aggregates:</b>	
Foundation Material	9-03.17, 9-03.18
Gravel Backfill for Pipe Zone Bedding	9-03.12(3)
Pipe Zone Backfill	9-03.19
Trench Backfill	9-03.15 or 9-03.19

It is not intended that materials listed herein are to be necessarily considered equal or generally interchangeable for all applications. Those suitable for the project shall be specified in the Special Provisions or shown on the Plans.

The pipe manufacturer shall test all pipe and fittings as required by these Standard Specifications and the standards referenced. The pipe manufacturer shall submit to the Engineer 2 copies of all test results including a written certification that material to be delivered is represented by the samples tested and that such delivered materials meet or exceed the specified requirements. No pipe shall be delivered until test results and certifications are in the hands of the Engineer.

The Engineer shall have free access to all testing and records pertaining to material to be delivered to the job site. The Engineer may elect to be present at any or all material testing operations.

The basis of acceptance shall be a certificate of compliance as described in Section 1-06.3, accompanied by 2 copies of pressure test results of the pipe or fittings involved.

### **7-09.3 Construction Requirements**

#### **7-09.3(1) General**

Trench excavation required for the installation of water mains and appurtenances shall be unclassified. Material excavated from trenches and piled adjacent to the trench or in a Roadway or public thoroughfare shall be piled and maintained so that the toe of the slope of the spoil material is at least 2-feet from the edge of the trench. It shall be piled in a manner to prevent surface water from flowing into the excavation and in a manner that will cause a minimum of inconvenience to public travel. Free access shall be provided to all fire hydrants, water valves, and meters; and clearance shall be left to enable the free flow of storm water in gutters, conduits, and natural watercourses.

**7-09.3(2) Ungraded Streets**

On ungraded streets, when grading is not called for in the Contract, the depth of trench excavation shall be as shown on the Plans and as staked.

Where the Plans show the pipe is to be laid above the existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Plans, and the water main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 2-03.3(14)C.

**7-09.3(3) Clearing and Grubbing in Ungraded Streets**

On ungraded streets, where clearing and grubbing is not called for in the Contract, the area to be excavated or filled shall be cleared and grubbed by the Contractor. This Work shall consist of the removal and disposal of logs, stumps, roots, brush, and other refuse within 5-feet of the centerline of the pipe. Such material shall be disposed of in accordance with the Special Provisions.

**7-09.3(4) Removal of Existing Street Improvements**

Removal of existing street improvements and pavement from driveways and sidewalks shall be performed as specified in Section 2-02. Stockpiling of waste materials along the trench shall not be allowed.

**7-09.3(5) Grade and Alignment**

The location of blow off assemblies and combination air release/air vacuum valves are shown on the Plans.

The Contractor shall verify the locations and establish the depth of the existing water mains at the points where connections are to be made prior to trenching for the pipelines. The profile shall be adjusted so no new high spots or low spots are created between the connection points to the existing water mains.

The depth of trenching for water mains shall be such as to give a minimum cover of 36-inches over the top of the pipe unless otherwise specified in the Special Provisions. Deeper excavation may be required due to localized breaks in grade, or to install the new main under existing culverts or other utilities where necessary. Where the profile of the pipeline and the ground surface is shown on the Plans, the pipeline shall be laid to the elevation shown regardless of depth. The excavation shall be to such depth that the minimum cover over valve operating nuts shall be 1-foot.

**7-09.3(6) Existing Utilities**

Existing utilities of record, except services, are shown on the Plans. These are shown for convenience only, and the Engineer assumes no responsibility for improper locations or failure to show utility locations on the Plans.

When utility services occupy the same space as the new water main, the Contractor shall complete necessary excavation to fully expose such services. The Contractor shall protect said services, and work around them during excavating and pipe laying operations. Any damages to services resulting from the Contractor's operation shall be reported to the appropriate utility. Such damage shall be repaired at the Contractor's expense.

**7-09.3(7) Trench Excavation**

The Contractor shall perform excavation of every description and in whatever materials encountered to the depth indicated on the Plans or specified in the Special Provisions. Excavations shall be made by open cut unless otherwise provided for. Trenches shall be excavated to true and smooth bottom grades and in accordance with the lines given by the Engineer or shown on the Plans. The trench bottom shall provide uniform bearing and support for each length of pipe.

Bell holes shall be excavated to the extent necessary to permit accurate Work in making and inspecting the joints. The banks of the trenches shall be kept as nearly vertical as soil conditions will permit, and where required to control trench width or to protect adjacent Structures, the trench shall be sheeted and braced. Trench widths

to 1-foot above the top of the pipe shall not exceed 30-inches maximum or 1½ times the outside diameter of the pipe plus 18-inches whichever is greater. Standard excavating equipment shall be adjusted so as to excavate the narrowest trench possible.

The length of trench excavation in advance of pipe laying shall be kept to a minimum. Excavations shall be either closed up at the end of the day or protected per Section 1-07.23(1).

The Contractor shall exercise sound engineering and construction practices in excavating the trench and maintaining the trench so that no damage will occur to any foundation, Structure, pole line, pipe line, or other facility because of slough or slopes, or from any other cause. If, as a result of the excavation, there is disturbance of the ground, which may endanger other property, the Contractor shall immediately take remedial action at no additional expense to the Contracting Agency. No act, representation, or instruction of the Engineer shall in any way relieve the Contractor from liability for damages or costs that result from trench excavation.

Care shall be taken not to excavate below the depth specified. Excavation below that depth shall be backfilled with foundation material and compacted as specified herein.

If workers have to enter any trench or other excavation 4-feet or more in depth that does not meet the open pit requirements of Section 2-09.3(3)B, it shall be shored. The Contractor alone shall be responsible for worker safety, and the Contracting Agency assumes no responsibility.

Upon completing the Work, the Contractor shall remove all shoring unless the Plans or the Engineer direct otherwise.

**7-09.3(7)A Dewatering of Trench**

Where water is encountered in the trench, it shall be removed during pipe-laying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

**7-09.3(7)B Rock Excavation**

Rock excavation shall cover the removal and disposal of rock that requires systematic drilling and blasting for its removal, and also boulders exceeding ½-cubic yard. Ledge rock, boulders, or stones shall be removed to provide a minimum clearance of 4-inches under the pipe.

Hardpan, hard clay, glacial till, sandstone, siltstone, shale, or other sedimentary rocks, which are soft, weathered, or extensively fissured will not be classified as rock excavation. Rock is defined as one that has a modulus of elasticity of more than 200,000-PSI or unconfined compressive strength at field moisture content of more than 2,000-PSI.

Materials removed shall be replaced with gravel backfill for pipe zone bedding, pipe zone backfill or trench backfill as designated by the Engineer.

#### **7-09.3(7)C Extra Trench Excavation**

Changes in grades of the water main from those shown on the Plans, or as provided in the Special Provisions, may be necessary because of unexpected utilities, or for other reasons. If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate, or in any way change the line and grade, such changes shall be made by the Contractor under the terms of these Standard Specifications.

When pipeline grade is lowered in excess of 1-foot below the grade indicated on the Plans, the Contractor shall make such extra excavation as necessary.

When the pipeline horizontal alignment is changed by more than 1-foot from the line indicated on the Plans, after the trench has been excavated, the Contractor shall excavate the trench at the changed location and backfill and compact the previous trench.

Additional excavation so required will be classified as extra trench excavation.

#### **7-09.3(8) Removal and Replacement of Unsuitable Materials**

Whenever in excavating the trench for water mains, the bottom of the trench exposes peat, soft clay, quicksand, or other unsuitable foundation material, such material shall be removed to the depth directed by the Engineer and backfilled with foundation material. When determined by the Engineer that silty soils or fine sandy soils are encountered, Class C foundation material shall be required. Silty soils or fine sandy soils usually flow in the presence of a stream of water. When determined by the Engineer that clay, peat, or other soft materials are encountered that become saturated with water, but do not break down into fine particles and flow, Class A or Class B foundation material shall be required.

Material removed from the trench that is unsuitable for trench backfill shall be removed and hauled to a waste site. If material is not available within the limits of the project for backfilling the trench, the Contractor shall furnish trench backfill meeting the requirements of Section 9-03.12(3) or 9-03.19 as required.

Unsuitable material shall be loaded directly into trucks and hauled to a waste site obtained by the Contractor. Stockpiling of unsuitable material at the project site shall not be allowed.

#### **7-09.3(9) Bedding the Pipe**

Gravel backfill for pipe zone bedding shall be select granular material free from wood waste, organic material, and other extraneous or objectionable materials and shall have a maximum dimension of 1½-inches. Gravel backfill for pipe zone bedding shall be placed to the depths shown in the Standard Plans. Gravel backfill for pipe zone bedding shall be rammed and tamped around the pipe to 95-percent of maximum density by approved hand-held tools, so as to provide firm and uniform support for the full length of the pipe, valves, and fittings. Care shall be taken to prevent any damage to the pipe or its protective coating.

**7-09.3(10) Backfilling Trenches**

Prior to backfilling, form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling.

Backfill up to 12-inches over the top of the pipe shall be evenly and carefully placed. Materials capable of damaging the pipe or its coating shall be removed from the backfill material. The remainder of the material shall be placed by dumping into the trench by any method at the option of the Contractor, and shall be compacted as specified hereinafter.

A minimum 3-inch sand cushion shall be placed between the water main and existing pipelines or other conduits when encountered during construction.

**7-09.3(11) Compaction of Backfill**

Backfill shall be compacted to at least 95-percent of maximum density as specified in Section 2-03.3(14)D.

At locations where paved streets, Roadway Shoulders, driveways, or sidewalks will be constructed or reconstructed over the trench, the backfill shall be spread in layers and be compacted by mechanical tampers. In such cases, the backfill material shall be placed in successive layers not exceeding 6-inches in loose thickness, and each layer shall be compacted with mechanical tampers to the density specified herein. Mechanical tampers shall be of the impact type as approved by the Engineer.

**7-09.3(12) General Pipe Installation**

Pipe shall be installed in accordance with the manufacturer's printed Specifications and instructions, and to the standards of the AWWA for installing the type of pipe used. The Contractor shall provide tools and equipment, including any special tools required for installing each particular type of pipe used.

Short lengths of pipe supplied by the manufacturer shall be used whenever possible to provide the proper spacing of valves, tees, or special fittings.

**7-09.3(13) Handling of Pipe**

Pipe shall be handled in a manner that will prevent damage to the pipe, pipe lining, or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. If any part of the coating or lining is damaged, repair thereof shall be made by the Contractor at no additional expense to the Contracting Agency and in a manner satisfactory to the Engineer. Damaged pipe shall be rejected, and the Contractor shall immediately place damaged pipe apart from the undamaged and shall remove the damaged pipe from the site within 24-hours.

Threaded pipe ends shall be protected by couplings or other means until laid.

Pipe and fittings shall be inspected for defects.

Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and re-laid. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure cleanliness inside the pipe.

**7-09.3(14) Cutting Pipe**

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. Pipe ends shall be square with the longitudinal axis of the pipe and shall be reamed and otherwise smoothed so that good connections can be made. Threads shall be cleanly cut. Oxyacetylene torch cutting of ductile iron pipe shall not be allowed.

**7-09.3(15) Laying of Pipe on Curves****7-09.3(15)A Ductile Iron Pipe**

Long radius curves, either horizontal or vertical, may be laid with standard pipe lengths by deflecting the joints. If the pipe is shown curved on the Plans and no special fittings are shown, the Contractor can assume that the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the Plans will indicate maximum lengths that can be used. The amount of deflection at each pipe joint when pipe is laid on a horizontal or vertical curve shall not exceed the manufacturer's printed recommended deflections.

Where field conditions require deflection or curves not anticipated by the Plans, the Engineer will determine the methods to be used. No additional payment will be made for laying pipe on curves as shown on the Plans, or for field changes involving standard lengths of pipe deflected at the joints. When special fittings not shown on the Plans are required to meet field conditions, additional payment will be made for special fittings as provided in Section 1-09.6.

When rubber gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

**7-09.3(15)B Polyvinyl Chloride (PVC) Pipe (4-Inches and Over)**

PVC pipe may be bent to allow for slight changes in direction. The minimum bending radius shall be as follows:

Size	Minimum Bending Radius
4-inch	125-feet
6-inch	175-feet
8-inch	225-feet
10-inch	275-feet
12-inch	325-feet
14-inch	400-feet

Axial deflection at the pipe joints shall not be allowed.

For 16-inch diameter pipe, changes in direction may be accomplished by axial deflection of the pipe joint. The maximum axial deflection allowed at each joint is 1-degree. For changes in direction greater than 1-degree per pipe joint, fittings shall be used.

**7-09.3(16) Cleaning and Assembling Joint**

The pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground.

Pipe not furnished with a depth mark shall be marked before assembly to ensure visual observation of the Work.

**7-09.3(17) Laying Ductile Iron Pipe with Polyethylene Encasement**

Where shown on the Plans, the Contractor shall lay ductile iron pipe with a polyethylene encasement. Pipe and polyethylene encasement shall be installed in accordance with AWWA C105.

**7-09.3(18) Coupled Pipe 4-inches in Diameter and Larger**

Joints for steel pipe shall be bell and spigot or welded as specified in the Special Provisions.

Component parts of couplings, rings, and bells shall receive a protective coating in the same manner as specified for the steel pipe. Bolts and nuts, exposed edges, and flanges shall, after installation, be covered with coal-tar protective coating conforming to AWWA C203 or other coating approved by the Engineer.

Steel pipe 4-inches and larger for aboveground service shall be coupled with flanges, compression type or grooved type couplings.

Pipe for outdoor service above ground shall be protected with a coal-tar protective coating conforming to AWWA C203 or other coating approved by the Engineer.

**7-09.3(19) Connections****7-09.3(19)A Connections to Existing Mains**

Connections to the existing water main shall not be made without first making the necessary scheduling arrangements with the Engineer in advance. Work shall not be started until all the materials, equipment, and labor necessary to properly complete the Work are assembled on the site.

Existing water mains shall be cut by the Contractor unless otherwise specified in the Special Conditions. The Contractor shall remove the portions of pipe to provide for the installation of the required fittings at the points of connection. Damage caused by the Contractor's operations to existing joints in piping to remain in-service shall be repaired by the Contractor at no additional expense to the Contracting Agency. The Contractor shall determine the exact length of the existing water main that must be removed. The pipe ends shall be beveled to prevent damage to the transition coupling gasket during installation of the coupling. The exterior of the existing pipe end shall be cleaned to a sound, smooth finish before installation of the coupling.

Transition couplings shall be installed by the Contractor and shall be provided with a plastic film wrap. The plastic film wrap shall be wrapped loosely around the pipe, fittings, and couplings, and secured with 2-inch-wide polyethylene adhesive tape. Pipelines in which the couplings are installed shall be wrapped a minimum of 3-feet on each side of the coupling. Joints or seams in the plastic film wrap shall be made using the 2-inch-wide polyethylene adhesive tape. The plastic film wrap need not be watertight, but no part of the pipe or coupling shall be exposed to the backfill. Care shall be exercised during backfilling to prevent the plastic film wrap from being punctured or otherwise damaged. Plastic film wrap and its installation shall conform to AWWA C105 except as modified herein.

Once Work is started on a connection, it shall proceed continuously without interruption and as rapidly as possible until completed. No shutoff of mains will be permitted overnight, over weekends, or on holidays.

If the connection to the existing system involves turning off the water, the Contractor shall be responsible for notifying the residents affected by the shutoff. The Engineer will advise which property owners are to be notified.

The Contractor may be required to perform the connection during times other than normal working hours. The Contractor shall not operate any valves on the existing system without specific permission of the Engineer.

The types of connections are varied and suggested piping arrangements have been shown on the Plans. For the installation of these connections, the surfaced portion of the Roadway shall not be penetrated unless the connecting point is directly under it. For connection by any other method, the Contractor shall furnish a detailed sketch for approval not less than 2 weeks prior to the expected construction.

**7-09.3(19)B Maintaining Service**

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate its Work with that of the Utility so that service will be resumed with the least possible inconvenience to customers.

To supply customers with water during the construction of a water main project where any section of the pipe has passed satisfactory hydrostatic and bacteriological tests, the Utility reserves the right to tap corporation stops into the section of new pipe and install service connections at such locations as the Utility may elect. The installation of any such service connections by the Utility shall not be construed by the Contractor as an acceptance by the Contracting Agency of any part of the Work required under the Contract.

**7-09.3(20) Detectable Marking Tape**

Detectable marking tape shall be installed over nonmetallic water lines including services lines. The tape shall be placed approximately 1-foot above the top of the line and shall extend its full length. Detectable marking tape shall meet the requirements of Section 9-15.18.

**7-09.3(21) Concrete Thrust Blocking**

Concrete thrust blocking, as detailed on the Plans, shall be placed at bends, tees, dead ends, and crosses. Blocking shall be commercial concrete meeting the requirement of Section 6-02.3(2)B poured in place.

Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

**7-09.3(22) Blowoff Assemblies**

Blowoff Assemblies shall be constructed at the locations shown on the Plans and in accordance with the Standard Plans.

**7-09.3(23) Hydrostatic Pressure Test**

Water main appurtenances and service connections to the meter setter shall be tested in sections of convenient length under a hydrostatic pressure equal to 150-psi in excess of that under which they will operate or in no case shall the test pressure be less than 225-psi. Pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring equipment necessary for performing the test shall be furnished and operated by the Contractor.

Sections to be tested shall normally be limited to 1,500-feet. The Engineer may require that the first section of pipe, not less than 1,000-feet in length, installed by each of the Contractor's crews, be tested in order to qualify the crew and the materials. Pipe laying shall not be continued more than an additional 1,000-feet until the first section has been tested successfully.

The pipeline shall be backfilled sufficiently to prevent movement of the pipe under pressure. Thrust blocks shall be in place and time allowed for the concrete to cure before testing. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking and remove it after testing.

The mains shall be filled with water and allowed to stand under pressure a sufficient length of time to allow the escape of air and allow the lining of the pipe to absorb water. The Contracting Agency will furnish the water necessary to fill the pipelines for testing purposes at a time of day when sufficient quantities of water are available for normal system operation.

The test shall be accomplished by pumping the main up to the required pressure, stopping the pump for 15-minutes, and then pumping the main up to the test pressure again. During the test, the section being tested shall be observed to detect any visible leakage.

A clean container shall be used for holding water for pumping up pressure on the main being tested. This makeup water shall be sterilized by the addition of chlorine to a concentration of 50-mg/l.

The quantity of water required to restore the pressure shall be accurately determined by pumping through a positive displacement water meter. The meter shall be approved by the Engineer. Acceptability of the test will be determined as follows:

$$L = \frac{SD\sqrt{P}}{266,400}$$

The quantity of water lost from the main shall not exceed the number of gallons per hour as determined by the formula:

in which

- L = allowable leakage, gallons/hour
- D = nominal diameter of the pipe in inches
- P = test pressure during the leakage test (psi)
- S = gross length of pipe tested, feet

There shall not be an appreciable or abrupt loss in pressure during the 15-minute test period.

Pressure gauges used in the test shall be accompanied with certifications of accuracy from a testing Laboratory approved by the Engineer.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test successfully as specified, the Contractor shall, at no additional expense to the Contracting Agency, locate and repair the defects and then retest the pipeline.

Tests shall be made with the hydrant auxiliary gate valves open and pressure against the hydrant valve. Each valve shall be tested by closing each in turn and relieving the pressure beyond. This test of the valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure comes against the valve being checked. The Contractor shall verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

Prior to calling out the Engineer to witness the pressure test, the Contractor shall have all equipment set up completely ready for operation and shall have successfully performed the test to ensure that the pipe is in satisfactory condition.

Defective materials or workmanship, discovered as a result of hydrostatic field test, shall be replaced by the Contractor at no additional expense to the Contracting Agency. Whenever it is necessary to replace defective material or correct the workmanship, the hydrostatic test shall be re-run at the Contractor's expense until a satisfactory test is obtained.

#### **7-09.3(23)A Testing Extensions From Existing Mains**

When an existing water main is extended with new pipe to a new valve and the distance from the existing pipe to the new valve is 18-feet or less, the section of new pipe installed between the new valve and the end of the existing main shall be made with pretested, prechlorinated pipe, and no hydrostatic test will be required. When the required hydrostatic tests are conducted in the new main section beyond the installed new valve in the closed position, the normal pressure of the existing main may be present against the other side of the new valve.

Where the distance between the end of an existing water main pipe extension to the new valve is more than 18-feet, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe for testing purposes.

The short length of pipe between the temporary cap or plug end with the new valve in the closed position, with no hydrostatic pressure active on the opposite side of the valve, shall be subjected to the required test pressure. The same test shall be made against the other side of the new valve when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing main. The final connection to the existing main shall be made with pretested prechlorinated pipe.

#### **7-09.3(23)B Testing Section with Hydrants Installed**

When hydrants are included with the section of main pipe to be tested, the testing shall be conducted in 3 separate tests as follows:

*Test No. 1* – Water main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.

*Test No. 2* – Water main gate valves and the hydrant operating the stem valves tightly closed but the hydrant auxiliary gate valves and hose ports wide open.

*Test No. 3* – Each hydrant shall be tested to the pressure indicated in Section 7-09.3(23) with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open.

#### **7-09.3(23)C Testing Hydrants Installed on Existing Mains**

For hydrants installed and connected to an existing main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves, shall be installed with pretested materials.

Before the hydrant connection is made to the existing main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 7-09.3(23)B. Hydrants installed and connected to an existing main shall have a satisfactory bacteriological sample obtained following the hydrostatic test.

**7-09.3(24) Disinfection of Water Mains**

Before being placed into service, new water mains and repaired portions of, or extensions to, existing mains shall be chlorinated and a satisfactory bacteriological report obtained. In the event 2 unsatisfactory bacteriological reports are obtained on a section of pipe, the Contractor shall revise his method of disinfection and the form of applied chlorine.

**7-09.3(24)A Flushing**

Sections of pipe to be disinfected shall first be flushed to remove any solids or contaminated material that may have become lodged in the pipe. If a hydrant is not installed at the end of the main, then a tap shall be provided large enough to develop a flow velocity of at least 2.5-fps in the water main.

Taps required by the Contractor for temporary or permanent release of air, chlorination or flushing purposes shall be provided by the Contractor as part of the construction of water mains.

Where dry calcium hypochlorite is used for disinfection of the pipe, flushing shall be done after disinfection.

The Contractor shall be responsible for disposal of treated water flushed from mains and shall neutralize the wastewater for protection of aquatic life in the receiving water before disposal into any natural drainage channel. The Contractor shall be responsible for disposing of disinfecting solution to the satisfaction of the Contracting Agency and local authorities. If approved by the Engineer, disposal may be made to an available sanitary sewer provided the rate of disposal will not overload the sewer.

**7-09.3(24)B Requirement of Chlorine**

Before being placed into service, new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than 25-mg/l remains in the water after standing 24-hours in the pipe. The initial chlorine content of the water shall be not less than 50-mg/l.

**7-09.3(24)C Form of Applied Chlorine**

Chlorine shall be applied by 1 of the methods which follow, to give a dosage of not less than 50-mg/l of available chlorine.

**7-09.3(24)D Dry Calcium Hypochlorite**

As each length of pipe is laid, sufficient high-test calcium hypochlorite (65 to 70-percent chlorine) shall be placed inside the pipe to yield a dosage of not less than 50-mg/l available chlorine, calculated on the volume of the water that the pipe and appurtenances will contain.

The number of grams of 65-percent test calcium hypochlorite required for a 20-foot length of pipe equals

$$0.008431 \times d^2,$$

in which "d" is the diameter in inches.

**7-09.3(24)E Liquid Chlorine**

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine.

**7-09.3(24)F Chlorine-Bearing Compounds in Water**

A mixture of water and high-test calcium hypochlorite (65 to 70-percent Cl) may be substituted for the chlorine gas-water mixture. The dry powder shall first be mixed as a paste and then thinned to a 1-percent chlorine solution by adding water to give a total quantity of 7.5-gallons of water per pound of dry powder. This solution shall be injected in 1 end of the section of main to be disinfected while filling the main with water.

**7-09.3(24)G Sodium Hypochlorite**

Sodium hypochlorite, commercial grade (12.5-percent Cl) or in the form of liquid household bleach (5 to 6-percent Cl), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the main in correct proportion to the fill water so that dosage applied to the water will be at least 50-mg/l.

**7-09.3(24)H Point of Application**

The point of application of the chlorinating agent shall be at the beginning of the pipeline extension or any valved section of it, and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved by the Engineer.

**7-09.3(24)I Rate of Application**

Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly into the newly-laid pipeline during application of the chlorine. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly-laid pipe that the dosage applied to the water will be at least 50-mg/l.

**7-09.3(24)J Preventing Reverse Flow**

No connections shall be made between the existing distribution system and pipelines not disinfected that are constructed under this Contract without a State Department of Health approved backflow preventer installed in the connecting line.

**7-09.3(24)K Retention Period**

Treated water shall be retained in the pipe at least 24-hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25-mg/l.

**7-09.3(24)L Chlorinating Valves, Hydrants, and Appurtenances**

In the process of chlorinating newly laid pipe, valves, hydrants, and other appurtenances shall be operated while the pipeline is filled with the chlorinating agent and under normal operating pressure.

**7-09.3(24)M Chlorinating Connections to Existing Water Mains and Water Service Connections**

The chlorinating procedure to be followed shall be as specified in AWWA Standard C651. All closure fittings shall be swabbed with a very strong chlorine solution at least as strong as liquid household bleach (5 to 6-percent Cl).

**7-09.3(24)N Final Flushing and Testing**

Following chlorination, treated water shall be flushed from the newly-laid pipe until the replacement water throughout its length shows, upon test, the absence of chlorine. In the event chlorine is normally used in the source of supply, then the tests shall show a residual not in excess of that carried in the water supply system.

A sample tap shall be located ahead of the flushing hose for convenience and for sanitary sampling.

Before placing the lines into service, a satisfactory report shall be received from the local or State Health Department on samples collected from representative points in the new system. Samples will be collected and bacteriological tests obtained by the Engineer.

**7-09.3(24)O Repetition of Flushing and Testing**

Should the initial treatment result in an unsatisfactory bacteriological test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained. Failure to get a satisfactory test shall be considered as failure of the Contractor to keep the pipe clean during construction, or to properly chlorinate the main.

**7-09.4 Measurement**

Measurement for payment of pipe for water mains will be by the linear foot of pipe laid and tested and shall be measured along the pipe through fittings, valves, and couplings.

Measurement for payment of blowoff assembly will be per each.

No measurement shall be made for clearing and grubbing, removal of existing street improvements, protection of existing utilities and services, trench excavation and pipe zone backfill, pipe zone bedding, and compaction of backfill.

When listed as a pay item, rock excavation will be measured in its original position by volume in cubic yards. The quantity measured for payment will include only the material excavated from within the limits hereinafter defined. Any additional excavation outside of these limits will be considered as having been made for the Contractor's benefit, and all costs in connection with such excavation shall be included in the unit Contract prices for the various items of Work.

The horizontal limits for measuring rock excavation will be the sides of the trench, except no payment will be made for material removed outside of vertical planes extended beyond the maximum trench widths, as specified in Section 7-09.3(7). Vertical distances shall be measured from the upper surface of the rock to an elevation 6-inches below the underside of the pipe barrel, or to the lower surface of the rock, whichever is less. Boulders exceeding 1-cubic yard in volume shall be paid for according to their measured volume.

Removal of the extra trench excavation as defined in Section 7-09.3(7)C will be measured by the cubic yard. The depth shall be the actual depth removed for the changed line or grade in accordance with Section 7-09.3(5) or as ordered by the Engineer in accordance with Section 1-04.4. The width shall be the actual width removed for the changed line or grade, but in no case shall the measured width exceed the allowable widths specified in Section 7-09.3(7).

Removal and replacement of unsuitable material will be measured by the cubic yard. The depth shall be the actual depth removed below the depth specified in Section 7-09.3(5). The width shall be the actual width removed, but in no case shall the measured width exceed the allowable widths specified in Section 7-09.3(7).

Measurement of bank run gravel for trench backfill will be by the cubic yard measured in trucks at the point of delivery.

Shoring or extra trench excavation will be measured as specified in Section 2-09.4 for shoring or extra excavation Class B.

### 7-09.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“ \_\_\_\_\_ Pipe for Water Main \_\_\_\_\_ In. Diam.”, per linear foot.

The unit Contract price per linear foot for each size and kind of “ \_\_\_\_\_ Pipe for Water Main \_\_\_\_\_ In. Diam.” shall be full pay for all Work to complete the installation of the water main including but not limited to trench excavation, bedding, laying and jointing pipe and fittings, backfilling, concrete thrust blocking, testing, flushing, disinfecting the pipeline, and cleanup.

Payment for restoration will be made under the applicable items shown in the Proposal. If no pay items for restoration are included in the Proposal, restoration shall be considered incidental to the Work of constructing the water main, and all costs thereof shall be included in the unit Contract price Bid for “ \_\_\_\_\_ Pipe for Water Main \_\_\_\_\_ In. Diam.”

“Rock Excavation”, per cubic yard.

If no pay item is listed, rock excavation shall be considered incidental to the Work to construct the water main and all costs shall be included in other items of Work specified in Section 7-09.5.

“Extra Trench Excavation”, per cubic yard.

“Removal and Replacement of Unsuitable Material”, per cubic yard.

“Bank Run Gravel for Trench Backfill”, per cubic yard.

No separate payment will be made for clearing and grubbing, removal of existing street improvements, furnishing and installing sand cushion, protection of existing utilities and services, trench excavation and backfill, bedding the pipe, and compacting the backfill. These items shall all be considered as incidental to the Work of constructing the water main, and all costs thereof shall be included in the payment as specified in Section 7-09.5.

“Shoring or Extra Excavation Trench”, per square foot.

“Blowoff Assembly”, per each.

The unit Contract price Bid per each for “Blowoff Assembly” shall be full pay for all Work to install the blowoff assembly, including but not limited to excavating, backfilling, laying and jointing pipe, tapping the main, corporation stop, pipe and fittings, gate valve, meter box, and cover and cleanup.