

## SECTION 6 – PIPELINE FLUSHING, HYDROSTATIC TESTING, AND DISINFECTING

### 6-01 GENERAL REQUIREMENTS

Hydrostatic testing and disinfecting (chlorination and flushing) of newly laid pipelines and appurtenances must be completed before the pipelines can be connected to the existing water distribution system. **Pipelines and appurtenances shall remain isolated from the existing water distribution system, during hydrostatic testing and disinfecting.**

Unless specified otherwise or approved by the Engineer, Contractor shall test against test plates for pipelines 12 inches and smaller. Contractor shall not remove said test plates until pipelines have been pressure tested, disinfected and accepted by the Engineer.

All services, hydrants, air release valves, and other appurtenances connected to the newly laid pipelines shall be pressure tested and disinfected at the same time as that of the pipelines. Care shall be taken to expel all air from the pipelines and services during any filling operations.

Independent newly installed large services (4 inches and larger), fire lines, fire hydrants and other appurtenances that are being connected to existing pipelines shall be subjected to the same hydrostatic testing and disinfecting requirements as described herein.

The Contractor shall disinfect the pipelines prior to hydrostatic testing for pipelines larger than 12 inches in diameter or as directed by the Engineer.

For pipelines with a diameter of 12 inches or less, Contractor may disinfect pipelines and appurtenances either before, concurrently with, or after they have been subjected to hydrostatic and leakage tests if approved by the Engineer. If Contractor elects to disinfect before or concurrently with the hydrostatic and leakage tests, Contractor shall again disinfect all or portions of the previously tested pipelines if bacteriological tests come back positive.

### 6-02 TEMPORARY PIPING AND APPURTENANCES FOR FLUSHING, TESTING, AND DISINFECTING

The Contractor and/or subcontractor shall supply all temporary piping, corporation and curb stops, test plates, bulkheads, plugs, pipe end caps, valves, fittings, calibrated meters, equipment, labor, and method necessary for pressure testing, chlorinating, and flushing of the newly laid pipeline. The Contractor shall also provide any temporary piping, backflow devices, and appurtenances needed to carry potable water to the section of pipeline being flushed, pressure tested, or disinfected.

Corporation curb stop taps used for flushing, pressure testing, and disinfecting shall comply with service tap requirements for ductile iron pipe or C900 PVC pipe. Unless specified otherwise, the tap shall be made at the top of pipe.

### 6-03 FLUSHING

If the tablet method of chlorination, as described later in this Section is not used, then the new pipeline shall be flushed prior to hydrostatic testing for chlorination or as directed by the Engineer. The pipeline flushing velocity shall not be less than 2½ feet per second. The minimum volume of water to be flushed, at the required velocity, shall not be less than 1½ times the volume of the pipeline from the point of filling to the point of blow-off.

It is the responsibility of the Contractor to dispose of the flushed water or the chlorinated water from the project area. The Contractor shall take all necessary precautions for adequate drainage of water from the site. The disposal of water is described later in this Section.

### 6-04 HYDROSTATIC PRESSURE TESTING

The Contractor shall hire a licensed independent subcontractor to conduct the required hydrostatic testing of newly laid pipelines. Unless specified differently on the plans or as supplemented herein, hydrostatic testing shall conform to the applicable requirements of AWWA Standard C600, "Installation of Ductile Iron Mains and Their Appurtenances" or AWWA Standard C605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water." After completion of the hydrostatic testing, the subcontractor shall provide a signed copy of all test results to the Engineer. The Contractor and Engineer shall be present during the testing.

#### 6-04.01 Preparation for Hydrostatic Test

All concrete anchor and thrust blocks associated with sections of the pipeline to be tested shall have cured for a minimum time of 72 hours prior to any flushing or pressurizing of the pipeline. Restrained joints or other methods of pipe support may be used to reduce this time if approved by the Engineer.

If hydrostatic tests precede disinfecting, and the tablet method of disinfecting is not used, the Contractor shall flush the pipeline with potable water to remove dirt and debris. Flushing and disposal of water is discussed elsewhere in this Section.

The amount of pipeline footage to be tested at one time shall be determined by the Engineer and shall not exceed 1,200 feet in length. Test plates (bulkheads), corporation stops, and other temporary facilities required for testing purposes shall be installed at the Contractor's expense. Testing against valves is not permitted unless approved by the Engineer.

#### 6-04.02 Procedures for Hydrostatic Testing

Each section of pipeline and all fire hydrants, services, and appurtenances connected thereto, shall be subjected to the hydrostatic test.

The pipelines shall be filled with potable water. Care shall be exercised to see that provisions are made for the escape of air at high points and ends of laterals. Contractor shall see that all combination air release valves are open and operating. After the line has been completely filled, it shall be allowed to stand at 40 psi minimum pressure for a sufficient length of time to permit the escape of any pockets of air and allow the mortar lining to absorb the maximum moisture. During this time, all visible pipes, fittings and joints shall be inspected for leakage.

After the entire section under test has been inspected and no leaks found, the test pressure shall be set at 1.5 times the static pressure at the lowest point along the test section (Engineer to furnish system static pressure data) or 150 psi, whichever is higher. Once the test pressure has been stabilized, the leakage test may begin. Leakage is defined as the quantity of water that must be supplied to continually maintain pressure within 5 psi of the test pressure during a four hour period. The amount of water added shall not be more than the allowable leakage requirements specified per AWWA C600.

6-04.03 Repetition of Hydrostatic Test

If leakage in the section of pipeline tested exceeds the maximum allowable rate specified above, such section will be considered defective. The Contractor shall determine the points of leakage and make the necessary repairs at no cost to City. The subcontractor will then conduct another hydrostatic test. This procedure shall be continued until the leakage falls below the allowed maximum.

6-04.04 After Satisfactory Hydrostatic Test

All valves shall be tested for leak proof tightness after the pipeline hydrostatic test with the test pressure on one side of the valve and atmospheric pressure on the other side.

After test sections have successfully met the hydrostatic test requirements to the satisfaction of the Engineer, the entire pipeline or each test section shall be filled or shall remain filled with potable water until the pipeline is disinfected. Test plates, corporation stops, and other test facilities shall remain in place if needed for disinfecting or removed as directed by the Engineer.

Regardless of the hydrostatic test results, the Contractor shall repair all detectable leaks.

6-05 DISINFECTING

The Contractor shall supply the materials, labor, equipment and methods necessary to disinfect the water main. The Contractor shall hire a state certified laboratory to perform the required bacteriological tests for the newly laid pipelines.

Unless specified differently on the plans or as supplemented herein, disinfecting of water mains and appurtenances shall conform to the applicable requirements of AWWA C651, "Disinfecting Water Mains."

6-05.01 Preparation For Disinfecting Pipe Lines

Contractor shall tightly shut off every service connection served by the pipeline being disinfected at the curb stop before water is applied to the pipeline. Care should be taken to expel all air from the main and services during the filling operation.

6-05.02 Forms of Chlorine for Disinfection

The forms of chlorine that may be used in the disinfection process are calcium hypochlorite tablets, calcium hypochlorite granules, sodium hypochlorite solution and liquid chlorine

6-05.02.01 Calcium Hypochlorite Tablets

The calcium hypochlorite tablets shall have an average weight of 0.009 pounds each and shall contain no less than 70% of available chlorine.

Adhesive for attaching the tablets to the inside top of the pipeline shall be a type that will not impart taste, odor or detrimental compounds to the water supply.

Calcium hypochlorite tablets shall be stored in tightly closed containers. Proper care shall be taken that they will not be accessible to children or unauthorized persons.

6-05.02.02 Calcium Hypochlorite (Granules)

Calcium Hypochlorite shall be in accordance with the requirements of AWWA Standard B300, "Hypochlorites," and shall be dissolved in water to known concentration in a container and pumped into the pipeline at a measured rate.

6-05.02.03 Sodium Hypochlorite (Solution)

Sodium Hypochlorite shall be in accordance with the requirements of AWWA Standard B300, and shall be diluted in water to desired concentration and pumped into the pipeline at a measured rate.

6-05.02.04 Liquid Chlorine Solution

Liquid chlorine solution shall be in accordance with the requirements of AWWA Standard B301, "Liquid Chlorine," and shall be injected with a gas solution feeder chlorinator and a water booster pump.

6-05.03 Methods of Chlorination

The two acceptable methods of chlorination are tablet (calcium hypochlorite tablets) and continuous-feed (direct chlorine solution injection). Chlorination of pipelines with a diameter of 12 inches or less shall be either direct chlorine solution injection or calcium hypochlorite tablets. Pipelines with a diameter of 14 inches and larger shall be chlorinated by direct chlorine solution injection only.

The end of the main being chlorinated shall be monitored during the application of chlorine and until the desired concentration is reached, after which each fire hydrant or any other connections to the pipeline shall be individually opened and flushed with the chlorine solution. The disposal of flushed water is described later in this section.

6-05.03.01 Calcium Hypochlorite Tablets

The use of calcium hypochlorite tablets is permitted in pipe sizes 4 through 12 inches and only if the pipelines and appurtenances have been maintained in a clean and dry condition during construction. The number of tablets used shall produce a residual of not less than 50 ppm of chlorine in all sections of the pipeline and appurtenances being disinfected when filled with water. During pipeline construction, five-gram calcium hypochlorite tablets shall be placed in each hydrant, hydrant branch, and other appurtenances.

The Contractor shall attach all tablets to the inside top of the pipeline, with approximately equal numbers of tables at each end of a given pipe length. Tablets are attached with an approved adhesive type that will not impart detrimental compounds to the water supply. The smallest practicable amount of adhesive shall be applied to one side of the tablet only. The following table may be used as a guideline of the number of five-gram tablets needed to achieve 50 ppm chlorine residual for each 18 foot length pipe section, based on 3.25-g available chlorine per tablet, and with any portions of tablet rounded to next higher integer.

<u>Pipe Dia. (in.)</u>	<u>Suggested Number of 5-g Tablets</u>
4	2
6	2
8	4
10	6
12	8

Water used to fill a new pipeline during the application of chlorine shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system. The fill rate when using tablets shall be regulated so as not to exceed one foot per second through the smallest pipeline being disinfected.

6-05.03.02 Continuous Feed

Chlorine shall be applied at a point not more than ten feet from the beginning of the section to be chlorinated and shall be injected through a corporation stop, a hydrant, or other approved connections to ensure treatment of the entire system being disinfected.

Potable water shall be introduced into the pipeline at a constant measured rate. A chlorine solution shall be injected into the potable feed water at a measured rate. The two rates shall be proportioned so that the chlorine concentration in the pipeline produces a residual of not less than 50 ppm of chlorine in all sections of the pipeline and appurtenances being disinfected. Concentration at points downstream shall be periodically checked during the filling to ascertain that sufficient chlorine is being added. Care shall be taken to prevent the strong chlorine solution in the line being treated from flowing back into the line supplying the water.

6-05.04 Retention Period Required and Required Residual

Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This retention period shall be at least 24 hours. After the chlorine-treated water has been retained for the 24 hours, the chlorine residual shall be tested at the pipeline extremities and at other representative points and shall be at least 25 ppm. If the tests show less than 25 ppm residual, the water main and appurtenances shall be rechlorinated and held for another 24 hour period.

During the retention period, all valves and other appurtenances shall be operated to insure internal exposure with the heavily chlorinated water.

6-05.05 Final Flushing

Following the chlorination period of 24 hours and after confirming that a 25 ppm or greater chlorine residual remains, the newly laid pipeline shall be thoroughly flushed to remove the chlorinated water and any foreign materials. A minimum flushing velocity of 2½ feet per second is required for each section of the pipeline. Water shall be flushed from the line at its extremities and at all outlets until the chlorine residual of the section being flushed is equal to or less than the distribution system level.

If so directed by the Engineer, Contractor shall remove portions of certain appurtenances such as combination air valves, blow-offs, and service installations in order to accomplish complete flushing. Contractor shall replace same without adversely affecting disinfected pipelines and appurtenances.

The disposal of the flushed chlorinated water is described later in this Section.

6-05.06 Bacteriological Tests

24 hours after the system has been flushed, the Contractor shall have tests conducted for chlorine residual. Should the chlorine residual in any part of the disinfected system be higher than the distribution system level, the Contractor shall repeat the flushing procedure. If the chlorine residual, after flushing, is equivalent to the distribution system level or less, the Contractor may proceed with the bacteriological tests.

The Contractor shall have a State certified laboratory perform the bacteriological tests. Samples shall be taken at the direction of the Engineer with at least one set of samples collected as every 1200 feet of the new water pipeline, plus one set at each dead-end main section, and at least one set from each branch (i.e., laterals 4 inch and larger). Samples shall be taken 24 or more hours after final flushing of chlorinated water. All samples shall be collected and tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater, and shall show the absence of coliform organisms.

The results of the bacteriological tests must be reviewed and approved by the Engineer prior to connecting the newly laid pipeline to the existing water distribution system. Should the test results from the State certified laboratory disclose that the water from the new pipeline does not meet drinking water bacteriological standards, or is not of equal or better quality to that in the distribution system, the process shall be repeated until it meets the required standard.

6-06 DISPOSAL OF TEST WATER

The disposal of all water used in flushing, hydrostatic testing, and disinfecting the sections of pipeline shall be the sole responsibility of the Contractor. The disposal of water shall, in all cases, be carried out in strict observance of the water pollution control requirements of the State Water Resources Control Board.

For contracts administered by the City, the Contractor will be authorized to discharge under the National Pollutant Discharge Elimination System (NPDES) permit issued to the City if all requirements and procedures per such permit are followed. For all other projects, including Developer projects, Contractor or Developer shall obtain an NPDES permit and comply with that permit.

The Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water. In addition, the flow of water from the section of pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, altering of ecological conditions in the area, and damage to any constructions or maintenance activities occurring in any ditches or storm drains downstream of discharge.

6-07 CONNECTING TO EXISTING DISTRIBUTION SYSTEM

After all hydrostatic tests and disinfections have been completed and demonstrated to comply with the Specifications, the Contractor shall connect newly laid pipeline to the existing distribution system in accordance with the requirements in Section 5 of these Specifications.

Where connections are to be made to an existing potable water system, swab or spray the interior surfaces of all pipe and fittings used in making the connections with a 5% or greater hypochlorite solution as directed by the Engineer.

As soon as the connection is completed, thorough flushing is required until all discolored water is removed.

6-08 REMOVAL OF TEMPORARY PIPING AND APPURTENANCES

After the newly laid section of pipeline has been approved by the Engineer for connection to the existing distribution system, the Contractor shall disconnect and remove all temporary piping, fittings, test plates, backflow devices, and other appurtenances used for pressure testing, chlorinating and flushing.

Contractor shall remove and replace all stops used for testing and disinfecting of the pipeline with stainless steel repair clamps. Approved stainless steel repair clamp manufacturers are listed in Section 4-05 of these Specifications.