SECTION 5100 – WATERLINE TESTING AND DISINFECTION

5101 GENERAL. This section covers hydrostatic pressure testing, leakage testing, disinfection, and flushing of all new mains and appurtenances. All waterlines installed shall be tested as specified herein.

All testing work shall be done in the presence of the City Engineer. The contractor shall notify the City at least two (2) working days prior to testing.

Temporary discharge piping shall be provided for discharge of test water at a suitable location. Discharge of test water into sanitary sewers shall not be permitted.

5102 TESTING EQUIPMENT AND FACILITIES. The contractor shall provide all necessary equipment, materials, and facilities required for testing.

The Contractor shall provide a backflow device approved by the City Engineer for flushing activities.

Test pressures shall be applied by means of a force pump capable of maintaining the required pressure for the duration of each test.

The pressure gauge used shall be calibrated and acceptable to the City Engineer.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with approved material at the expense of the contractor.

5103 PRESSURE AND LEAKAGE TESTING OF PVC WATER MAINS. Pressure and leak testing shall meet the requirements set forth in the latest edition of KDHE'S *Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas.*

The hydrostatic pressure during testing shall be 150 PSI and in no case, shall the test pressure exceed the pressure rating for the pipe, valves, and appurtenances. Test pressure shall be maintained for a minimum of 2 hours.

Leakage measurements shall not be started until test pressures have sufficiently stabilized. The Contractor shall furnish and install a water meter for testing on the pressure supply piping of the force pump.

Allowable loss for the minimum 2-hour test shall be computed as follows:

For PVC: $$L = \frac{SD(P^{0.5})}{148{,}000}$$

L = Allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during the leakage test, in pounds per square Inch (gauge) (PSIG)

Line leakage shall be the total amount of water introduced into the line as measured by the meter during the leakage test.

The test pressure shall be restored whenever it drops 5 psi. A calibrated recorder shall be used during the test and the results of the test shall be provided to the City Engineer. The amount of water needed to re-pressurize the line shall be measured each time re-pumping is required.

In the event that the system contains pipe of more than one size, the allowable leakage shall be calculated separately for each segment of pipe and then summed to obtain the total allowable leakage from the entire system.

5104 PRESSURE AND LEAKAGE TESTING OF HDPE WATER MAINS. Pressure and leak testing of HDPE water mains shall be in accordance with ASTM F2164 and the manufacturer's recommendations. The Contractor shall furnish a calibrated water meter for the purpose of measuring the water introduced into the line where required.

The hydrostatic pressure during testing shall generally be 150 PSI and in no case shall the test pressure exceed the pressure rating for the pipe, valves and appurtenances. If the temperature of test section is greater than 80 degrees Fahrenheit, the test pressure shall be multiplied by the factors shown in Table 5104-1.

Table 5104-1 – Elevated Temperature Multiplier

Test Section Temperature (◦F)	Test Pressure Factor
≤ 80	1.00
≤ 90	0.90
≤ 100	0.80
≤ 110	0.75
≤ 120	0.65
≤ 130	0.60
≤ 140	0.50

The maximum test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize shall be less than 8 hours.

5105 DEFECTS. All joints in piping shall be watertight and free from visible leaks during the prescribed leakage test and throughout the duration of the two (2) year maintenance period.

Leaks in mechanical and push on joints shall be repaired by dismantling, cleaning, realigning gland and gasket, and re-bolting. The gland bolts shall not be tightened beyond the allowable torque limits.

Wrap-around bands shall not be used for repairs.

5106 TAPPING SLEEVES AND VALVES. The tapping sleeve and valve will be tested in place with water for 30 minutes. Test pressure must not exceed rated working pressure (150 psig). No leaks will be permitted.

5107 DISINFECTION. Materials, methods and procedures for disinfection work shall conform to the requirements of the latest revision of AWWA C651, *Standard for Disinfecting Water Mains,* except as modified herein.

General: Water in reasonable amounts for proper completion of flushing or disinfection work shall be furnished at existing fire hydrants at the Contractor's expense. The Contractor shall furnish all necessary labor, pipe, hose, nozzles and tools. The Contractor shall schedule testing at least two (2) working days prior to testing. The City Engineer shall determine the flowrate and duration of each withdrawal from the distribution system.

All hydrants and valves involved in the disinfection operation shall be bagged by the Contractor as "Out of Service".

Disinfection: The pipelines shall be disinfected by the continuous feed method. The chlorine feed shall be proportional to the rate of flow into the pipe so that the entering water contains at least 25 mg/L of chlorine. The chlorine solution shall be retained in the pipeline for at least twenty-four (24) hours and the free chlorine residual at the end of the period shall equal to or greater than 10 mg/L.

Prior to flushing the line, a test shall be conducted to verify the chlorine residual. Such test shall be performed by the City Engineer using the DPD (N, N Diethyl-1, 4 Phenlenediamine) method in accordance with EPA approved methodology (Standard Method 4500-Chlorine-G). The Contractor shall dispose of chlorine and flushing water in a proper manner at no cost to the City. The Contractor shall prevent the chlorine solution from entering the supply system during the disinfection process. The Contractor shall ensure a flushing outlet is open at all times during the pumping process to prevent pressure from building in the line being disinfected.

Prior to flushing the pipe of chlorinated water, the discharge environment shall be inspected. Sodium bisulfite or an approved equal neutralizing chemical shall be applied to the chlorinated discharge to assure thorough neutralization of the chlorine residual in environmentally sensitive discharge locations in accordance with the latest revision of AWWA C655. The chlorinated water shall be neutralized, and the free chlorine shall be non-detectable unless the City Engineer deems dechlorination is not necessary.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. During final flushing operations, valves shall be manipulated in such a manner that the chlorine solution will not flow back into the supply line.

Following the successful disinfection process, the disinfection corporation shall be removed and replaced with a brass plug. Saddles shall not be allowed unless otherwise approved by the City Engineer on PVC water lines.

Flushing: All flushing work shall be done in the presence of the City Engineer. All flushing and sampling must be completed utilizing a combination blowoff and sampling tap in accordance with Standard Details. The Contractor shall notify the City Engineer at least twenty-four (24) hours in advance of the flushing operation.

Flushing of waterline and appurtenances, after the disinfection process, shall be performed with a minimum velocity of at least three (3) feet per second. All flushing shall be performed after the hydrostatic test is completed and accepted.

Below is Flushing Table 3 from AWWA C651 for Continuous-Feed Method for Chlorination.

Table 3 Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (0.91 m/sec) (40 psi [276 kPa] residual pressure in water main)*

Pipe Diameter		Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main		Size of Tap Used, *in. (mm)*			Number of Hydrant Outlets	
				1 (25)	1½ (38)	2 (51)		
in.	*(mm)*	*gpm*	*(L/sec)*	Number of Taps Required on Pipe†			2½-in. (64-mm)	4½-in. (114 mm)
4	(100)	120	(7.4)	1	—	—	1	1
6	(150)	260	(16.7)	—	1	—	1	1
8	(200)	470	(29.7)	—	2	—	1	1
10	(250)	730	(46.3)	—	3	2	1	1
12	(300)	1,060	(66.7)	—	—	3	2	1
16	(400)	1,880	(118.6)	—	—	5	2	1

*With a 40-psi (276-kPa) pressure in the main with the hydrant flowing to atmosphere, a 2½-in. (64-mm) hydrant outlet will discharge approximately 1,000 gpm (63.1 L/sec); and a 4½-in. (114-mm) hydrant outlet will discharge approximately 2,500 gpm (160 L/sec).

†Number of taps on pipe based on 3.0-ft/sec discharge through 5 ft (1.5 m) of galvanized iron (GI) pipe with one 90° elbow.

Bacteriological Tests: After chlorine solution has been flushed out of the line, and before the line is placed in service, samples shall be collected by the City Engineer to confirm the presence or absence of coliform organisms. The samples shall be collected and tested in accordance with EPA sampling and preservation techniques.

Flushing of the waterline between two consecutive bacteriological testing samples shall not be allowed except for a minimum amount to flush the sampling taps. Two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main.

At least one set of samples shall be collected from every 1,200 ft. of the new water main, plus one set from the end of the line and at least one set from each branch. The test results shall be provided to the City Engineer and the Contractor. These initial tests shall be made at no cost to the Contractor. A certified testing laboratory may be used if approved by the City Engineer.

If initial disinfection testing fails, the new main may be flushed and shall be re-tested. If the second set of tests also fails, the main shall be disinfected and flushed until satisfactory test results are obtained. All disinfection, repetitive testing and sampling costs incurred shall be at the expense of the Contractor.

5108 <u>CUTTING INTO EXISTING WATERMAINS</u>. If the trench is wet, liberal quantities of hypochlorite shall be applied to the open trench to reduce risk of contamination.

When connections of pipe equal to or less than 20-feet in length are made to an existing system, the exposed pipe and fitting interiors shall be sprayed or swabbed with a minimum 1% chlorine disinfection solution.

When connection length is greater than 20-feet, the piping shall be assembled aboveground and shall meet the requirements of these Technical Specifications. Between the time of satisfactory bacteriological samples and installation, the ends of the piping must be sealed or capped.