

**Item No. 515
Pipeline Testing and Acceptance**

515.1 Description

This item shall consist of the testing and acceptance of water and wastewater pipes, including hydrostatic testing for pressure pipes, low pressure air testing for gravity pipes, deflection and settlement testing.

A. Tests shall be required in accordance with the following table:

| | Bacteriological Testing | Hydrostatic Testing | Exfiltration Test | Infiltration Test | Low Pressure Air Test | Settlement Testing | Deflection Testing | CCTV Inspection |
|---------------------------|-------------------------|---------------------|-------------------|-------------------|-----------------------|--------------------|--------------------|-----------------|
| Water Mains | X | X | | | | | | |
| PVC Gravity Sewer Mains | | | | | X | X | X | X |
| Other Gravity Sewer Mains | | | X | X | | X | X | X |
| Force Mains | | X | | | | | | |

515.2 Submittals

A. Furnish test reports as described below:

1. Submit written plan for disinfection.
2. Submit detailed hydrostatic test procedure 10 days prior to conducting the test.
3. Contractor shall submit his proposed pipe mandrels or testing balls to the E/A or his designated representative for concurrence prior to testing the line.
4. Submit Hydrostatic Pipe Test Reports.

515.3 Standards

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. ASTM International (ASTM):

| | |
|------------|--|
| ASTM F2164 | Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure |
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| | |
|----------------|---|
| ASTM F1417-11A | Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Line Using Low-Pressure Air |
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2. American Water Works Association (AWWA):

| | |
|-----------|--|
| AWWA B300 | Hypochlorites |
| AWWA C200 | Steel Water Pipe, 6 In (150 mm) and Larger |
| AWWA C600 | Installation of Ductile-Iron Mains and Their Appurtenances |
| AWWA C604 | Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger |
| AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings |
| AWWA C651 | Disinfecting Water Mains |
| AWWA M9 | Concrete Pressure Pipe |
| AWWA M11 | Steel Pipe – A Guide for Design and Installation |
| AWWA M23 | PVC Pipe – Design and Installation |
| AWWA M41 | Ductile-Iron Pipe and Fittings |
| AWWA M55 | PE Pipe – Design and Installation |

515.4 Products

A. Water for Testing

1. Obtain water for filling and testing the pipeline and provide all temporary pumps and piping necessary to fill the pipeline.
2. If chlorinated water is used, then dechlorinate it before disposal per all regulations.
3. Water for the Work shall be metered and furnished by the Contractor in accordance with of the Standard Contract Documents.

B. Test Plugs

1. Design plugs or blind flanges to withstand the test pressure on either side with only atmospheric pressure on the opposite side.
2. Provide a 30-inch access manhole in one side of the plug and a 12-inch flanged outlet on the other side of the plug unless shown differently on the Drawings.

C. Pressure Gauge

1. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.)

D. CCTV Equipment

1. General

Equipment used shall be designed for use in gravity wastewater collection systems per Specification Item No. 315 "CCTV Inspection".

515.5 EXECUTION**A. General**

Perform tests in accordance with this Section, AWWA Standards, AWWA Manuals, and the supplier's recommendations.

B. Water Pipe Acceptance Testing

Acceptance testing for potable water pipes requires two tests, bacteriological and hydrostatic. Bacteriological testing should be done on the pipe after disinfection and prior to the hydrostatic testing, unless the pipe is isolated in the system such that there are no services or trunk line connected and approved by an NBU inspector. After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a hydrostatic test will be conducted by the Contractor.

1. Disinfection of Potable Water Lines**a. Preventing Contamination**

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry, and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work.

b. Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16-inches in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16-inches in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging).

c. Procedure and Dosage

- i. The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately five percent (5%) to fifteen percent (15%) available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16-inch diameter or smaller lines, if it is included as part of the written plan of disinfection that is approved by New Braunfels Utilities. The Contractor, at its expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the Utility.
- ii. One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be manned during these operations. Backflow prevention in the form of a reduced pressure backflow assembly must be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system

uniformly into the new piping in such proportions that every part of the line has a minimum concentration of 50 mg/liter available chlorine.

- iii. The disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, services, stubs, etc. shall be operated so as to disinfect all their parts. After this retention period, the water shall contain no less than 25 mg/liter chlorine throughout the treated section of the pipeline.
 - iv. For pipelines larger than 16-inches in diameter, the Contractor may use the AWWA C-651 "Slug Method" for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.
 - v. Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods for the Examination of Water and Wastewater," jointly published by AWWA, WEF, and AHPA. The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.
- d. Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. Proper planning and appropriate preparations in handling, diluting, if necessary, and disposing of this strong chlorine solution is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by NBU before flushing of the line may begin. Additionally, the flushing must be witnessed by an authorized representative of NBU.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from New Braunfels Utilities. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system or cause damage to the odor feed systems at the lift stations. The Utility shall designate its own representative to oversee the work. Daily notice of line discharging must be reported to New Braunfels Utilities Dispatch office.

2. Bacteriological Testing

After final flushing of the disinfecting solution, the system will be tested for bacteriological quality by the Utility and must be found free of coliform organisms before the pipeline may be placed in service. All stubs shall be tested before connections are made to existing systems.

- a. Contractor must collect two (2) sets of water samples taken at least twenty-four (24) hours apart. Each set shall consist of one (1) sample that is drawn from the end of the

- main and additional samples that are collected at intervals of not more than 1000 feet along the pipeline.
- b. The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
 - c. Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The Utility, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with Utility personnel.
 - d. If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.
 - e. An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods for the Examination of Water and Wastewater." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the Utility. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.
 - f. New Braunfels Utilities Water Quality Laboratory will notify the assigned Utility Inspector in writing of all test results. The Inspector will subsequently notify the Contractor of all test results. The Water Quality Laboratory will not release test results directly to the Contractor.
3. Hydrostatic Test
- a. The Contractor will furnish the pump and gauges for the tests. The Utilities Representative shall be present during the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.
 - b. Determine the HGL for each test section, and test such that the pressure range below is achieved (lower pressure at high point and higher pressure at low point).
 - i. Test pressure shall in no case be less than 200 psi, or more than 2X the working pressure.
 - c. All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and nozzle caps open, shall be included in the test.
 - d. Prior to pressure testing against an existing system valve, a bacteriological test shall be performed to determine potability of water.
 - e. A hydrostatic test will be conducted on the entire project or each valved section to test for leakage. The leakage test shall be at 150 psi for at least 4 hours.

i. Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if the leakage exceeds 25 gallons/24 hours/mile of pipe/inch nominal pipe diameter.

$$\frac{(25 \text{ gpd})}{(\text{in.} \cdot \text{mi.})}$$

ii. Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at his own expense.

C. Wastewater Pipe Acceptance Testing

Gravity sewer pipe installed in the New Braunfels Utility System shall be tested for exfiltration or infiltration as described below in "Exfiltration Test" and "Infiltration Test" or by acceptable low pressure air test, as described below. At the conclusion of either test series, the Work shall be further tested for pipeline settlement and also for deflection as described below. Finally, the pipe shall be inspected with closed circuit television (CCTV) camera per Specification Item No. 315 "CCTV Inspection".

Force main sewer pipe shall be tested in accordance with the hydrostatic test procedure outlined in the "Water Pipe Acceptance Testing."

The Contractor shall be solely responsible for making proper repairs to those elements which do not pass these test requirements.

1. Wastewater Exfiltration Test

- a. The pipeline shall be completely filled with water for its complete length or by sections as determined by the E/A. If tested for its complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be completely filled with water. After the pipeline has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount in excess of 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.
- b. For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 50 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the exfiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

2. Wastewater Infiltration Test

- a. When the pipe placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be used to assure that water will stand over the trench. After it is apparent that the trench is completely saturated, the main shall then be inspected with closed-circuit television for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.
- b. This procedure shall not be used for pipes installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.
- c. For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the total infiltration as determined by water test, must be at a rate not greater than 50 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the infiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.
- d. If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken to reduce the infiltration to an amount within the limits specified.

3. Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

Wastewater lines, at the discretion of the E/A, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test. Use only qualified personnel to conduct the test.

a. Plugs

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed.

b. Pressure Relief Device

The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.)

c. Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

d. Test Procedure

- i. The E/A may, at any time, require a calibration check of the instrumentation used. All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.
- ii. Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table for Low Pressure Air Testing of Plastic Pipe:

| Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated | | | | | | | | |
|---|--|--------|--------|--------|--------|--------|--------|--------|
| Diameter of Pipe, (in.) | Specification Time (min: sec) for length shown | | | | | | | |
| | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 |
| 6 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:42 | 6:24 |
| 8 | 7:34 | 7:34 | 7:34 | 7:34 | 7:36 | 8:52 | 10:08 | 11:24 |
| 10 | 9:26 | 9:26 | 9:26 | 9:53 | 11:52 | 13:51 | 15:49 | 17:48 |
| 12 | 11:20 | 11:20 | 11:24 | 14:15 | 17:05 | 19:56 | 22:47 | 25:38 |
| 15 | 14:10 | 14:10 | 17:48 | 22:15 | 26:42 | 31:09 | 35:36 | 40:04 |
| 18 | 17:00 | 19:13 | 25:38 | 32:03 | 38:27 | 44:52 | 51:16 | 57:41 |
| 21 | 19:50 | 26:10 | 34:54 | 43:37 | 52:21 | 61:00 | 69:48 | 78:31 |
| 24 | 22:47 | 34:11 | 45:34 | 56:58 | 68:22 | 79:46 | 91:10 | 102:33 |
| 27 | 28:51 | 43:16 | 57:41 | 72:07 | 86:32 | 100:57 | 115:22 | 129:48 |
| 30 | 35:37 | 53:25 | 71:13 | 89:02 | 106:50 | 124:38 | 142:26 | 160:15 |
| 33 | 43:05 | 64:38 | 86:10 | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 |
| 36 | 51:17 | 76:55 | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 |

NOTES: 1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.

- iii. Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.
- e. Edwards Aquifer Recharge/Transition Zone Test Procedure
 - i. Low-pressure air tests must conform to the procedure described in ASTM F1417-11A or other equivalent procedures. For safety reasons, air testing of pipe sections will be limited to line sizes of 36 inches inside diameter or less. Lines that are 36 inches or larger inside diameter must be air tested at each joint.
 - ii. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds.
 - iii. For sections of pipe less than 36-inch inside diameter, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge must be computed by the following equation:

$$T = 0.0850 (D)(K)/(Q), \text{ where}$$
 - T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;
 - K = 0.000419(D)(L), but not less than 1.0
 - D = nominal inside diameter in inches;
 - L = length of line of same pipe size in feet; and
 - Q = rate of loss, assume 0.0015 cubic feet per minute per square foot (ft³/min/ft sq) of internal surface area.
 - iv. Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.
- f. Manholes
 - i. Manholes must be tested separately and independently in accordance with Standard Specification Item No. 304, "Manholes".

D. Settlement Testing

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flushed into the pipe to permit meaningful observations. Prior to flushing, the manholes and pipes should be cleared of all debris. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8" dia.) submerged at any point along the line.

E. Deflection Testing

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days.

Testing for in-place deflection shall be with a pipe mandrel or rigid ball sized at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.

1. Test(s) must be performed without mechanical pulling devices and must be witnessed by the E/A or his designated representative.
2. Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

F. Closed Circuit Television (CCTV) Inspection

1. CCTV Televising / Inspection shall be in accordance with Specification Item No. 315 "CCTV Inspection".

510.5 Measurement and Payment

No direct measurement or payment will be made for the work to be done or the equipment to be furnished under this Item but shall be considered subsidiary to the particular items required by the bid.

End