

## SECTION 15062

### DUCTILE IRON PIPING AND DUCTILE IRON AND CAST IRON FITTINGS

#### PART 1 - GENERAL

##### 1.01 SCOPE

The work covered by this section includes furnishing all labor, equipment, and materials required to furnish, install, and test ductile iron piping, including all fittings, wall pipe and sleeves, couplings, toppings, anchor blocks, and accessories, as specified herein and/or shown on the Drawings.

##### 1.02 QUALITY ASSURANCE

- A. The CONTRACTOR shall submit to the ENGINEER written evidence that the pipe furnished under this specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the ENGINEER may require that the CONTRACTOR furnish test reports from an independent testing laboratory on samples of pipe materials.
- B. Each ductile iron pipe length and fitting and cast iron fitting shall be clearly marked with the pressure rating, metal thickness class, heat mark, net weight (excluding lining or coating) and name of the manufacturer. In addition, each item of piping shall be marked with an identifying mark corresponding to the appropriate mark on the shop drawings for that particular item of piping.

##### 1.03 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data on all piping and accessories shall be submitted to the ENGINEER in accordance with the requirements of the section entitled "Submittals" of these Specifications.
- B. Shop drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The Drawings shall include a complete schedule of all pipe, fittings, specials, hangers, and supports. Special castings shall be clearly detailed showing all pertinent dimensions.
- C. The CONTRACTOR shall furnish the ENGINEER with lists, in duplicate, of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size, and description of each item received.

## 1.04 STORAGE AND PROTECTION

Piping and accessories shall be stored and protected in accordance with the requirements of the section entitled "General Equipment Stipulations" of these Specifications.

## 1.05 SHOP PAINTING

Unless otherwise specified herein, all ductile iron pipe and fittings and cast iron fittings shall be cleaned and provided with a bituminous coating and cement lining applied at the factory.

## 1.06 GUARANTEE

Provide a guarantee against defective materials and workmanship in accordance with the requirements of the section entitled "Guarantees and Warranties" of these Specifications.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. No broken, cracked, deformed, mishappened, imperfectly coated, or otherwise damaged or defective pipe or fittings shall be used. All such material shall be removed from the site of the work.
- B. Unless otherwise shown on the Drawings or directed by the ENGINEER and justified by specifying adequate types of bedding, the minimum pipe wall thickness and thickness class of pipe shall be as follows:

PIPE SIZE	THICKNESS CLASS	METAL WALL THICKNESS IN INCHES
3-Inch Ductile Iron	51	0.25
4-Inch Ductile Iron	51	0.26
6-Inch Ductile Iron	50	0.25
8-Inch Ductile Iron	50	0.27
10-Inch Ductile Iron	50	0.29
12-Inch Ductile Iron	50	0.31
14-Inch Ductile Iron	50	0.33
16-Inch Ductile Iron	50	0.34
18-Inch Ductile Iron	50	0.35
20-Inch Ductile Iron	50	0.36
24-Inch Ductile Iron	50	0.38
30-Inch Ductile Iron	51	0.43
36-Inch Ductile Iron	51	0.48
42-Inch Ductile Iron	51	0.53
48-Inch Ductile Iron	51	0.58
54-Inch Ductile Iron	51	0.65

## 2.02 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed in accordance with ANSI A21.50, "Thickness Design of Ductile Iron Pipe", using 60,000 psi tensile strength, 42,000 psi yield strength, and 10 percent elongation.
- B. Ductile iron pipe shall be manufactured in accordance with ANSI A21.51; "Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Line Molds for Water or Other Liquids", and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi and 10 percent minimum elongation.

## 2.03 CAST IRON AND DUCTILE IRON FITTINGS

- A. All fittings shall conform in every respect to ANSI A21.10, 2 inches through 48 inches, for Water and Other Liquids.
- B. Unless otherwise shown on the Drawings, directed or specified, all fittings shall be for pressure rating of 250 psi.
- C. In general, flanged fittings shall be ANSI pattern using long radius elbows except where space limitations prohibit the use of same. Design of all fittings, whether long or short pattern, shall be as indicated or dimensioned on the Drawings. Special fittings and cast iron and ductile iron wall pipes and sleeves shall conform to the dimensions and details shown on the Drawings.

## 2.04 JOINTS FOR DUCTILE IRON PIPE AND FITTINGS AND CAST IRON FITTINGS

### A. GENERAL

- 1. Joints for ductile iron pipe and fittings and cast iron fittings shall be mechanical joints, flanged joints, push-on joints, or bell and spigot joints, as shown on the Drawings or specified herein.
- 2. Unless otherwise shown on the Drawings, specified or directed, all ductile iron pipe laid underground shall be joined using mechanical joints or push-on type joints.

### B. MECHANICAL JOINTS

- 1. Mechanical joints shall consist of a bolt joint of the stuffing box type as detailed in ANSI A21.10 and described in ANSI A21.11.
- 2. Mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high

strength, heat treated cast iron containing 0.50 percent copper or high strength low-alloy steel having a minimum yield point strength of 40,000 pounds per square inch and an ultimate tensile strength of 70,000 pounds per square inch.

3. Gaskets and bolts and nuts shall conform to ANSI A21.11. Gaskets shall be of neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact.
4. Glands for ductile iron shall be of high strength ductile iron, and glands for cast iron shall be of high strength cast iron.

### C. FLANGED JOINTS

1. Flanged joints shall conform to ANSI B16.1, Class 125, and in accordance with Table 10.23 of ANSI A21.10.
2. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, conforming to ASTM A 307, Grade B. Cadmium plating shall be by an approved process and shall be between 0.003- to 0.0005-inch thick. After each joint has been made, all bolts, heads, and nuts shall be coated with two coats of heavy asphaltum or other approved coating.
3. Gaskets of "Cranite," red rubber, asbestos composition, or other approved quality shall be used in all flanged joints. Gaskets shall conform to the requirements so of ANSI B16.21.
4. Flanged ductile iron pipe approximately twelve (12) inches or less in length shall have flanges cast solidly to the pipe barrel. Flanges on ductile iron pipe longer than (12) inches may be of the screw type. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. Flange faces on cast iron fittings shall be coated with white lead immediately after they have been faced and drilled. All pipe with screw type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the ENGINEER.
5. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

#### D. PUSH-ON JOINTS

1. Push -on joints shall conform to ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as "Fastite," "Bell-Tite," or "Tyton" joints.
2. Gaskets shall be in accordance with ANSI A21.11 and shall be of such quality that they will not be damaged by the liquid or gases with which they will come into contact.

#### 2.05 PIPE COATING AND LINING

- A. All ductile iron pipe and fittings and cast iron fittings buried underground or submerged shall have a standard bituminous outside coating conforming to ANSI A21.6 or A21.51. All exposed ductile iron pipe and ductile iron and cast iron fittings shall have an outside coating of universal primer.
- B. All ductile iron pipe used for water or Wastewater shall have cement mortar lining of standard thickness in accordance with ANSI A21.4. Cement mortar lining for cast iron and ductile iron fittings shall be double the standard thickness under ANSI A21.4
- C. No lining shall be provided for ductile iron pipe and ductile iron and cast iron fittings used for air.
- D. Where a special lining is indicated on the Drawings for resistance to corrosive wastewaters, pipe and fittings shall be furnished with a minimum 20 mil thick lining of chemically inert, abrasion resistant polyethylene. The lining shall be a blend of high density and low density polyethylene powders complying with ASTM D 1248 compounded with carbon black to provide resistance to ultraviolet rays during storage above ground. The pipe shall be preheated in a furnace (to ensure uniformity of heat distribution) to an adequate temperature to provide uniform fusing of the polyethylene powders and proper bonding to the pipe. The lining shall be unaffected by hydrogen sulfide, detergents, grease, oil, inorganic acid, alkalis, and most organic materials found in municipal wastewaters and shall be suitable for service at operating temperatures of up to 180 degrees F. The lining shall have a Hazen-Williams "C" coefficient of approximately 150 and a Manning "n" coefficient of approximately 0.010. Polyethylene- lined ductile iron pipe shall be U.S. Pipe "Polylined," American Cast Iron Pipe "Polybond," or equal.

#### 2.06 PIPE COUPLINGS

- A. Pipe couplings shall be installed where shown on the Drawings, required for installation, or directed by the ENGINEER.
- B. Pipe couplings shall conform to the requirements of the section entitled "Pipe Couplings and Expansion Joints" of these Specifications.

## 2.07 WALL PIPE AND WALL SLEEVES

- A. CONTRACTOR shall furnish and install ductile iron wall pipe or wall sleeves where ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors.
- B. Where wall pipes or sleeves are to be installed flush with the wall or slab, the flange or bell shall be tapped for studs. Where the flange or bell will project beyond the wall, the projection shall be sufficient to allow for installation of connecting bolts.

## 2.08 SPARE PARTS

The CONTRACTOR shall furnish four (4) spare gaskets for each size and type of joint requiring the use of a gasket. The CONTRACTOR shall furnish eight (8) bolts and nuts of each size and type used for cast iron and ductile iron pipe joints.

## PART 3 EXECUTION

### 3.01 LAYING

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement lining on the inside of the pipes and fittings. Any damage shall be remedied as directed by the ENGINEER.
- B. All pipe and fittings shall be carefully examined by the CONTRACTOR for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the CONTRACTOR at his own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of ductile iron pipe in underground pressure piping systems shall conform to the requirements of AWWA C600. Excavation of trenches and backfilling around pipes shall conform to the requirements of the section entitled "Earthwork" of these Specifications.

- E. All ductile iron piping laid underground shall have a minimum of 36 inches of cover above the top of the pipe unless otherwise shown on the Drawings.
- F. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping containing unharnessed push-on or mechanical joints or expansion joints shall be restrained by thrust blocks. Thrust blocks shall consist of Class B concrete conforming to the requirements of the section entitled "Cast-In-Place Concrete" of these Specifications and shall be of the size and shape as shown on the Drawings. The CONTRACTOR may use forms or earth walls to mold the thrust blocks. When earth walls are used, they shall be cut true to shape and all excess earth removed. The work shall be conducted so that no loose earth will become mixed with the concrete. At the end of 24 hours, damp earth may be placed over the concrete to retain moisture.
- G. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth as shown on the Drawings to prevent breakage resulting from settlement of backfill around the structure.
- H. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and wall sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.
- I. Wall pipe and wall sleeves shall be installed when the wall or slab is constructed. Blocking out or breaking of the wall for later insertion shall not be permitted.
- J. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- K. Sufficient couplings and flanged joints shall be provided to facilitate equipment installation and removal.
- L. Exposed ductile iron piping shall be supported as shown on the Drawings and specified in the section entitled "Pipe Supports and Hangers" of these Specifications.

### 3.02 CUTTING

- A. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made for the portion cut off and not used.
- B. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.

- C. All cutting of ductile iron pipe shall be done with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe

### 3.03 JOINING

#### A. MECHANICAL JOINTS

1. The successful operation of the mechanical joint specified require that the spigot be centrally located in the bell and that adequate anchorage shall be provided where abrupt changes in direction and dead ends occur.
2. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
3. Joint bolts shall be tightened by the use of approved wrenches to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side and last, the remaining bolts. This cycle shall be repeated until all bolts are within the range of acceptable torque. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
4. After installation, bolts and nut in buried or submerged piping shall be given two (2) heavy coats of bituminous paint.

#### B. FLANGED JOINTS

1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by cross over sequence. Where screwed flanges are used, the finished pip edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.
2. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.



3. After installation, bolts and nuts in buried or submerged piping shall be given two (2) heavy coats of a bituminous paint.

#### C. PUSH-ON JOINTS

1. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the yellow guide stripe and to the inside of the gasket. The plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand; however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight.
2. Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

#### D. PERMISSIBLE DEFLECTION OF JOINTS

1. Deflection of ductile iron pipe at joints for long radius curves or for avoiding obstacles shall be permitted only upon approval of the ENGINEER.
2. Where deflection of joints is permitted, such deflection shall be made in accordance with and shall not exceed limits provided in Section 9b.5 and Section 9c.4 as applicable, of AWWA C600.

#### E. JOINTS OF DISSIMILAR METALS

When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat-faced and furnished with full-faced gaskets, insulating bushings, and stainless steel bolts.

### 3.04 SERVICE CONNECTIONS

- A. In general and unless otherwise shown, small service lines and branches shall connect to larger cast iron or ductile iron mains using cast iron tapped tees and crosses.
- B. Tapped tees and crosses shall have minimum 2-inch NPT branch connections and shall be furnished with mechanical joint ends.

### 3.05 CUT-INS TO EXISTING PIPING

- A. In general and unless otherwise shown, cut-ins to existing ductile iron piping for installation of new mechanical joint fittings and valves shall be made using ductile iron cutting-in sleeves.
- B. Cutting-in sleeves shall have a pressure rating not less than that of the existing pipeline and shall be furnished with a mechanical joint end on one end and a plain end on the other.

### 3.06 DRILLING AND TAPPING

- A. Wherever required ductile iron pipe and fittings and cast iron pipe and fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
- B. Where the size of the pipe to be connected is such as to require bosses for connections and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, the CONTRACTOR shall furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe. Alternately, where shown or specified a tapped saddle clamp may be used in lieu of a cast-on boss. Saddle clamp shall be of the heavy-duty type with O-ring gaskets and two heavy U-bolt clamps.
- C. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.
- D. Where connections are made between new and old piping, the connection shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
- E. Cut-ins to existing and operating pipelines shall be done at times agreeable to the Owner upon approval of the ENGINEER.
- F. Existing pipelines that may be cut or damaged during the performance of work under this item shall be repaired, reconnected, and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.
- G. No separate payment will be made for drilling, tapping, making connections, cut-ins, repairs to damaged existing pipelines, and reconnections in existing pipelines.

### 3.07 FIELD TESTING-PRESSURE PIPING

- A. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the CONTRACTOR in the presence of the ENGINEER, and tests shall be continued until all leaks have been made tight to the satisfaction of the ENGINEER.
- B. All pressure piping shall be subject to a hydrostatic gauge pressure equal to 150 percent of the maximum operating pressure of the pipe section under test or 150 psig, whichever is greater, based on the elevation of the lowest point of the section of pipe under test and corrected to the elevation of the test gauge. The above pressures shall be maintained for a minimum of two consecutive hours. No leakage will be allowed. Leakage may be determined by losses of pressure or other methods approved by the ENGINEER.
- C. The CONTRACTOR shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- D. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
- E. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs, or air release valves are not available at the high places, the CONTRACTOR shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- F. After satisfactory completion of the pressure test, a leakage test shall be performed on each section of pipe in accordance with Section 4.2 of AWWA C600 at a hydrostatic pressure equal to the maximum operating pressure of the pipe section under test, based on the elevation of the lowest point of the line or lowest point of the section under test and corrected to the elevation of the gauge.
- G. Any leakage developing during the test shall be corrected at the CONTRACTOR'S expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If the defective portion cannot be located, the CONTRACTOR, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility tested without leakage.
- H. After all tests on any section have been completed to the satisfaction of the ENGINEER, the CONTRACTOR shall carefully clean, blow out, and drain the line of all water to prevent the freezing of the same. The CONTRACTOR shall also demonstrate to the satisfaction of the ENGINEER that any and all lines are free from obstructions and foreign material.

- I. The CONTRACTOR shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other materials required to conduct the tests.

### 3.08 FIELD TESTING - GRAVITY PIPING

- A. After completion of any section of sewer, the grades, joints, and alignment shall be true to line and grade. Joint surfaces shall be smooth. There shall be no visual leakage and the sewer shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, or other materials on the inside.
- B. Infiltration shall not exceed 25 gallons per 24 hours per inch of diameter per mile of sewer. Contractor shall furnish all supplies, materials, labor, services, etc., needed to make infiltration or exfiltration tests including water. No separate payment will be made for equipment, supplies, material, water, or services.
- C. Any leakage, including active seepage, shall be corrected by removal and replacement of pipe or joint where such leakage exists until the pipelines meet the requirements of the allowable leakage specifications.
- D. The sewers installed under this contract will be subject to television inspection by the Owner and/or Engineer. It is the intent to televise all sewers which are suspected to contain defects in order to insure that all installation is water tight. The Owner reserves the right to perform this work and will furnish all equipment and materials for such inspection. Otherwise the Contractor will cause to have the television work performed.
- E. If the television work is performed by the Owner, the Contractor shall provide access for the Owner's crews and equipment for the television inspection and shall have his representative present during inspection.
- F. The television work, if performed by the Owner, shall be scheduled so as to take advantage of the time when the groundwater table is most likely to cause infiltration. Work shall be scheduled during or after rainy periods rather than after prolonged periods of dry weather. Logs and/or tapes of the inspections will be made available to the Contractor. Otherwise, the Contractor shall perform the work and furnish tapes and logs to the Owner and the Engineer.
- G. All sewer pipe shall be tested using low pressure air testing in accordance with the procedures and standards listed below.
  1. Clean pipe to be tested by propelling a snug-fitting inflated rubber ball through pipe with water.
  2. Plug all pipe outlets with suitable test plugs. Brace each plug securely to prevent blowouts. As a safety precaution, pressurizing equipment shall include a regulator set at slightly above test pressure to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.

3. A plug shall be installed in one end of the pipe to be tested. A second plug with a 1/2" opening to allow for the introduction of air into the portion of pipe to be tested shall be put in place in the other end of the pipe.
4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any groundwater above the pipe (0.43 psi per foot of groundwater above the pipe invert), but not greater than 9.0 psig.
5. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
6. When pressure decreases to 3.5 psig, start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 3.0 psig. Minimum permissible pressure holding times for runs of single pipe diameter are indicated in the table in seconds. No separate allowance shall be given for laterals.

SPECIFICATION TIME REQUIRED FOR 0.5 PSIG PRESSURE DROP  
FOR SIZE AND LENGTH OF PIPE INDICATED

Pipe Dia. ft.	Time min.:ft.	Min. Time ft.	Length (ft.)														
			100	150	200	250	300	350	400	450	(in.)	sec.)	(ft.)	(sec.)			
8	3:47	298		3:47	3:47	3:47	3:47	3:48	4:26								
10	4:43	239		4:43	4:43	4:43	4:57	5:56	6:55								
12	5:40	199		5:40	5:40	5:42	7:08	8:33	9:58								
15	7:05	159		7:05	7:05	8:54	11:08	13:21	15:35								
18	8:30	133		8:30	9:37	12:49	16:01	19:14	22:26	25:38							
21	9:55	114		9:55	13:05	17:27	21:49	26:11	30:32	34:54							
24	11:20	99	6.837xL	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17						
27	12:45	88	8.653xL	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54						
30	14:10	80	10.683xL	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07						
33	15:35	72	12.926xL	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57						
36	17:00	66	15.384xL	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23						

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