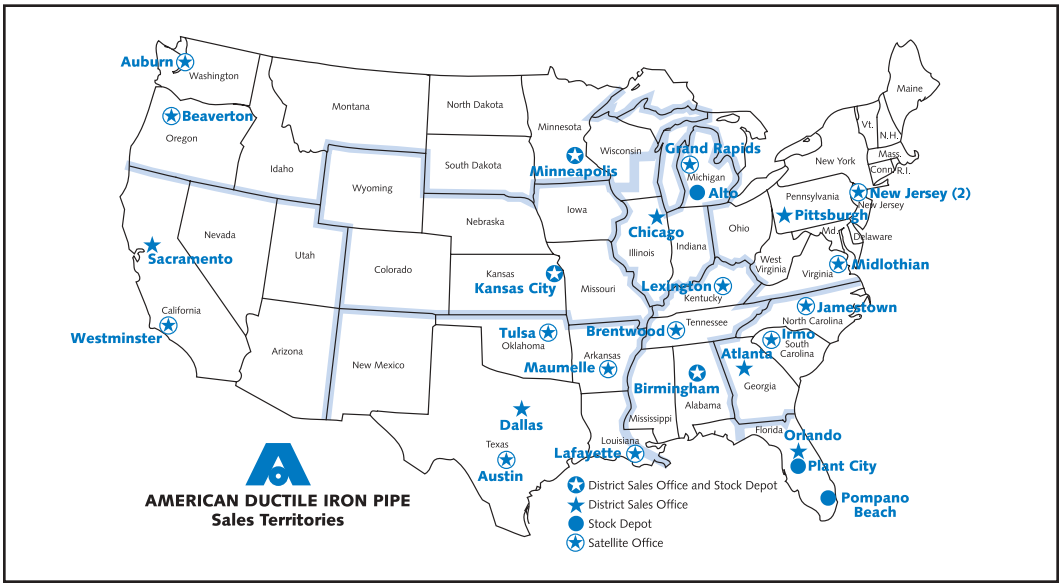
AMERICAN Ductile Iron Pipe

AMERICAN DUCTILE IRON PIPE



American Ductile Iron Pipe (A Division of ACIPCO)

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AMERICAN Ductile Iron Pipe

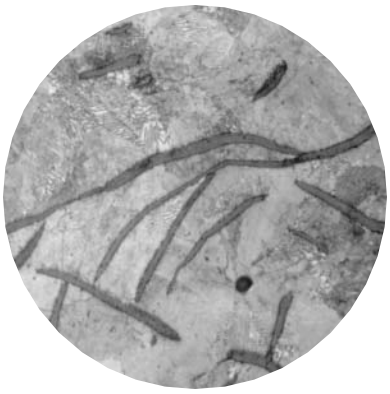
Centrifugally Cast in Metal Molds or Sand-Lined Molds For Water or Other Liquids.

What is AMERICAN Ductile Iron?

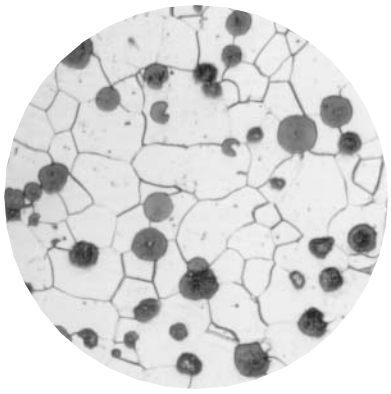
The ideal of cast iron with ductility, long sought by metallurgists, was realized with the introduction of ductile iron in 1948. Acclaimed to be one of the most significant metallurgical developments in this century, ductile iron has had an increasing impact in many industries. Ductile iron has ductility—as the name implies—and in addition, it has strength and impact resistance far greater than that of gray iron; yet it retains the proven corrosion resistance of gray iron, thus making it an ideal piping material.

American Cast Iron Pipe Company pioneered in the development of ductile iron pipe and produced experimental casts of ductile pipe and fittings as early as 1948. In 1949 Mr. C.K. Donoho, AMERICAN's chief metallurgist, authored a paper on the amazing properties of this new metal. Following this experimental work, the first shipment of AMERICAN Ductile Iron pipe was made in 1955. Production of ductile iron pipe has grown steadily and it is now a predominant piping material for conveying water and other liquids.

Ductile iron is produced by treating molten low-sulfur base iron with magnesium under closely controlled conditions. The startling change in the metal is characterized by the free graphite in ductile iron being deposited in spheroidal or nodular form instead of flake form as in gray iron. With the free graphite in nodular form, the continuity of the metal matrix is at a maximum, accounting for the formation of a far stronger, tougher ductile material greatly exceeding gray iron in strength, in ductility, and in impact characteristics.



Photomicrograph showing graphite form in gray iron.



Photomicrograph showing graphite form in ductile iron.

AMERICAN Ductile Iron-Grade 60-42-10
Minimum Physical Properties
AWWA C151

These properties are verified by tensile samples taken from the wall of the pipe.

Tensile Strength	60,000 psi
Yield Strength	42,000 psi
Elongation	10 percent

Fig. 3-1

AMERICAN Ductile Iron pipe provides...

High Impact Resistance

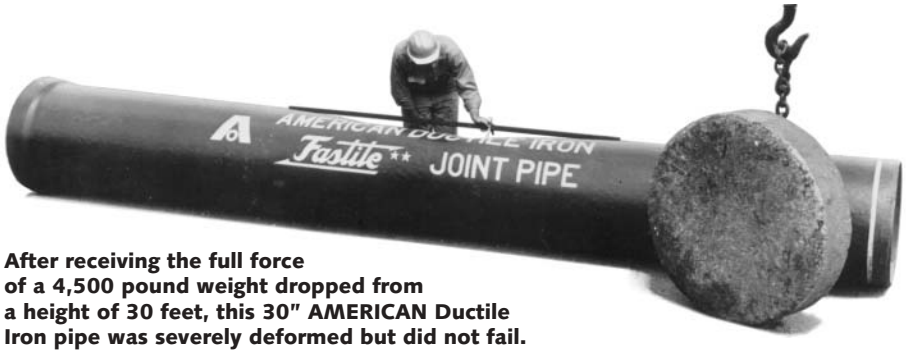
AMERICAN Ductile Iron pipe has the high impact strength and toughness to withstand shocks usually encountered in transportation, handling and installation. These characteristics also provide added security against stresses induced by water hammer, highway traffic and unexpected adverse forces. Excellent impact resistance is confirmed by tests made at regular intervals in accordance with ANSI/AWWA C151/A21.51 Standard.

Superior Strength

AMERICAN utilizes the ideal combination of chemical analysis and heat treatment to produce a pipe with the most desirable combination of high strength and excellent ductility...a pipe that will withstand high internal pressure and deep cover...a pipe providing added reliability and additional factors of safety for normal and for unusual conditions such as expansive soils and earth movement due to freezing and thawing.

Assured, Proven Long Life

Historical records document the proven service for centuries of gray cast iron pipe. Extensive laboratory and field tests conducted by many authorities under various installation conditions prove the soil corrosion resistance of ductile iron is at least as good as, if not better than, that of gray cast iron. The outstanding resistance of ductile iron pipe to soil corrosion has been verified by more than four decades of service.



After receiving the full force of a 4,500 pound weight dropped from a height of 30 feet, this 30" AMERICAN Ductile Iron pipe was severely deformed but did not fail.

Design of AMERICAN Ductile Iron Pipe

The principal standards covering ductile iron pipe are ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. These and other standards are referenced throughout this Section either by the full ANSI/AWWA designation or by only the AWWA numbering, such as AWWA C150.

AMERICAN Ductile Iron pipe is designed for combinations of internal pressure, water hammer, earth load and truck load. Thicknesses are determined in accordance with ANSI/AWWA C150/A21.50, employing design methods applicable to flexible pipe. Utilizing the principal mechanical properties of high tensile strength, ductility and impact resistance, the design of ductile iron pipe is conservative in all respects and embodies high factors of safety. For qualification of pipe these properties are confirmed during production by frequent tensile and impact tests of specimens from the wall of pipe.

Physical Properties

The ductile iron in AMERICAN pipe is grade 60-42-10, an annealed grade with the following specified minimum properties: tensile strength, 60,000 psi; yield strength, 42,000 psi; elongation, 10 percent.

A typical stress-strain curve obtained on a tensile specimen from the wall of ductile iron pipe shows that the pipe metal is an elastic material; that is, its stress-strain relation is linear over a substantial portion of the ultimate strength range. The average modulus of elasticity is 24,000,000 psi, the value used in the design equations. Beyond the yield point the metal continues to exhibit substantial ductility before ultimate failure.

The high tensile strength of ductile iron allows the use of diameter-to-thickness ratios in which the deflection of the pipe, under trench loads, is of sufficient magnitude that the principles of flexible pipe design are applicable.

Design Steps

1. Pipe is designed for internal pressure including working pressure and surge pressure as follows:

Working pressure is the specified design working pressure.

Surge pressure is 100 psi unless a different surge pressure is specified by the buyer or his engineer.

The design internal pressure in psi is the safety factor 2.0 multiplied by the sum of the working pressure and the surge pressure (100 psi). The metal design strength is the minimum yield strength in tension of 42,000 psi.

2. Pipe is designed for external loads including both earth load and truck load as follows:

Earth load is based on the prism load concept and normally conservative weight of backfill soil of 120 lb/cu.ft.

Truck load is based on an AASHTO H-20 truck with 16,000-lb wheel load and 1.5 impact factor considered at all depths for all sizes of pipe.

The ring bending stress used in design is 48,000 psi. The maximum pipe deflection used in the design of cement-lined pipe is 3%.

The design values for the five types of standard laying conditions in AWWA C150 and C151 (see Fig. 3-2, page 3-12) are as follows:

Type 1:
E′= 150 Bedding Angle = 30°
Type 2:
E′= 300 Bedding Angle = 45°
Type 3:
E′= 400 Bedding Angle = 60°
Type 4:
E′= 500 Bedding Angle = 90°
Type 5:
E′= 700 Bedding Angle = 150°

3. The larger net thickness is selected from the internal pressure design thickness and the bending stress design thickness. To this thickness is added a service allowance of 0.08″. The minimum thickness for deflection is then calculated and compared to that thickness. The larger of the two is selected. A casting tolerance is then added giving the total design thickness of the pipe. Casting tolerances are listed in Table No. 3-1.

4. The pressure class thickness is determined by the selection of a standard pressure class thickness from Table No. 3-8. If the calculated thickness is between two standard pressure class thicknesses, the larger of the two is selected.

Later in this Section, tables show thicknesses of ductile pipe for a number of different pressures and depths of cover. For conditions not covered in tables, all formulas and data for designing ductile iron pipe are given in AWWA C150.

Manufacture of AMERICAN Ductile Iron Pipe

AMERICAN Ductile Iron pipe is cast centrifugally in nominal 20-foot laying lengths by the deLavaud process.

After the careful proportioning of select high-quality raw materials, the melting of iron for the manufacture of AMERICAN Ductile Iron pipe takes place in one of the world's largest iron melting facilities under continually controlled conditions.

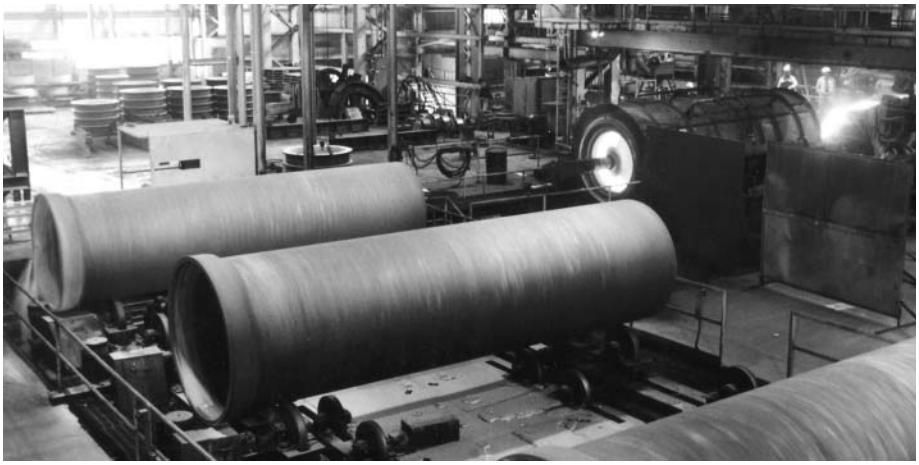
AMERICAN also owns and operates one of the most impressive and modern scrap recycling facilities in the world. This facility ensures a dependable supply of high-quality shredded ferrous scrap for the production of high-quality piping products, conserving valuable natural resources in the process. This means, unlike many other types of pipe materials, AMERICAN Ductile Iron pipe is manufactured using predominantly recycled iron and steel, not virgin materials.

The melting process utilizes a control computer in the operation of the highly sophisticated electronic and mechanical components of the system. Rigid clean air requirements are satisfied through modern emission control equipment.

Molten iron flows from a Contiarc furnace and/or cupola, and in the melting facility is collected in 60-ton capacity ladles where it is desulfurized. From here the iron is transferred into a 1300-ton holder which provides a reservoir of iron of uniform chemistry. The molten iron is then transferred from the holder to coreless electric induction furnaces where chemistry and temperature are adjusted to the precise requirements of each production unit. The iron is then ready for treatment with magnesium, the most important step in the production of ductile iron, requiring close control of both the mechanics of the operation and the final chemistry of the iron. After treatment, each ladle is checked for exact content of magnesium and other elements, and the metal is sent to the production area for pouring.

The molten iron is introduced into a horizontal rotating mold with the quantity of the metal poured controlling the pipe thickness. The centrifugal force generated by rotation holds the metal against the mold wall and forces lighter, non-metallic impurities to the inside of the pipe to be removed in the cleaning process. After the iron has solidified, the casting machine is stopped and the pipe is stripped from the mold.

All AMERICAN Ductile Iron pipe is annealed in modern heat treating ovens with precisely controlled time and temper-



View of modern plant where the large diameter sizes of pipe are centrifugally cast in nominal 20-foot lengths by the deLavaud process.

ature cycles to produce optimum physical properties. The pipe is then moved to processing stations where it is cleaned, machined, hydrostatically tested, lined and coated, and given final inspection.

AMERICAN Ductile Iron pipe in sizes 4" through 64" is manufactured in accordance with and meets or exceeds all applicable requirements of AWWA C151 Standard for "Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids." The quality of AMERICAN's products and conformance to appropriate specifications is assured by the British Standards Institute's certification that AMERICAN's quality system complies with the ISO 9001 Quality Management System Standard.

GENERAL REQUIREMENTS

AMERICAN Ductile Iron pipe, with Fastite or mechanical joints, complies with AWWA C151 and the joints meet requirements of AWWA C111. The outside diameters of 4"-48" are the same as for gray iron pipe that was formerly manufactured per AWWA C106 or C108, making ductile iron pipe completely interchangeable with gray iron pipe made to those standards with respect to joining diameters, accessories and fittings.

The installation of ductile iron pipe is covered in AWWA C600, including general instructions for the assembly of push-on and mechanical joint pipe. See Section 2 of this Pipe Manual for detailed assembly instructions for Fastite and Mechanical Joint pipe.

The nominal laying length of the pipe is as shown in tables in this Section. A maximum of 20 percent of the total number of pipe of each size specified in an order may be furnished as much as 24" shorter than the nominal laying length, and an additional 10 percent may be furnished as much as 6" shorter than nominal laying length.

Dimensions

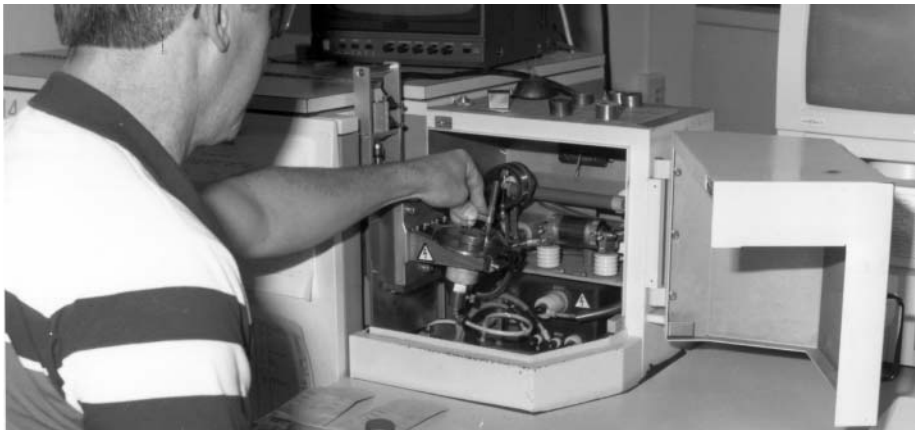
The plain end, the socket of the pipe, and the accessories are gauged at sufficiently frequent intervals to ensure that the dimensions comply with the requirements of AWWA C151.

Thickness

Minus thickness tolerances of pipe are shown below:

Table No. 3-1

Size in.	Minus Tolerance in.
4"-8"	0.05
10"-12"	0.06
14"-42"	0.07
48"	0.08
54"-64"	0.09



During production, each ladle of ductile iron is checked for exact content of magnesium and other elements with this computer-controlled optical emission spectrometer.

An additional minus tolerance of 0.02" is permitted along the barrel of the pipe for a distance not to exceed 12".

Weight

The weight tolerance of pipe is minus 6 percent for pipe 12" and smaller in diameter, and minus 5 percent for pipe larger than 12" in diameter.

COATINGS AND LININGS

Outside Coating

The outside coating for use under normal conditions is an asphaltic coating approximately 1 mil thick as specified in AWWA C151. The coating is applied to the outside of all pipe, unless otherwise specified. See Section 11.

Inside Lining

AMERICAN Ductile Iron pipe for water service is normally furnished with standard cement lining on the inside as specified in AWWA C104.

For other types of service, pipe can be furnished uncoated inside or with cement lining, asphaltic lining, Polybond*Plus*® lining, coal tar epoxy or with other special linings as may be required to meet special service conditions and as agreed upon at time of purchase.

For more detailed information on coatings and linings see Section 11.

TESTING

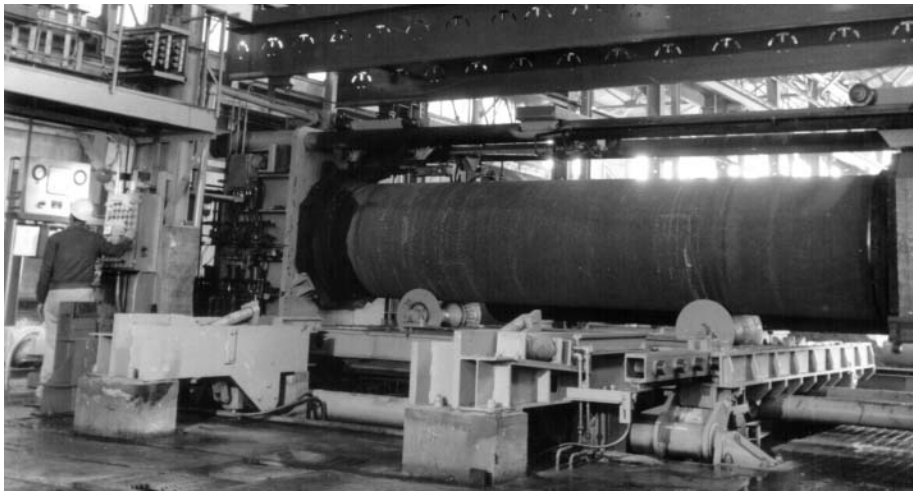
To ensure that the properties of the finished pipe meet or exceed the requirements of AWWA C151 and those of AMERICAN's quality control program, continuous inspection and testing are performed.

Spectral Analysis

Following magnesium treatment of the molten metal, a sample is poured from each ladle for spectral analysis. Within minutes, the amount of magnesium and other elements in the iron is determined. This early verification of the metal composition is a vital factor in the control of pipe quality.

Tensile Test

The physical characteristics of the pipe are continually checked by tensile tests made at a frequency of at least one such test during each casting period of approximately 3 hours. The tensile test specimens are cut from the pipe wall, and are machined from the midsection for testing. The acceptance values for test specimens are as follows:



Each 30" and larger diameter AMERICAN Ductile Iron pipe is hydrostatically tested to 75% of yield strength which results in higher test pressures than those required by AWWA C151, varying to over 900 psi, depending on size and thickness of the pipe.

Grade of Iron: 60-42-10

Minimum tensile strength .....60,000 psi
Minimum yield strength.....42,000 psi
Minimum elongation .....10 percent

Impact Test

Impact tests are made on at least one sample machined from the pipe wall during each operating hour to ensure the desired toughness in the finished pipe. Notched Charpy impact tests are performed in accordance with ASTM E23, except that specimen size is 0.500" by full thickness of the pipe wall. The corrected acceptance value for this test is a minimum of 7 ft-lb for test conducted at 70°F ± 10°. Low-temperature impact tests are made from at least 10% of the test pipe to ensure compliance with a minimum corrected value of 3 ft-lb for tests conducted at -40°F ± 2°F.

Hydrostatic Test

As specified by AWWA C151, each pipe is subjected to a hydrostatic test of not less than 500 psi with the pipe under the full test pressure for at least 10 seconds. Suitable controls and recording devices are provided so that the test pressure and duration are positively controlled. Any pipe that leaks or does not withstand the test pressure is rejected.

For even greater assurance of pipe quality, each 30" and larger AMERICAN Ductile Iron pipe is hydrostatically tested to 75% of yield strength of the metal, based on the nominal thickness of the pipe. As an example of the higher test pressures this dictates, each length of 30" diameter ductile iron pipe, Class 150 (the lightest class produced), 0.34" nominal wall, is tested to 669 psi. See Table No. 3-2 for a listing of AMERICAN's hydrostatic tests on 30" and larger pressure class pipe. Contact AMERICAN if higher test pressures are desired.

Hardness Test

Hardness tests of pipe samples are routinely made to further ensure the quality of the final product.

MARKING PIPE

The weight, class or nominal thickness, and casting period are shown on each pipe. AMERICAN's identifying mark, the year in which the pipe is produced, and the letters "DI" or "DUCTILE" are cast or stamped on the pipe. When specified on the purchase order, initials not exceeding four in number are stamped on the pipe. All marks are on or near the bell.

WEIGHING PIPE

Each pipe is weighed before the application of any lining or coating other than the asphaltic coating. The weight is painted on the outside of the bell end.

AMERICAN Ductile Iron Pipe
Hydrostatic Proof Test Pressures
30"-64" Pressure Classes

Table No. 3-2

Size in.	Outside Diameter in.	Pressure Class									
		150		200		250		300		350	
		Wall Thickness in.	Test Pressure psi	Wall Thickness in.	Test Pressure psi	Wall Thickness in.	Test Pressure psi	Wall Thickness in.	Test Pressure psi	Wall Thickness in.	Test Pressure psi
30	32.00	0.34	669	0.38	748	0.42	827	0.45	886	0.49	965
36	38.30	0.38	625	0.42	691	0.47	773	0.51	839	0.56	921
42	44.50	0.41	580	0.47	665	0.52	736	0.57	807	0.63	892
48	50.80	0.46	570	0.52	645	0.58	719	0.64	794	0.70	868
54	57.56	0.51	558	0.58	635	0.65	711	0.72	788	0.79	865
60	61.61	0.54	552	0.61	624	0.68	695	0.76	777	0.83	849
64	65.67	0.56	537	0.64	614	0.72	691	0.80	767	0.87	835

These pressures produce a 31,500 psi stress in the pipe wall (which is equal to 75% of the 42,000 psi minimum yield strength for ductile iron pipe) based on outside diameter and total standard thickness. Test pressure = 2 x T x 31,500 / O.D.

AMERICAN Ductile Iron Fastite® Joint Pipe

ANSI/AWWA C151/A21.51

Standard Dimensions

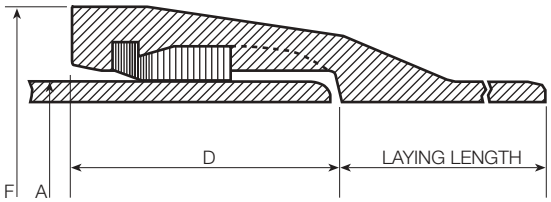


Table No. 3-3

Size in.	Nominal Laying Length ft.	Dimensions in Inches		
		A Outside Diameter	D Depth of Socket	F* Bell O.D.
4	20	4.80	3.31	6.71
6	20	6.90	3.38	8.90
8	20	9.05	3.75	11.16
10	20	11.10	3.75	13.25
12	20	13.20	3.75	15.22
14	20	15.30	5.23	17.73
16	20	17.40	5.23	19.86
18	20	19.50	5.50	22.16
20	20	21.60	5.50	24.28
24	20	25.80	5.50	28.50
30	20	32.00	6.50	34.95
36	20	38.30	6.50	41.37
42	20	44.50	7.50	48.27
48	20	50.80	8.00	54.71
54	20	57.56	8.50	61.65
60	20	61.61	8.75	65.80
64	20	65.67	9.00	70.04

*Dimensions subject to change at our option. Check AMERICAN if exact dimensions required.
For Fastite assembly instructions see Section 2.

The liberal allowable deflection in the Fastite Joint facilitates pipeline installation with sweeping horizontal or vertical curves without the use of fittings.

AMERICAN Ductile Iron Fastite® Joint Pipe

Allowable Joint Deflection

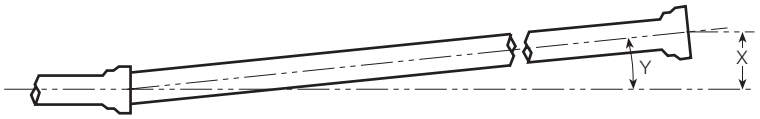


Table No. 3-4

Size in.	Nominal Laying Length ft.	Maximum Recommended Deflection	
		X Offset per Length (in.)	Y Deflection Angle (degrees)
4	20	21	5°
6	20	21	5°
8	20	21	5°
10	20	21	5°
12	20	21	5°
14	20	21	5°
16	20	21	5°
18	20	21	5°
20	20	21	5°
24	20	21	5°
30	20	21	5°
36	20	17	4°
42	20	12	3°
48	20	12	3°
54	20	12	3°
60	20	12	3°
64	20	12	3°

For optimum assembly, the joints should be assembled with the pipe in reasonably straight alignment. After joint assembly, the pipe may be deflected up to the maximum shown above. Offset distances are based on nominal 20-foot lengths.
See Section 2 Table 2-4 for maximum allowable internal separation of 24" and larger Fastite joints.

Special Fastite Deflection Bells

Special Fastite bells are available which allow greater maximum joint deflection as follows:

Table No. 3-5

Size in.	X Offset per Length in.	Y Deflection Angle
36	21	5°
42	21	5°
48	17	4°
54	17	4°
60	17	4°
64	17	4°

Offset distances are based on 20-foot lengths.

AMERICAN Ductile Iron Mechanical Joint Pipe*

ANSI/AWWA C151/A21.51

Standard Dimensions

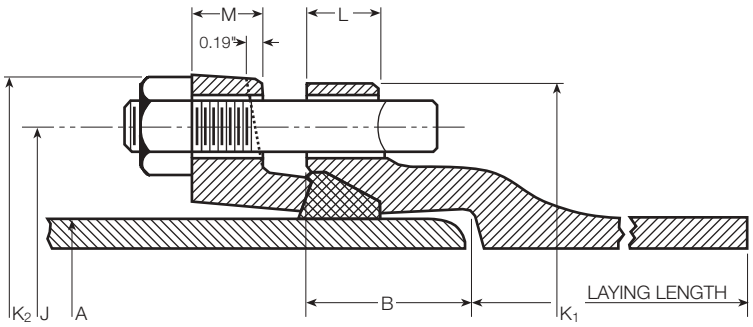


Table No. 3-6

Size in.	Nominal Laying Length ft.	Dimensions in Inches							Bolts	
		A	B	J	K_1**	K_2	L†	M	No. per Joint	Size in.
4	20	4.80	2.5	7.50	9.06	9.12	.91	.75	4	¾ X 3½
6	20	6.90	2.5	9.50	11.06	11.12	.94	.88	6	¾ X 3½
8	20	9.05	2.5	11.75	13.31	13.37	.98	1.00	6	¾ X 4
10	20	11.10	2.5	14.00	15.62	15.62	.98	1.00	8	¾ X 4
12	20	13.20	2.5	16.25	17.88	17.88	.98	1.00	8	¾ X 4

*Mechanical Joint Pipe is available in Special Thickness Class 53 only.
**These dimensions for pipe only. Refer to Table No. 5-1 for fitting joint dimensions.
†The bell flanges may be furnished thicker than specified under "L" above as provided in AWWA C111.
Bolt holes are ⅛" larger than bolt diameters.
For Mechanical Joint assembly instructions and for additional dimensions see Section 2.
See Section 12 when retainer glands are being considered in lieu of regular glands.
When bell flanges tapped for studs are required, alloy steel stud bolts with the required stud length equal to the length of the Tee head bolt it replaces should normally be specified.
Boltless Fastite, Fast-Grip, Flex-Ring, and Lok-Ring push-on joint pipe and fittings are normally less labor-intensive and labor-reliant than mechanical joints pictured and are often preferred for many applications. See appropriate sections of the Pipe Manual for more information with regard to these joint configurations.

AMERICAN Ductile Iron Mechanical Joint Pipe

Allowable Joint Deflection

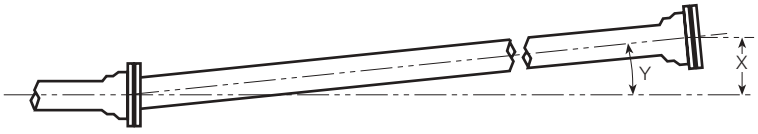


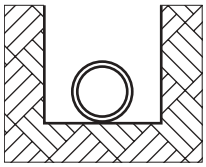
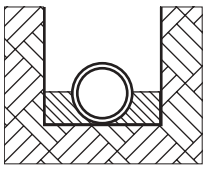
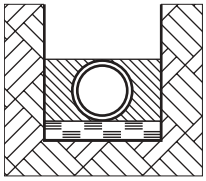
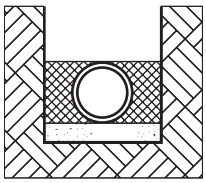
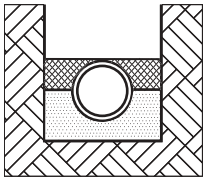
Table No. 3-7

Size in.	Nominal Laying Length ft.	Maximum Recommended Deflection	
		X Offset per Length (in.)	Y Deflection Angle (degrees)
4	20	35	8°-18'
6	20	30	7°-07'
8	20	22	5°-21'
10	20	22	5°-21'
12	20	22	5°-21'

The joint should be assembled with the pipe in reasonably straight alignment. Joint deflection to the maximum shown above may be made after assembly but before tightening bolts. Offset distances are based on nominal 20-foot lengths.

AMERICAN Ductile Iron Pipe

ANSI/AWWA C150/A21.50
and
ANSI/AWWA C151/A21.51
Standard Laying Conditions

Laying Condition	Description
 Type 1*	Flat-bottom trench.† Loose backfill.
 Type 2	Flat-bottom trench.† Backfill lightly consolidated to centerline of pipe.
 Type 3	Pipe bedded in 4" minimum loose soil.†† Backfill lightly consolidated to top of pipe.
 Type 4	Pipe bedded in sand, gravel or crushed stone to depth of ⅛ pipe diameter, 4" minimum. Backfill compacted to top of pipe. (Approximately 80% Standard Proctor, AASHTO T-99.)
 Type 5	Pipe bedded to its centerline in compacted granular§ material, 4" minimum under pipe. Compacted granular or select material†† to top of pipe. (Approximately 90% Standard Proctor, AASHTO T-99.)

*For 14" and larger pipe, consideration should be given to the use of laying conditions other than Type 1.
†"Flat-bottom" is defined as undisturbed earth.
††"Loose soil" or "select material" is defined as native soil excavated from the trench, free of rocks, foreign material and frozen earth.
§ Granular materials are defined per the AASHTO Soil Classification System (ASTM D3282) or the Unified Soil Classification System (ASTM D2487), with the exception that gravel bedding/backfill adjacent to the pipe is limited to 2" maximum particle size per ANSI/AWWA C600.

Fig. 3-2

AMERICAN Ductile Iron Pipe

ANSI/AWWA C150/A21.50
and
ANSI/AWWA C151/A21.51
Standard Pressure Classes – Wall Thickness and Nominal Wall Thicknesses

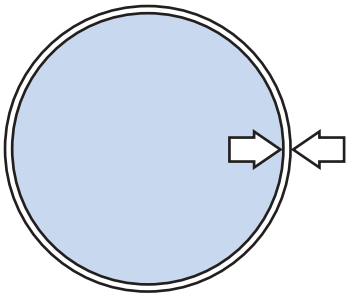


Table No. 3-8

Size in.	Outside Diameter in.	Pressure Class				
		150	200	250	300	350
		Nominal Thickness in Inches				
4	4.80	-	-	-	-	0.25
6	6.90	-	-	-	-	0.25
8	9.05	-	-	-	-	0.25
10	11.10	-	-	-	-	0.26
12	13.20	-	-	-	-	0.28
14	15.30	-	-	0.28	0.30	0.31
16	17.40	-	-	0.30	0.32	0.34
18	19.50	-	-	0.31	0.34	0.36
20	21.60	-	-	0.33	0.36	0.38
24	25.80	-	0.33	0.37	0.40	0.43
30	32.00	0.34	0.38	0.42	0.45	0.49
36	38.30	0.38	0.42	0.47	0.51	0.56
42	44.50	0.41	0.47	0.52	0.57	0.63
48	50.80	0.46	0.52	0.58	0.64	0.70
54	57.56	0.51	0.58	0.65	0.72	0.79
60	61.61	0.54	0.61	0.68	0.76	0.83
64	65.67	0.56	0.64	0.72	0.80	0.87

Pressure classes are defined as the rated water working pressure of the pipe in psi. The thicknesses shown are adequate for the rated water working pressure plus a surge allowance of 100 psi. Calculations result in net thicknesses and are based on a minimum yield strength in tension of 42,000 psi and 2.0 safety factor times the sum of working pressure and 100 psi surge allowance.

Thickness can be calculated for rated water working pressure and surges other than the above by use of equation 1 in ANSI/AWWA C150/A21.50.

AMERICAN Ductile Iron pipe is available for water working pressures greater than 350 psi. Check AMERICAN for details.

These are standard pressure classes as given in AWWA C150 and C151. AMERICAN can furnish any thickness in between these standard thicknesses if deemed economical for major projects.

AMERICAN Ductile Iron pipe is also available with thicknesses greater than Pressure Class 350. For special applications, contact AMERICAN.

AMERICAN Ductile Iron

Fastite® Joint Pipe
ANSI/AWWA C151/A21.51
Weights for Pressure Classes

Table No. 3-9

Size in.	Pressure Class	Wall Thickness in.	Weight in Pounds		
			Per Foot Plain End	Fastite Joint	
				Per Foot inc. Bell	Per 20' Nominal Length
4	350	0.25	10.9	11.4	230
6	350	0.25	16.0	16.7	335
8	350	0.25	21.1	22.1	445
10	350	0.26	27.1	28.4	570
12	350	0.28	34.8	36.4	730
14	250	0.28	40.4	43.2	865
	300	0.30	43.3	46.1	925
	350	0.31	44.7	47.6	955
16	250	0.30	49.3	52.5	1050
	300	0.32	52.5	55.7	1115
	350	0.34	55.8	59.0	1180
18	250	0.31	57.2	60.8	1220
	300	0.34	62.6	66.3	1330
	350	0.36	66.2	69.8	1400
20	250	0.33	67.5	71.5	1435
	300	0.36	73.5	77.5	1555
	350	0.38	77.5	81.5	1635
24	200	0.33	80.8	85.6	1715
	250	0.37	90.5	95.3	1910
	300	0.40	97.7	102.5	2055
	350	0.43	104.9	109.7	2200
30	150	0.34	103.5	111.7	2240
	200	0.38	115.5	123.7	2480
	250	0.42	127.5	135.7	2720
	300	0.45	136.5	144.7	2900
	350	0.49	148.4	156.6	3140
36	150	0.38	138.5	149.2	2990
	200	0.42	152.9	163.6	3280
	250	0.47	170.9	181.6	3640
	300	0.51	185.3	196.0	3930
	350	0.56	203.2	213.9	4285
42	150	0.41	173.8	188.3	3765
	200	0.47	198.9	213.3	4265
	250	0.52	219.9	234.3	4685
	300	0.57	240.7	255.2	5105
	350	0.63	265.7	280.2	5605
48	150	0.46	222.6	240.3	4805
	200	0.52	251.3	269.0	5380
	250	0.58	280.0	297.7	5955
	300	0.64	308.6	326.3	6525
	350	0.70	337.1	354.8	7095

AMERICAN Ductile Iron

Fastite Joint Pipe
ANSI/AWWA C151/A21.51
Weights for Pressure Classes

Table No. 3-9—Continued

Size in.	Pressure Class	Wall Thickness in.	Weight in Pounds		
			Per Foot Plain End	Fastite Joint	
				Per Foot inc. Bell	Per 20' Nominal Length
54	150	0.51	279.7	301.7	6035
	200	0.58	317.7	339.7	6795
	250	0.65	355.6	377.5	7550
	300	0.72	393.4	415.3	8305
	350	0.79	431.1	453.1	9060
60	150	0.54	317.0	346.4	6930
	200	0.61	357.7	387.1	7740
	250	0.68	398.3	427.7	8555
	300	0.76	444.6	474.0	9480
	350	0.83	485.0	514.4	10290
64	150	0.56	350.5	386.1	7720
	200	0.64	400.1	435.7	8715
	250	0.72	449.6	485.2	9705
	300	0.80	498.9	534.5	10690
	350	0.87	542.0	577.6	11550

60" AMERICAN Fastite® Joint Ductile Iron pipe being installed as a water transmission main.

AMERICAN Ductile Iron Pipe

ANSI/AWWA C151/A21.51
Pressure Ratings and Depths of Cover
Minimum Pressure Classes

In Table No. 3-10 on the following page the relationships of Minimum Pressure Classes, rated working pressure and maximum depths of cover are tabulated. Following in Table No. 3-11 this same information is tabulated for all Pressure Classes. Information in these tables is based on the same conservative design principles as is the information shown in Table No. 14 of AWWA C150 and Table No. 51.3 of AWWA C151. The information included and the intended use of these tables are as follows:

Table No. 3-10—Working Pressure/ Maximum Depths of Cover for Minimum Pressure Classes

In Table No. 3-10 are tabulated the corresponding nominal wall thickness, maximum rated working pressure, and maximum depth of cover for the five types of laying conditions, all for Minimum Pressure Classes of ductile iron pipe.

The information in this table is taken from Table No. 3-11 and is offered as a convenience for those wanting to quickly check the capabilities of Minimum Pressure Classes of ductile iron pipe under a given set of conditions. For the majority of internal pressure and external loading conditions, Minimum Pressure Classes are more than adequate and possess substantial true safety factors.

Table No. 3-11—Working Pressure/ Maximum Depths of Cover

In Table No. 3-11 are listed the standard Pressure Classes and for each class are tabulated the corresponding nominal wall thickness, maximum rated working pressure, and maximum depths of cover for the five types of laying conditions.

For any specified standard Pressure Class the nominal wall thickness, the maximum rated working pressure, and the maximum depth of cover for each standard laying condition can be determined.

For any water working pressure of 150, 200, 250, 300 or 350 psi, the corresponding standard Pressure Class and nominal wall thickness can be determined. (Note: Although not listed in the following table, ductile iron pipe for working pressures higher than 350 psi is available. Consult AMERICAN regarding specific conditions involved.)

For any required depth of cover from 2.5′ up to the maximums shown in this table the Pressure Class and the corresponding nominal wall thickness can be determined for laying conditions Type 1 through Type 5.

For other conditions not covered in these tables see AWWA C150 or consult AMERICAN for design of pipe thickness. Special thickness classes shown in Table No. 3-12 may be appropriate in such cases.

AMERICAN Ductile Iron Pipe for Water or Other Liquids

ANSI/AWWA C151/A21.51

WORKING PRESSURES AND MAXIMUM DEPTHS OF COVER for Minimum Pressure Classes of Ductile Iron Pipe 4" thru 64"

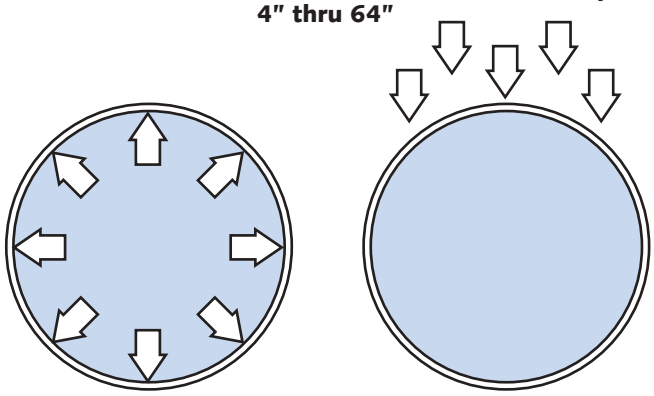


Table No. 3-10

Size in.	Pressure Class	Thickness in.	Working Pressure† psi	LAYING CONDITIONS Maximum Depth of Cover in Feet††				
				Type 1	Type 2	Type 3	Type 4	Type 5
4	350	0.25	350	53.0	61.0	69.0	85.0	100.0‡
6	350	0.25	350	26.0	31.0	37.0	47.0	65.0
8	350	0.25	350	16.0	20.0	25.0	34.0	50.0
10	350	0.26	350	11.0**	15.0	19.0	28.0	45.0
12	350	0.28	350	10.0**	15.0	19.0	28.0	44.0
14	250	0.28	250	*	11.0**	15.0	23.0	36.0
16	250	0.30	250	*	11.0**	15.0	24.0	34.0
18	250	0.31	250	*	10.0**	14.0	22.0	31.0
20	250	0.33	250	*	10.0	14.0	22.0	30.0
24	200	0.33	200	*	8.0**	12.0	17.0	25.0
30	150	0.34	150	*	-	9.0	14.0	22.0
36	150	0.38	150	*	-	9.0	14.0	21.0
42	150	0.41	150	*	-	9.0	13.0	20.0
48	150	0.46	150	*	-	9.0	13.0	20.0
54	150	0.51	150	*	-	9.0	13.0	20.0
60	150	0.54	150	*	5.0**	9.0	13.0	20.0
64	150	0.56	150	*	5.0**	9.0	13.0	20.0

†These pipe are adequate for the rated working pressure plus a surge allowance of 100 psi. Ductile iron pipe for working pressures higher than 350 psi is available. Figures include 2.0 safety factor times the sum of working pressure and 100 psi surge allowance.

††An allowance for single H-20 truck with 1.5 impact factor is included for all sizes and all depths of cover.

‡Calculated maximum depth of cover exceeds 100'.

*Laying condition Type 1 is limited to 12" and smaller pipe. For 14" and larger pipe, laying condition Type 1 should not be used.

**Minimum allowable depth of cover is 3'.

AMERICAN Ductile Iron Pipe for Water or Other Liquids

ANSI/AWWA C151/A21.51

WORKING PRESSURES AND MAXIMUM DEPTHS OF COVER for Pressure Classes

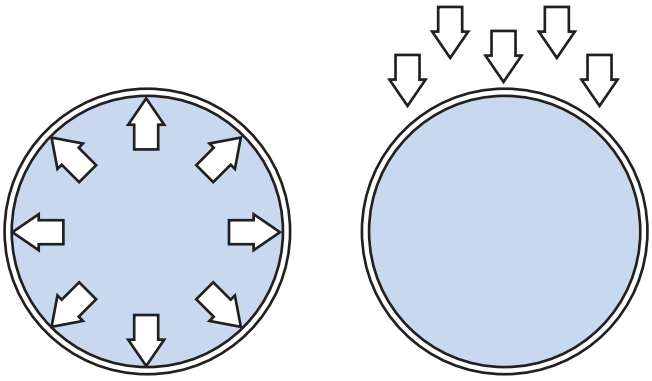


Table No. 3-11

Size in.	Pressure† Class psi	Nominal Thickness in.	LAYING CONDITIONS Maximum Depth of Cover in Feet‡				
			Type 1	Type 2	Type 3	Type 4	Type 5
4	350	0.25	53	61	69	85	100*
6	350	0.25	26	31	37	47	65
8	350	0.25	16	20	25	34	50
10	350	0.26	11**	15	19	28	45
12	350	0.28	10**	15	19	28	44
14	250	0.28	††	11**	15	23	36
	300	0.30	††	13	17	26	42
	350	0.31	††	14	19	27	44
16	250	0.30	††	11**	15	24	34
	300	0.32	††	13	17	26	39
	350	0.34	††	15	20	28	44
18	250	0.31	††	10**	14	22	31
	300	0.34	††	13	17	26	36
	350	0.36	††	15	19	28	41
20	250	0.33	††	10	14	22	30
	300	0.36	††	13	17	26	35
	350	0.38	††	15	19	28	38
24	200	0.33	††	8**	12	17	25
	250	0.37	††	11	15	20	29
	300	0.40	††	13	17	24	32
	350	0.43	††	15	19	28	37

See notes at end of table.

AMERICAN Ductile Iron Pipe for Water or Other Liquids

ANSI/AWWA C151/A21.51

WORKING PRESSURES AND MAXIMUM DEPTHS OF COVER for Pressure Classes

Table No. 3-11—Continued

Size in.	Pressure† Class psi	Nominal Thickness in.	LAYING CONDITIONS Maximum Depth of Cover in Feet‡				
			Type 1	Type 2	Type 3	Type 4	Type 5
30	150	0.34	††	-	9	14	22
	200	0.38	††	8**	12	16	24
	250	0.42	††	11	15	19	27
	300	0.45	††	12	16	21	29
	350	0.49	††	15	19	25	33
36	150	0.38	††	-	9	14	21
	200	0.42	††	8**	12	15	23
	250	0.47	††	10	14	18	25
	300	0.51	††	12	16	20	28
	350	0.56	††	15	19	24	32
42	150	0.41	††	-	9	13	20
	200	0.47	††	8	12	15	22
	250	0.52	††	10	14	17	25
	300	0.57	††	12	16	20	27
	350	0.63	††	15	19	23	32
48	150	0.46	††	-	9	13	20
	200	0.52	††	8	11	15	22
	250	0.58	††	10	13	17	24
	300	0.64	††	12	15	19	27
	350	0.70	††	15	18	22	30
54	150	0.51	††	-	9	13	20
	200	0.58	††	8	11	14	22
	250	0.65	††	10	13	16	24
	300	0.72	††	13	15	19	27
	350	0.79	††	15	18	22	30
60	150	0.54	††	5**	9	13	20
	200	0.61	††	8	11	14	22
	250	0.68	††	10	13	16	24
	300	0.76	††	13	15	19	26
	350	0.83	††	15	18	22	30
64	150	0.56	††	5**	9	13	20
	200	0.64	††	8	11	14	21
	250	0.72	††	10	13	16	24
	300	0.80	††	12	15	19	26
	350	0.87	††	15	17	21	29

*Calculated maximum depth of cover exceeds 100'.

†These pipes are adequate for the rated working pressure indicated for each nominal size plus a surge allowance of 100 psi. Calculations are based on a 2.0 safety factor times the sum of working pressure and 100 psi surge allowance. Ductile iron pipe for working pressures higher than 350 psi is available.

‡An allowance for a single H-20 truck with 1.5 impact factor is included for all sizes and all depths of cover.

††Laying condition Type 1 is limited to 12" and smaller pipe. For 14" and larger pipe, laying condition Type 1 should not be used.

**Minimum allowable depth of cover is 3'.

AMERICAN Ductile Iron Pipe

ANSI/AWWA C150/A21.50
and
ANSI/AWWA C151/A21.51
Nominal Wall Thicknesses for Special Thickness Classes

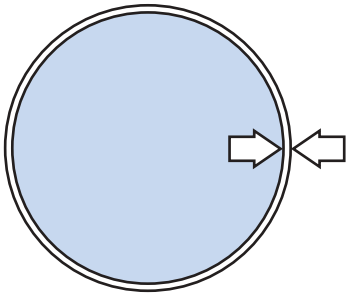


Table No. 3-12

Size in.	Outside Diameter in.	SPECIAL THICKNESS CLASSES—Wall Thickness in Inches*						
		50	51	52	53	54	55	56
4	4.80	-	.26	.29	.32	.35	.38	.41
6	6.90	.25	.28	.31	.34	.37	.40	.43
8	9.05	.27	.30	.33	.36	.39	.42	.45
10	11.10	.29	.32	.35	.38	.41	.44	.47
12	13.20	.31	.34	.37	.40	.43	.46	.49
14	15.30	.33	.36	.39	.42	.45	.48	.51
16	17.40	.34	.37	.40	.43	.46	.49	.52
18	19.50	.35	.38	.41	.44	.47	.50	.53
20	21.60	.36	.39	.42	.45	.48	.51	.54
24	25.80	.38	.41	.44	.47	.50	.53	.56
30	32.00	.39	.43	.47	.51	.55	.59	.63
36	38.30	.43	.48	.53	.58	.63	.68	.73
42	44.50	.47	.53	.59	.65	.71	.77	.83
48	50.80	.51	.58	.65	.72	.79	.86	.93
54	57.56	.57	.65	.73	.81	.89	.97	1.05

*These are Special Thickness Classes as shown in AWWA C150 and C151. They were previously designated standard thickness classes. AMERICAN can furnish any thickness in between these Special Thicknesses if deemed economical for major projects.

Special classes are most appropriately used for some threaded, grooved, or ball and socket pipes or for extraordinary design conditions, and they are generally less available than standard pressure class pipe.

For pressure rating and maximum depth of cover capabilities of Special Thickness Classes, check AMERICAN. These capabilities can be estimated by comparing metal thickness and capabilities of those of Pressure Classes in Table No. 3-11, or may be calculated by using the design formulas shown in AWWA C150.

AMERICAN Ductile Iron Fastite® Joint and Mechanical Joint Pipe
ANSI/AWWA C151/A21.51
Wall Thickness and Weights for Special Thickness Classes

Table No. 3-13

Size in.	Thickness Class	Wall Thickness in.	Weight in Pounds				
				Fastite Joint		Mechanical Joint*	
			Per Foot Plain End	Per Foot inc. Bell	Per 20' Nominal Length	Per Foot inc. Bell	Per 20' Nominal Length
4	51	.26	11.3	11.8	235	-	-
	52	.29	12.6	13.1	265	-	-
	53	.32	13.8	14.3	285	14.5	290
	54	.35	15.0	15.5	310	-	-
	55	.38	16.1	16.6	335	-	-
	56	.41	17.3	17.8	355	-	-
6	50	.25	16.0	16.7	335	-	-
	51	.28	17.8	18.5	370	-	-
	52	.31	19.6	20.3	410	-	-
	53	.34	21.4	22.1	445	22.3	450
	54	.37	23.2	23.9	480	-	-
	55	.40	25.0	25.7	515	-	-
	56	.43	26.7	27.4	550	-	-
8	50	.27	22.8	23.8	480	-	-
	51	.30	25.2	26.2	525	-	-
	52	.33	27.7	28.7	575	-	-
	53	.36	30.1	31.1	625	31.3	630
	54	.39	32.5	33.5	675	-	-
	55	.42	34.8	35.8	720	-	-
	56	.45	37.2	38.3	770	-	-
10	50	.29	30.1	31.4	630	-	-
	51	.32	33.2	34.5	695	-	-
	52	.35	36.2	37.5	755	-	-
	53	.38	39.2	40.5	815	40.7	820
	54	.41	42.1	43.5	875	-	-
	55	.44	45.1	46.5	935	-	-
	56	.47	48.0	49.3	990	-	-
12	50	.31	38.4	40.0	805	-	-
	51	.34	42.0	43.6	875	-	-
	52	.37	45.6	47.2	950	-	-
	53	.40	49.2	50.8	1020	51.1	1030
	54	.43	52.8	54.3	1090	-	-
	55	.46	56.3	57.9	1165	-	-
	56	.49	59.9	61.5	1235	-	-
14	50	.33	47.5	50.3	1010	-	-
	51	.36	51.7	54.6	1095	-	-
	52	.39	55.9	58.7	1175	-	-
	53	.42	60.1	62.9	1260	-	-
	54	.45	64.2	67.0	1345	-	-
	55	.48	68.4	71.3	1430	-	-
	56	.51	72.5	75.3	1510	-	-
16	50	.34	55.8	59.0	1180	-	-
	51	.37	60.6	63.8	1280	-	-
	52	.40	65.4	68.6	1375	-	-
	53	.43	70.1	73.3	1470	-	-
	54	.46	74.9	78.1	1565	-	-
	55	.49	79.7	82.9	1660	-	-
	56	.52	84.4	87.6	1755	-	-
18	50	.35	64.4	68.0	1365	-	-
	51	.38	69.8	73.4	1470	-	-
	52	.41	75.2	78.8	1580	-	-
	53	.44	80.6	84.2	1690	-	-
	54	.47	86.0	89.6	1795	-	-
	55	.50	91.3	95.0	1905	-	-
	56	.53	96.7	100.3	2010	-	-

*Mechanical Joint Pipe is available in 4"-12" diameters and Special Thickness Class 53 only.

AMERICAN Ductile Iron Fastite® Joint and Mechanical Joint Pipe
ANSI/AWWA C151/A21.51
Wall Thickness and Weights for Special Thickness Classes

Table No. 3-13—Continued

Size in.	Thickness Class	Wall Thickness in.	Weight in Pounds				
			Per Foot Plain End	Fastite Joint		Mechanical Joint	
				Per Foot inc. Bell	Per 20' Nominal Length	Per Foot inc. Bell	Per 20' Nominal Length
20	50	.36	73.5	77.5	1555	-	-
	51	.39	79.5	83.5	1675	-	-
	52	.42	85.5	89.5	1795	-	-
	53	.45	91.5	95.5	1915	-	-
	54	.48	97.5	101.5	2035	-	-
	55	.51	103.4	107.5	2155	-	-
	56	.54	109.3	113.3	2270	-	-
24	50	.38	92.9	97.7	1960	-	-
	51	.41	100.1	104.9	2100	-	-
	52	.44	107.3	112.1	2245	-	-
	53	.47	114.4	119.2	2390	-	-
	54	.50	121.6	126.4	2535	-	-
	55	.53	128.8	133.5	2675	-	-
	56	.56	135.9	140.7	2820	-	-
30	50	.39	118.5	126.7	2540	-	-
	51	.43	130.5	138.7	2780	-	-
	52	.47	142.5	150.7	3020	-	-
	53	.51	154.4	162.6	3260	-	-
	54	.55	166.3	174.5	3495	-	-
	55	.59	178.2	186.4	3735	-	-
	56	.63	190.0	198.2	3970	-	-
36	50	.43	156.5	167.2	3350	-	-
	51	.48	174.5	185.2	3710	-	-
	52	.53	192.4	203.1	4070	-	-
	53	.58	210.3	221.0	4430	-	-
	54	.63	228.1	238.8	4785	-	-
	55	.68	245.9	256.5	5140	-	-
	56	.73	263.7	274.4	5500	-	-
42	50	.47	198.9	213.3	4265	-	-
	51	.53	224.0	238.4	4770	-	-
	52	.59	249.1	263.5	5270	-	-
	53	.65	274.0	288.5	5770	-	-
	54	.71	298.9	313.3	6265	-	-
	55	.77	323.7	338.2	6765	-	-
	56	.83	348.4	362.8	7255	-	-
48	50	.51	246.6	264.3	5285	-	-
	51	.58	280.0	297.7	5955	-	-
	52	.65	313.4	331.1	6620	-	-
	53	.72	346.6	364.3	7285	-	-
	54	.79	379.8	397.5	7950	-	-
	55	.86	412.9	430.6	8610	-	-
	56	.93	445.9	463.6	9270	-	-
54	50	.57	312.3	334.3	6685	-	-
	51	.65	355.6	377.5	7550	-	-
	52	.73	398.8	420.8	8415	-	-
	53	.81	441.9	463.8	9275	-	-
	54	.89	484.9	506.8	10135	-	-
	55	.97	527.7	549.7	10995	-	-
	56	1.05	570.4	592.3	11845	-	-

60" and 64" sizes are not available in Special Classes.

Ductile Iron Pipe for Gravity Flow Service

Due to its high strength and stiffness with the resulting ability to support heavy earth and other type external loads, ductile iron pipe has found wide acceptance in gravity flow service such as sewer lines, outfalls and culvert pipe.

The problems of infiltration, root intrusion, and leakage are eliminated in sewer service with the use of the Fastite joint. The resistance of ductile iron to impact, the convenient pipe lengths, and the ease of assembly represent additional advantages of using ductile iron pipe in sewer service. In addition, ductile iron pipe has an inside diameter greater than nominal pipe size which results in greater flow capacity with potential cost savings. Ductile iron pipe is available for normal domestic sewage service with cement lining, or Polybond*Plus*® lining. Other linings are available for sewer and special services. See Section 11.

Ductile Iron Culvert Pipe ASTM A716

ASTM A716 is the standard for Ductile Iron Culvert Pipe covering sizes 14" through 64" manufactured per ANSI/AWWA C151/A21.51. AMERICAN Ductile Iron Culvert Pipe is furnished with Fastite or other suitable joints and is coated inside and outside with an asphaltic coating approximately 1 mil thick; or may be cement lined.

Minimum pressure classes are shown in this standard for sizes 14" through 64" for the range of cover from 2 to 41 feet, depending on size, based on Type 5 trench condition. This is the same Type 5 laying condition shown in current AWWA Standards C150 and C151. See Fig. 3-2. Pipe thickness for other conditions can be calculated by using formulas and design criteria in AWWA C150, except with modifications as specified in A716.

Ductile Iron Gravity Sewer Pipe ASTM A746

ASTM A746 is the standard for Ductile Iron Gravity Sewer Pipe in sizes 4" through 64" with Fastite Joints.

The design of AMERICAN Ductile Iron Gravity Sewer Pipe in this standard is based on the same formulas and design criteria as pipe designed per ANSI/AWWA C150/A21.50, except that pipe with a flexible lining, such as Polybond*Plus*®, is designed with maximum allowable deflection of 5% of the outside diameter of the pipe instead of 3%. In the A746 Standard are thickness tables for **Cement-lined** pipe and for **Flexible-lined** pipe.

The thicknesses for **Cement-lined** pipe will be the same as those in AWWA C151 for the same depths of cover and laying conditions. See Table No. 3-11.

Table No. 3-14 shows depths of cover for the different laying conditions for 4" through 64" Pressure Classes of **Flexible-lined** pipe. The shaded areas indicate the depths of cover which are different from **Cement-lined** pipe per A746 and from AWWA C151 as shown in Table No. 3-11. These depths of cover are controlled by design deflection (instead of ring bending stress) and are greater than those for **Cement-lined** pipe due to the 5% design deflection.

AMERICAN Ductile Iron Fastite® Joint Gravity Sewer Pipe

ASTM A746

PIPE WITH FLEXIBLE LININGS

Depths of Cover for Standard Pressure Classes

Table No. 3-14

Size in.	Pressure Class	Thickness in.	Maximum Depth of Cover in Feet LAYING CONDITIONS				
			Type 1	Type 2	Type 3	Type 4	Type 5
4	350	0.25	53	61	69	85	109
6	350	0.25	26	31	37	47	65
8	350	0.25	16	20	25	34	50
10	350	0.26	11*	15	19	28	45
12	350	0.28	10*	15	19	28	44
14	250	0.28	-	11*	15	23	41
	300	0.30	-	13	17	26	43
	350	0.31	-	14	19	27	44
16	250	0.30	-	11*	15	24	41
	300	0.32	-	13	17	26	43
	350	0.34	-	15	20	28	45
18	250	0.31	-	10*	14	23	40
	300	0.34	-	13	17	26	43
	350	0.36	-	15	19	28	45
20	250	0.33	-	10*	14	23	40
	300	0.36	-	13	17	26	43
	350	0.38	-	15	19	28	44
24	200	0.33	-	8*	12	20	37
	250	0.37	-	11	15	23	41
	300	0.40	-	13	17	26	43
	350	0.43	-	15	19	28	45
30	150	0.34	-	-	9*	17	33
	200	0.38	-	8*	12	20	37
	250	0.42	-	11	15	23	40
	300	0.45	-	12	16	25	42
	350	0.49	-	15	19	28	44
36	150	0.38	-	-	9	17	33
	200	0.42	-	8*	12	20	37
	250	0.47	-	10	14	23	40
	300	0.51	-	12	17	25	42
	350	0.56	-	15	19	28	45

See notes at end of Table.

AMERICAN Ductile Iron Fastite Joint Gravity Sewer Pipe

ASTM A746

PIPE WITH FLEXIBLE LININGS

Depths of Cover for Standard Pressure Classes

Table No. 3-14—Continued

Size in.	Pressure Class	Thickness in.	Maximum Depth of Cover in Feet LAYING CONDITIONS				
			Type 1	Type 2	Type 3	Type 4	Type 5
42	150	0.41	-	-	9	16	32
	200	0.47	-	8	12	20	37
	250	0.52	-	10	14	23	40
	300	0.57	-	12	17	25	42
	350	0.63	-	15	19	28	45
48	150	0.46	-	-	9	17	33
	200	0.52	-	8	12	20	37
	250	0.58	-	10	14	23	40
	300	0.64	-	12	17	25	42
	350	0.70	-	15	19	28	44
54	150	0.51	-	-	9	17	33
	200	0.58	-	8	12	20	37
	250	0.65	-	10	14	23	40
	300	0.72	-	13	17	25	43
	350	0.79	-	15	19	28	45
60	150	0.54	-	5*	9	17	33
	200	0.61	-	8	12	20	37
	250	0.68	-	10	14	23	40
	300	0.76	-	13	17	25	43
	350	0.83	-	15	19	28	45
64	150	0.56	-	5*	9	17	33
	200	0.64	-	8	12	20	36
	250	0.72	-	10	15	23	40
	300	0.80	-	13	17	26	43
	350	0.87	-	15	19	28	45

*Minimum allowable depth of cover is 3'.

The shaded areas denote the depths of cover resulting from the pipe thickness being governed by deflection in the design; these covers are greater due to the design deflection of 5% for flexible-lined pipe instead of 3% for cement-lined pipe.

AMERICAN Ductile Iron Pipe Tapping and Cutting

TAPPING* DUCTILE IRON PIPE

AMERICAN Ductile Iron pipe is readily tapped either dry or under pressure by using conventional tapping equipment utilized by most contractors and water utilities.

Taps made directly into the pipe result in clean, sharp, strong threads, making tapping saddles unnecessary for small diameter taps.

Teflon tape or a commercial thread compound which is suitable to the service is recommended to be used on threads.

Above is shown a 6" AMERICAN Ductile Iron pipe that has been tapped for a 1" corporation stop, showing the excellent threading properties of ductile iron pipe.

*Caution should be employed when cutting or tapping pipe when any potentially hazardous condition might exist.

CUTTING* DUCTILE IRON PIPE

AMERICAN Ductile Iron pipe is easily cut in the field by several methods, the most common as follows:

Abrasive Wheel

A rotary-type abrasive wheel saw is probably one of the most popular tools used for cutting ductile iron pipe. This equipment is commercially available with gasoline engines as well as pneumatic motors. Cutting time is usually no more than one minute per inch of pipe diameter with most commonly used thicknesses.

Cutting ductile iron pipe with abrasive wheel.

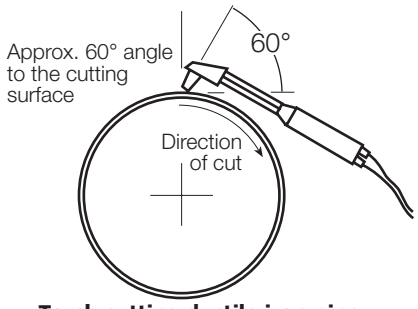
Torch Cutting

Ductile iron pipe can be cut in the field or shop by using an oxyacetylene torch. Best results are obtained by using a No. 8 or No. 10 tip with approximately 75 psi oxygen and 10 to 15 psi acetylene. For cement-lined ductile pipe, the best results are normally obtained when the torch head is inclined approximately 60 degrees to the direction of cutting. See Fig. 3-3.

Cutting ductile iron pipe with torch.

Metallurgical studies have shown that the heat-affected zone in pipe cut by this method exists within only 1/4-inch from the cut face. The hardening of the metal in the 1/4-inch affected heat zone causes some difficulty in threading or machining in this particular portion of the pipe, but such hardening does not interfere with push-on or mechanical joint assembly

or performance. Cutting speed for pipe cut by oxyacetylene methods is approximately one minute per inch of diameter for cement-lined pipe and even less for unlined pipe.



Torch cutting ductile iron pipe
Fig. 3-3

Milling Cutter

Several types of milling pipe cutters are available which operate hydraulically, pneumatically or electrically, or are self-powered by a gasoline engine.

The milling-type cutter will normally cut pipe from 6"- 64" diameter. This type of cutter is usually supplied with an air motor which also makes submarine cuts possible. The set-up time for this cutter is usually less than ten minutes; it requires a minimum clearance of 12" and has a cutting speed of approximately one minute per inch of pipe diameter.

Cutting ductile iron pipe with milling cutter.

Other Cutting Methods

Portable guillotine saws are available for cutting pipe from 3"- 18" diameter.

Caution: Hydraulic squeeze cutters are not suitable for cutting ductile iron pipe.

Field Gauging/Rounding

AWWA C151 requires the factory-gauging of the spigot ends of ductile iron pipe. Accordingly, pipe selected for cutting in the field should be field-gauged. A circumferential "π" tape can be used for this. Also, a mechanical joint gland inserted over the barrel of the pipe might serve as a convenient indicator for field cutting. Some pipe, especially in the largest diameters, may be out-of-round to the degree that they will need to be rounded by jacking or other methods to facilitate making the joint. This is a normal occurrence and does not in any way affect the serviceability of ductile iron pipe. Instructions for the rounding operation can be obtained from AMERICAN if desired.

Preparation of Field-Cut Joints

Field cuts that will be assembled with mechanical joints will require little or no preparation other than cleaning. When a torch cut is made, the last few inches of the plain end need to be cleaned of any oxides, slag or other protrusions.

When the cut end is to be assembled in a Fastite® bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. See Fig. 3-4. If desired, a thin field "Assembly Line" can be drawn in marker or with paint, with the line located from the spigot end the same distance as the far edge of factory-applied assembly stripe.

Note: Generous bevels are advantageous in the assembly of field-prepared ends. To confirm the effectiveness of pipe end preparation and the subsequent assembly of a field-prepared end, a thin "automotive" or other feeler gauge can be effectively used to check (probe) for proper and uniform gasket positioning all around the assembled joints.

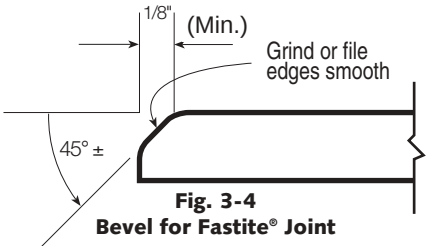


Fig. 3-4
Bevel for Fastite® Joint

*Caution should be employed when cutting or tapping pipe when any potentially hazardous condition might exist.

AMERICAN Ductile Iron Pipe Outlets

Welded-on outlets for flanged, mechanical joint, Fastite and restrained joint connections are furnished for optimum design, installation and economy. See Section 7.

Outlet/Tapping Saddles provide an effective, field adaptable, and economical means of making connection to a pipeline, either during construction or while under pressure. Saddles are available with flanged or mechanical joint outlet for use on pipe sizes 16" through 54". See Section 7.

AMERICAN Ductile Iron Pipe Stacking

It is recommended that pipe to be stored for any extended period of time should not be stacked higher than indicated in the table below. To prevent dirt and debris from entering the pipe, bottom tiers should be kept off the ground on timbers, rails, or concrete supports.

Pipe on succeeding tiers should be alternated — bell-plain end, plain end-bell, etc. Timbers 4″ X 4″ size should be placed between each tier and chocks nailed at each end to prevent movement of the pipe. For safety and convenience, each size should be stacked separately.

Suggested Maximum Allowable Stacking Heights

Table No. 3-15

Pipe Size in.	Number of Tiers	Pipe Size in.	Number of Tiers
4	*16	24	5
6	*13	30	4
8	*11	36	4
10	*10	42	3
12	*9	48	3
14	*8	54	3
16	7	60	2
18	6	64	2
20	6	-	-

***Stacking heights are limited by practical consideration to a height of approximately 12 feet for purposes of safety and handling ease.**

Loading

Ductile iron pipe is normally shipped in truckload or carload lots for freight economies. Tabulated below are practical loading quantities for minimum classes, Fastite Joint ductile iron cement-lined pipe. Truckload quantities are based on standard 40,000-lb loading.

Quantities can vary due to changes in joints, classes, ICC tariff, linings, weights, dunnage, other material or sizes included in loads, etc. Therefore, this table should be used as a guide only. Check AMERICAN if more exact information is required.

Practical Loading Quantities Minimum Pressure Classes of Fastite Joint Ductile Iron Pipe

Table No. 3-16

Pipe Size in.	No. of 20' Lengths		Pipe Size in.	No. of 20' Lengths	
	Truckload	Carload		Truckload	Carload
4	153	459	24	18	27
6	108	288	30	16	27
8	81	216	-	-	-
10	63	126	36	8	12
12	48	108	42	8	12
14	40	75	48	4	12
16	35	60	54	2	12
18	32	48	64	2	12
20	26	48	-	-	-

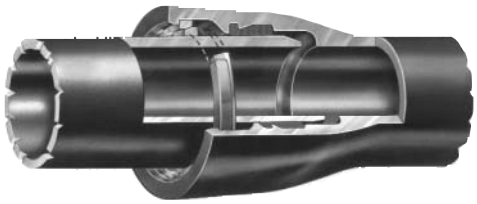
Other AMERICAN Joints

AMERICAN Fastite® Joint with Fast-Grip® Gasket, 4"-30"

The AMERICAN Fast-Grip Gasket furnished in sizes 4"-30" provides flexible, field-adaptable joint restraint in a standard AMERICAN Fastite (or Flex-Ring) Bell.

See Sections 4 and 9.

AMERICAN Flex-Ring® Joint, 4"-12"



The AMERICAN Flex-Ring Joint provides flexible joint restraint against thrust due to internal water working pressure or external forces. It is also used in horizontal directional drilling (HDD) and pipe bursting applications.

See Sections 4 and 9.

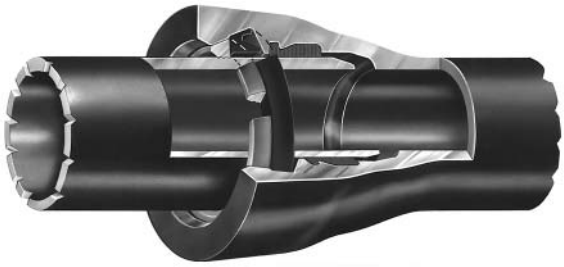
AMERICAN Flex-Ring® Joint, 14"-36"

The AMERICAN Flex-Ring Joint provides flexible joint restraint against thrust due to internal water-working pressure or external forces.

See Section 9.

AMERICAN Joints for Pipe and Fittings

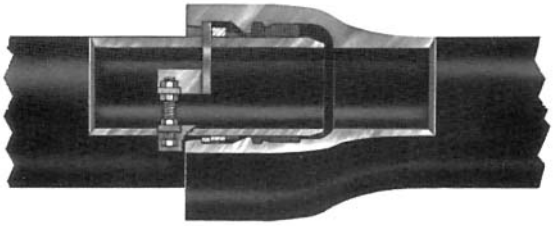
AMERICAN Field Flex-Ring®, 14"-36"



The AMERICAN Field Flex-Ring provides dependable field adaptable restraint against thrust due to external forces or internal water working pressure up to 350 psi for 14"-24" sizes and up to 250 psi for the 30"-36" sizes in the standard Flex-Ring Joint.

See Section 9.

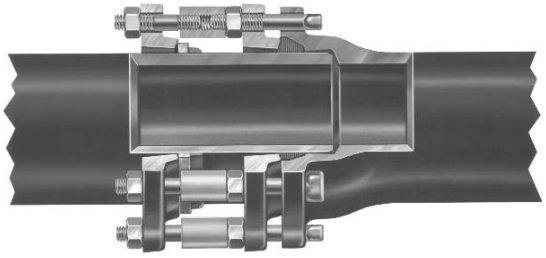
AMERICAN Lok-Ring® Joint, 42"-64"



The AMERICAN Lok-Ring Joint is furnished in sizes 42" through 64" and provides flexible joint restraint against thrust due to internal water working pressure up to 250 psi.

See Section 9.

AMERICAN MJ Coupled Joint

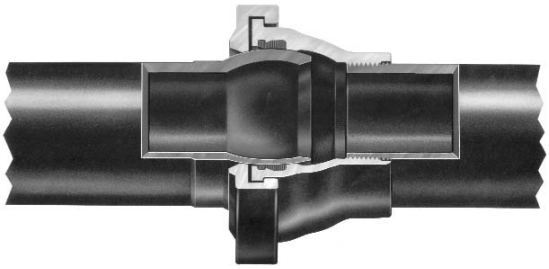


The AMERICAN MJ Coupled Joint is furnished in sizes 4" through 48" and is an adaptation of the standard Mechanical Joint to provide joint restraint against thrust due to internal pressure up to 350 psi through 12" and 250 psi for 14"-48" sizes.

See Section 9.

AMERICAN Joints for Pipe and Fittings

AMERICAN Flex-Lok® Joint, 4"-24"



The AMERICAN Flex-Lok Joint, furnished in sizes 4" through 24", is a super-service, boltless flexible joint. This joint is designed to provide up to 15° joint deflection for subaqueous or other difficult installations potentially subject to substantial joint deflections or movements.

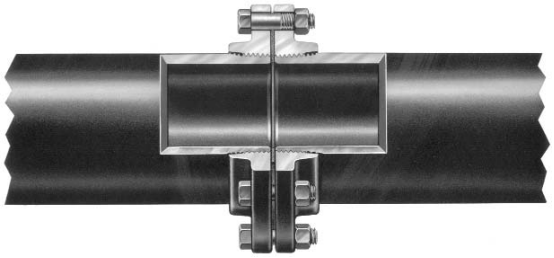
See Section 10.

AMERICAN Flex-Lok® Joint, 30"-54"*

The AMERICAN Flex-Lok Joint, furnished in sizes 30" through 54"*, is a super-service, boltless flexible joint. This joint is designed to provide up to 15° joint deflection for subaqueous or other difficult installations potentially subject to substantial joint deflections or movements. *Check AMERICAN for 60" and 64" requirements.

See Section 10.

AMERICAN Flanged Joint

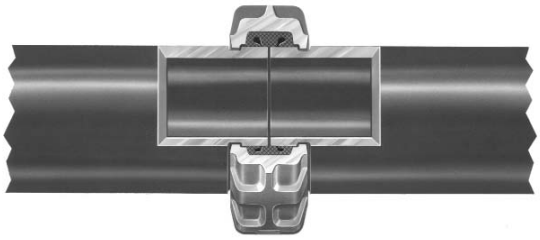


The AMERICAN Flanged Joint, furnished in sizes 4" through 64", is a rigid joint widely used for exposed plant piping. In combination with other joints and AMERICAN's Toruseal® gasket, it is also commonly used for Long Span service.

See Sections 6, 7 and 8.

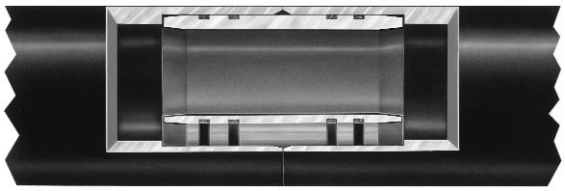
AMERICAN Joints for Pipe and Fittings

AMERICAN Grooved and Shouldered Joint



The AMERICAN Grooved Joint pictured above—and to a limited extent the Shouldered Joint (not pictured)—are furnished for some plant piping installations. See Section 2.

AMERICAN MT Push Pipe Joint, 4"-16"

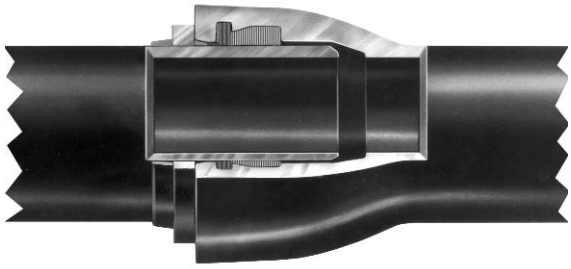


The AMERICAN MT Push Pipe Joint pictured above is a bell-less ductile iron pipe used for microtunneling or other trenchless installations of gravity and pressure service lines, including pipe bursting, for 4"-16" sizes and up to 350 psi.

AMERICAN GS Push Pipe Joint, 4"-16"

The AMERICAN GS Push Pipe Joint pictured above is a bell-less ductile iron pipe used for microtunneling or other trenchless installations of gravity service lines, including pipe bursting, for 4"-16" sizes and up to 100 feet of head (43 psi).

AMERICAN Fastite® Joint Push-Bar™ Pipe, 4"-64"



AMERICAN Fastite Joint Push-Bar pipe, furnished in sizes 4"-64", allows the AMERICAN Fastite Joint to be used in trenchless installation using direct jacking or pushing (including high load installations such as microtunneling and some pipe bursting applications). See Section 7.

AMERICAN DUCTILE IRON PIPE

AMERICAN reserves the right to modify or change designs, materials, specifications, or dimensions shown herein without prior notice.

This is a revised reprint of a section from the 18th Edition of the AMERICAN Pipe Manual. References may be made in this section to other sections of this manual.

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Litho in USA