2009 EDITION

TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

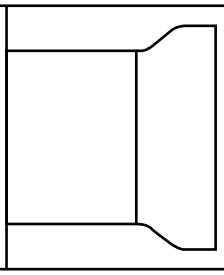
4"–36"

NSF® Certified to ANSI/NSF 61

FOR FIRE PROTECTION, WATER & WASTEWATER

MORE THAN JUST PIPE.

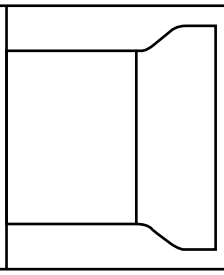
U.S. PIPE



TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Table of Contents



TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX Restrained Joint Pipe and Fittings 4"-36"

TR FLEX Pipe and Fittings provide flexible restrained push-on joints for 4" through 36" Ductile Iron pipe and fittings. The TR FLEX Restrained Joint has a working pressure rating equivalent to the working pressure rating of the parent pipe with a maximum working pressure rating of 350 psi for 4" through 24" and 250 psi for 30" through 36".

For fire protection service, 4" through 12" pipe and fittings are listed by Underwriters Laboratories for 350 psi and are approved by Factory Mutual for 250 psi.

TR FLEX Pipe and Fittings utilize the conventional TYTON® Gasket for 4" through 36" sizes.

Ductile Iron locking segments, inserted through a slot (or slots) in the bell face, provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.

**For higher pressure ratings, consult your U.S. Pipe Sales Representative.*

For a suggested design procedure for the restraint of thrust forces in pressurized, buried Ductile Iron piping systems, the design engineer should refer to the current DIPRA publication "Thrust Restraint Design for Ductile Iron Pipe" or the U.S. Pipe Brochure "The Use And Application of Restrained Joints for Ductile Iron Pipelines."

ANSI/AWWA Standards

ANSI/AWWA C151/A21.51 "Ductile-Iron Pipe, Centrifugally Cast, for Water."

Asphaltic outside coating and inside lining are in accordance with ANSI/AWWA C151/A21.51.

ANSI/AWWA C153/A21.53 "Ductile-Iron Compact Fittings For Water Service" or ANSI/AWWA C110/A21.10 "Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., For Water."

TR FLEX® Fittings conform to applicable requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10.

ANSI/AWWA C104/A21.4 "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water."

Cement lining, in accordance with ANSI/AWWA C104 or special linings and/or coatings can be furnished for specific conditions.

ASTM A746-03 "Standard Specification for Ductile Iron Gravity Sewer Pipe."

ASTM A716-08 " Standard Specification for Ductile Culvert Pipe."

ASTM A536 "Standard Specification for Ductile Iron Castings."

NOTE: *If specifiers or users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Ductile Iron Pipe Systems" for proper external protection procedures.*

For certain wastewater applications a ceramic epoxy lining is available - see PROTECTO 401™ Ceramic Epoxy Lined Pipe and Fittings Brochure.

Suggested Specification Wording For 4"-36" Restrained Push-on Joint Pipe and Fittings

When joint restraint for a 4" through 36" push-on joint pipe installation is required and indicated in the project plans and specifications, restrained push-on joint pipe and fittings utilizing Ductile Iron components shall be provided.

Restrained joint pipe shall be Ductile Iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron Pipe and Fittings." Pipe thickness shall be designed in accordance with ANSI/AWWA C150/A21.50 “Thickness Design of Ductile-Iron Pressure Pipe,” and shall be based on laying conditions and internal pressures as stated in the project plans and specifications.

Restrained joint fittings and the restraining components shall be Ductile Iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 and/or C153/A21.53 with the exception of the manufacturer’s proprietary design dimensions. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11.

Restrained joint pipe and fittings shall be U.S. Pipe’s TR FLEX Pipe and Fittings or approved equal. Restraint of field cut pipe shall be provided with U.S. Pipe’s TR FLEX GRIPPER® Ring, TR FLEX Pipe field weldments or approved equal.

Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with ANSI/AWWA C104/A21.4. Asphaltic outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 for fittings.

Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi for sizes 4" through 24" and 250 psi for sizes 30" through 36".

TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

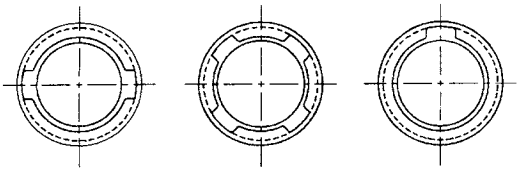
Assembly Instructions for Pipe and Fittings

CAUTION: THE INSIDE OF THE SOCKET, THE GASKET, AND THE PLAIN END TO BE INSERTED, MUST BE KEPT CLEAN THROUGHOUT THE ASSEMBLY. JOINTS ARE ONLY AS WATERTIGHT AS THEY ARE CLEAN. IF THE JOINT IS SOMEWHAT DIFFICULT TO ASSEMBLE, INSPECT FOR PROPER GASKET POSITIONING, ADEQUATE LUBRICATION, AND REMOVAL OF FOREIGN MATTER IN THE JOINT.

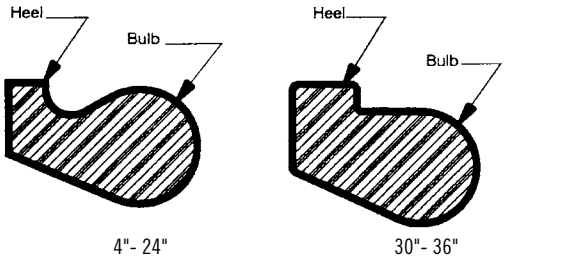
The recommended orientation of segment insertion slots located in the face of the TR FLEX Pipe bell is important for ease of assembly and is also used as a reference point for location of welded outlets (refer to U.S. Pipe's Welded Outlet brochure). Therefore particular attention should be paid to that portion of the assembly instructions.

Clean the sockets of all dirt, sand, gravel, or other foreign matter.

Conventional TYTON® Gaskets are used for TR FLEX Pipe and Fitting sockets in the 4" through 36" size range.



Insertion Slot Orientation



Gasket Installation

NOTE: *For the 4" through 10" sizes where TR FLEX GRIPPER® Rings are not used, it may be preferable to locate the bell slots vertically with only the slot in the 12 o'clock position being used for inserting locking segments.*

Assembly Instructions for Pipe and Fittings (cont.)

Clean the gasket and the socket. Loop the gasket as shown in the illustrations. Place the gasket into the mating gasket seating area of the socket with the rounded bulb end of the gasket entering first. Seat the gasket heel firmly in the retainer groove of the socket.

Smaller size gaskets (4" through 12") require only one loop. With larger sizes, additional loops may be required: 14" through 36", two to three loops. Do not apply lubricant to the gasket seat.

Make sure the gasket is uniformly seated around the inside of the socket.

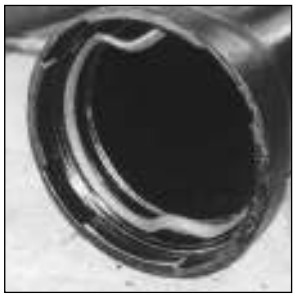
In colder weather, the gaskets should be kept at temperatures above 40ºF to ensure the resiliency of the gasket during installation. In such conditions, the gaskets should be stored in a heated area or heated in drums of hot water prior to installation. If warm water is used, the gaskets should be dried before installation in the socket.

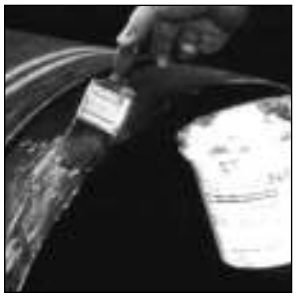
Lubrication

After the gasket has been inserted into the gasket seating area of the socket, a thin film of TYTON JOINT® Lubricant should be applied to the inside surface of the gasket which will come in contact with the beveled end of the pipe. Only TYTON JOINT Lubricant should be used.

CAUTION: The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.

Clean the spigot end of the pipe back to the assembly stripes. Apply TYTON JOINT Lubricant to the cleaned spigot end. Do not allow the lubricated surface to touch the ground or trench sides prior to installation.





NOTE: *For underwater installations, a special lubricant is available from U.S. Pipe.*

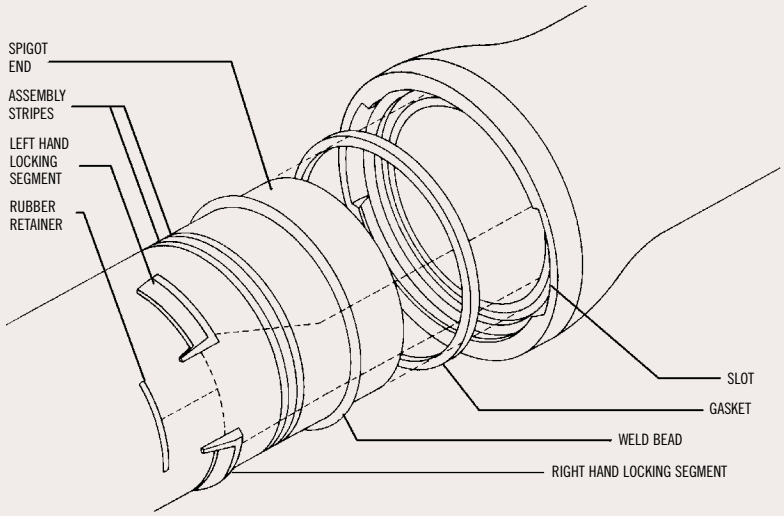
TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Assembly Instructions for Pipe and Fittings 4"-10"

Two Bell Slots

1. Lay pipe or fitting such that one of the bell slots is accessible.
2. Clean the socket and insert a TYTON® Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert the right-hand locking segment into a bell slot and slide the segment clockwise around the pipe.
7. Insert the left-hand locking segment into the same bell slot and slide the segment counter-clockwise around the pipe.
8. Hold the segments apart and wedge the rubber retainer into the slot between the two locking segments. The opposite bell slot is not used but is required for use with a TR FLEX GRIPPER® Ring.
9. Extend the joint to remove the slack in the locking segment cavity. Joint extension is necessary to obtain the marked laying length on the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the Table on page 22 for average pull-out of each size.)
10. Set the joint deflection as required. (See Table on page 22.)



Components required for each joint:

1 right-hand locking segment (painted red, marked RH)

1 left-hand locking segment (painted black, marked LH)

1 rubber retainer

1 TYTON® Gasket

TYTON JOINT® Lubricant

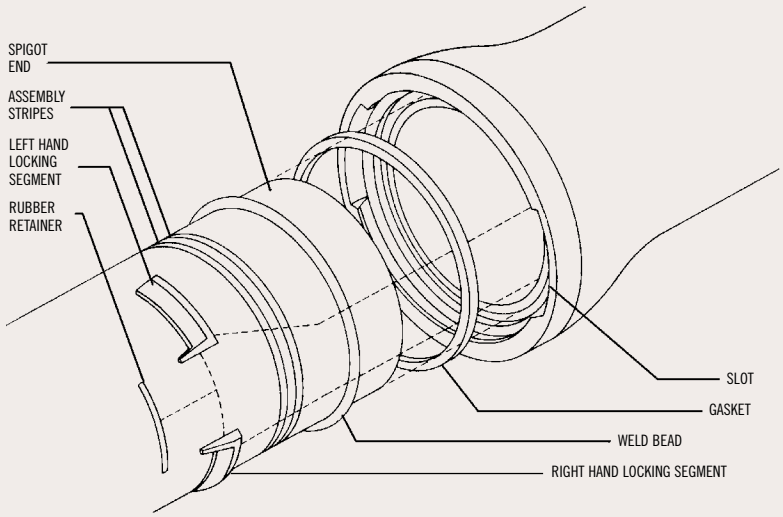
TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Assembly Instructions for Pipe and Fittings 12"-20"

Two Bell Slots

1. Lay pipe or fitting such that both of the bell slots are accessible (in the horizontal position if possible).
2. Clean the socket and insert a TYTON® Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert lower locking segment into a bell slot and slide the segment around the pipe.
7. Insert upper locking segment into the same bell slot and rotate around the pipe.
8. Hold the upper segment in place and wedge the rubber retainer into the slot between the two locking segments.
9. Repeat steps 6-8 for other slot. Make sure that all 4 locking segments and 2 rubber retainers are securely in place.
10. Extend the joint to remove the slack in the locking segment cavity. Joint extension is necessary to attain the marked laying length on the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the Table on page 22.)
11. Set the joint deflection as required. (See Table on page 22.)



Components required for each joint:

2 right-hand locking segments (painted red, marked RH)

2 left-hand locking segments (painted black, marked LH)

2 rubber retainers

1 TYTON® Gasket

TYTON JOINT® Lubricant

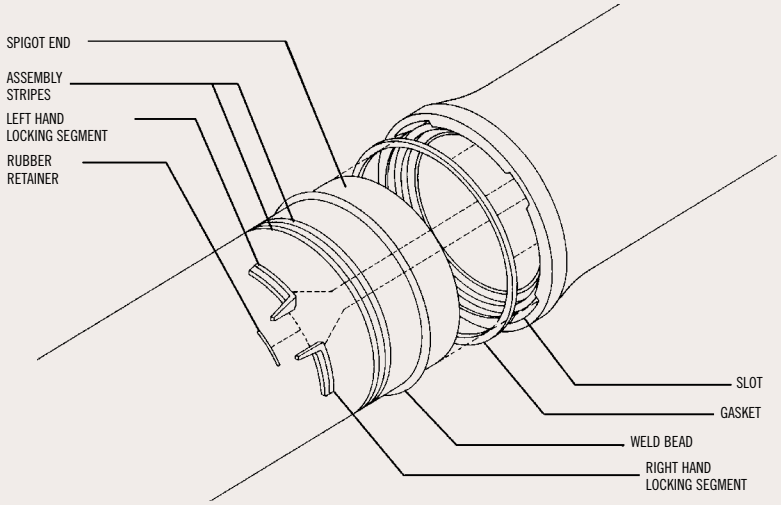
TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Assembly Instructions for Pipe and Fittings 24"-36"

Four Bell Slots

1. Lay pipe or fitting such that all four of the bell slots are accessible (in the diagonal position if possible).
2. Clean the socket and insert a TYTON® Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert lower locking segment into a bell slot and slide the segment around the pipe.
7. Insert upper locking segment into the same bell slot and rotate around the pipe.
8. Hold the upper segment in place and wedge the rubber retainer into the slot between the two locking segments.
9. Repeat steps 6-8 for other slots. Make sure that all 8 locking segments and 4 rubber retainers are securely in place.
10. Extend the joint to remove the slack in the locking segment cavity. Joint extension is necessary to attain the marked laying length on the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the Table on page 22.)
11. Set the joint deflection as required. (See Table on page 22.)



Components required for each joint:

4 right-hand locking segments (painted red, marked RH)

4 left-hand locking segments (painted black, marked LH)

4 rubber retainers

1 TYTON® Gasket

TYTON JOINT® Lubricant

Pipeline Expansion

TR FLEX Pipe and Fittings Socket Pull Out

(Linear Expansion Within The Assembled Socket)

In TR FLEX Pipe and Fitting sockets, there is a small amount of slack or pullout available at each joint. This pullout, or expansion capability, is the result of clearance inside the socket required for the insertion of the locking segments. The expansion can be minimized by extending the joint after installing the locking segments and prior to setting the joint deflection.

The expansion of the joint in both pipe and fitting sockets must be considered, particularly in the following cases:

a. When TR FLEX Pipe are used above ground (bridge crossings, on piers, etc.)

b. When TR FLEX Pipe are used in poor soil conditions (swamps, marshes, etc.)

c. When long lengths of TR FLEX Pipe are required for restraint due to high operating pressures and/or unfavorable soil parameters

d. Where TR FLEX Pipe are used inside casing pipe

e. Where TR FLEX Pipe and Fittings are in vertical alignment

When TR FLEX Pipe are used inside a casing pipe, it is recommended that the assembled pipe be pulled through the casing. Additional security may be required to ensure that the locking segments are adequately retained in the socket during such installation.

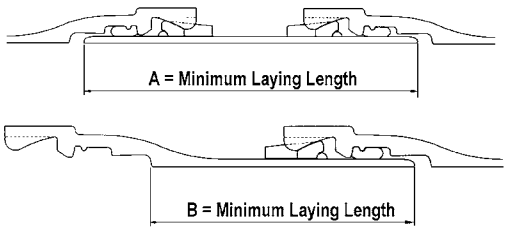
Please note that if the joint is not extended during assembly, the expansion per joint during line pressurization will increase the length of a 1000 foot long installation by 2 to 5 feet, depending upon the pipe size. (Refer to Table 1 for the Pullout at each joint.)

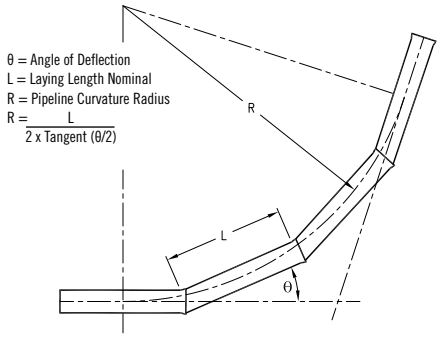
Table 1. Minimum Laying Lengths & Average Pullout For Each TR FLEX Pipe or Fittings Socket

SIZE Inches	DIMENSIONS Inches		PULLOUT Feet
	A	B	
4	12.75	10.25	.03
6	14.00	11.00	.04
8	15.25	12.00	.04
10	15.75	12.25	.05
12	16.50	13.00	.06
14	19.75	15.25	.05
16	20.25	15.50	.05
18	21.00	16.00	.05
20	21.50	16.25	.05
24	23.00	17.25	.05
30	26.25	19.00	.05
36	28.00	20.25	.05

Minimum Laying Lengths For TR FLEX Pipe

The following drawings and dimensions in Table 1 define the minimum lengths for TR FLEX pipe when furnished in either Plain End x Plain End, or Bell x Plain End. The minimum laying lengths are determined on the basis of the socket depth and the minimum space required in front of the pipe bell face to insert the locking segments. These minimum laying lengths must be considered when ordering factory cut lengths or field cutting TR FLEX Pipe.





TR FLEX Field Cut Pipe Instructions

Making a Field Cut

Before making the field cut, measure the pipe diameter or circumference at the location to be cut. The diameter or circumference should fall within the range shown in Table 2. If the measurement is not within the prescribed range, another pipe should be selected and checked before cutting.

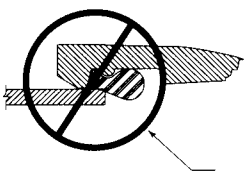
The pipe must be cut as square as is practical. A field cut end that is not square may leak, especially if the joint is fully deflected. Measure from the factory manufactured spigot end to the desired cut location. Mark the measured distance around the circumference of the pipe at sufficient intervals to determine a square cut-line (a line perpendicular to the axis of the pipe). Scribe the square cut-line around the O.D. of the pipe.

When Ductile Iron pipe 14" and larger is to be cut in the field, the material should be ordered as "GAUGED FULL LENGTH." A *Full Length Gauged Pipe* is a pipe whose barrel outside diameter is within the spigot diameter dimensional specifications as determined by diameter tape measurements over the pipe's length to within approximately two feet of the bell chime. Pipe that is "gauged full length" is specially marked to avoid confusion. ANSI/AWWA C151 Standard for Ductile Iron pipe requires factory gauging of the spigot end. Accordingly, pipe selected for field cutting should also be field gauged in the location of the cut and ensured to be within the tolerances shown in Table 2. In the field a mechanical joint gland can be used as a gauging device.

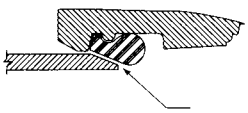
Cut the pipe. (Abrasive saws are commonly used.) Bevel the field cut end (a disk grinder can be used). Refer to a shop manufactured bevel as a guide for proper shape. Additional grinding may be required to further bevel the pipe if difficulty in assembly of the joint is encountered.

Table 2.

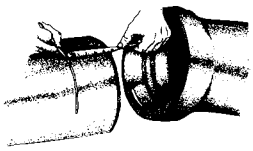
NOM. PIPE SIZE Inches	CIRCUMFERENCE MINIMUM Inches	CIRCUMFERENCE MAXIMUM Inches	DIAMETER MINIMUM Inches	DIAMETER MAXIMUM Inches
4	14-7/8	15-9/32	4.74	4.86
6	21-15/32	21-7/8	6.84	6.96
8	28-1/4	28-5/8	8.99	9.11
10	34-11/16	35-1/16	11.04	11.16
12	41-9/32	41-21/32	13.14	13.26
14	47-13/16	48-7/32	15.22	15.35
16	54-13/32	54-13/16	17.32	17.45
18	61	61-13/32	19.42	19.55
20	67-19/32	68-1/32	21.52	21.65
24	80-25/32	81-7/32	25.72	25.85
30	100-11/32	100-25/32	31.94	32.08
36	120-1/32	120-9/16	38.24	38.38



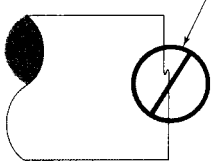
Sharp Edges or Burrs
Can Cut or Push Gasket



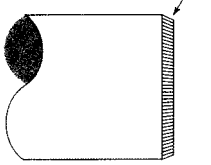
Properly Cut and Beveled End.



Spiral Cuts Leave
Jagged Edges



Square Cut End
With Proper Bevel



TR FLEX Field Cut Pipe Instructions (cont.)

Clean Spigot End

Clean the pipe spigot end of any excess coating, cement, dirt, etc. In general, if the peen pattern is not visible on the pipe surface, the coating can be assumed to be too thick and must be removed prior to assembly of the joint.

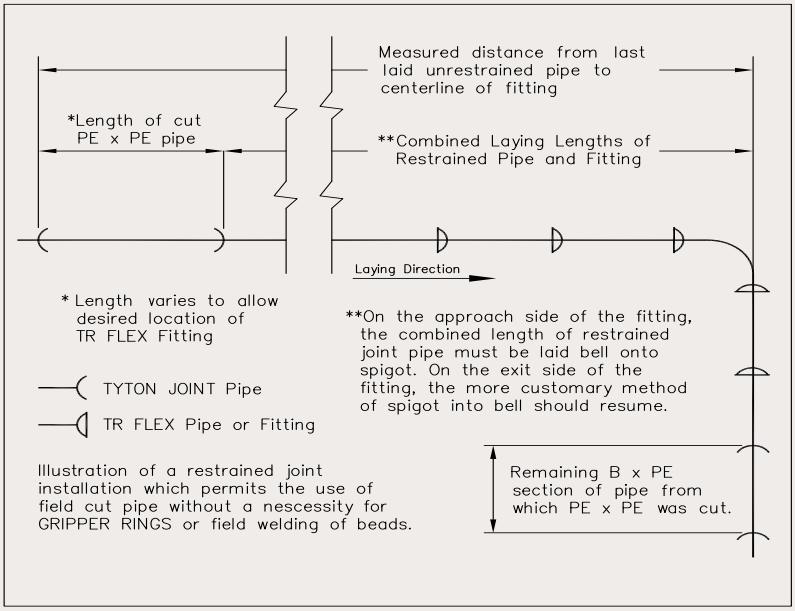
Assembly Stripe Tape

It is important to have a highly visible assembly mark accurately located on the pipe spigot end. It is recommended that 2-inch duct tape, or a similar type tape, be used for this assembly stripe.

Measure from the square field cut end to the location shown in the Table 3 and make several marks around the pipe barrel at the measured distance. Apply the tape around the pipe spigot such that the spigot end of the tape is aligned with the marks.

Unrestrained Field Cut Pipe Instruction Method

The following schematic illustrates the use of a field cut pipe in the unrestrained portions of the line, thus eliminating the requirements for TR FLEX GRIPPER® Rings or field weldments.



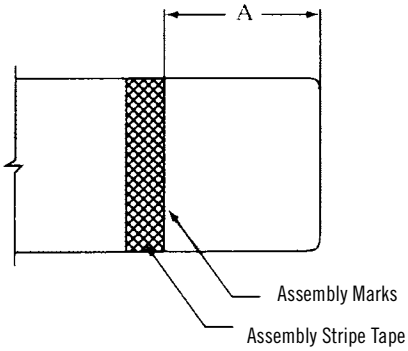


Table 3. Assembly Stripe Location

NORMAL PIPE SIZE Inches	A Inches
4	4 3/8
6	4 7/8
8	5 3/8
10	5 5/8
12	5 7/8
14	7 3/8
16	7 1/2
18	7 3/4
20	8
24	8 1/2
30	10
36	10 1/2

TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX GRIPPER® Rings

TR FLEX GRIPPER Rings are used to restrain 4" through 36" field cut pipe (pipe without weldment) inside TR FLEX Pipe and Fittings. These joints are suitable for 350 psi working pressure for sizes 4" through 24" and 250 psi working pressure for 30" and 36" products. On many installations a "less than nominal" length of pipe (a closure piece) is required to complete a pipe run. These closure pieces can be made in the field, saving time and money.

THE TR FLEX GRIPPER Ring consists of Ductile Iron locking segments, which have stainless steel teeth mounted on the I.D. surface. These replace the locking segments normally used on TR FLEX Pipe and Fittings which have a weldment to provide a positive axial lock between the bell interior surface and the spigot end of the pipe.

Obvious advantages to using the TR FLEX GRIPPER Ring include:

1. Cost Savings: No special order spool piece is required.

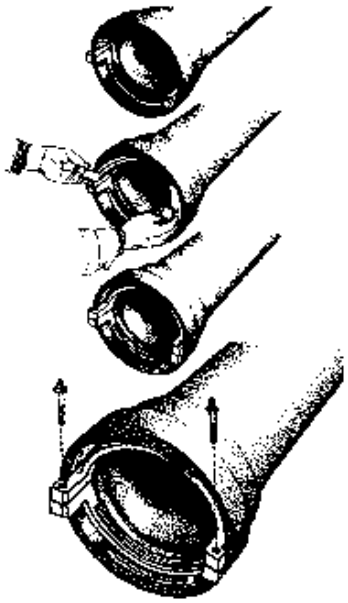
2. Delivery: By cutting pipe in the field, the closure piece can be made when required.

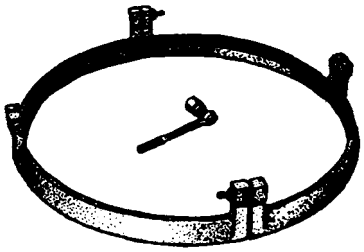
Field weldments can be used for small diameter Ductile Iron Pipe. Field weldment bars, kits and instructions are available from U.S. Pipe. (See U.S. Pipe brochure, "Field Cutting and Welding Procedure for TR FLEX Pipe.")

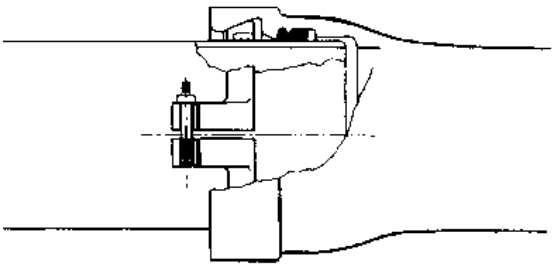
It is easier to properly install TR FLEX GRIPPER Rings in TR FLEX Pipe sockets than TR FLEX Fitting sockets, since it is easier to keep a pipe to pipe joint in alignment during assembly.

TR FLEX GRIPPER Rings must not be used with Horizontal Drilling Pull Process. TR FLEX GRIPPER Rings must not be used in buried or aerial vertical installations greater than 45 degrees. A field weld bar or fabricated pipe closure should be used.

Prior to installing the TR FLEX GRIPPER Ring, please follow the instructions for TR FLEX Field Cutting on Ductile Iron pipe included in this brochure.







TR FLEX GRIPPER Ring

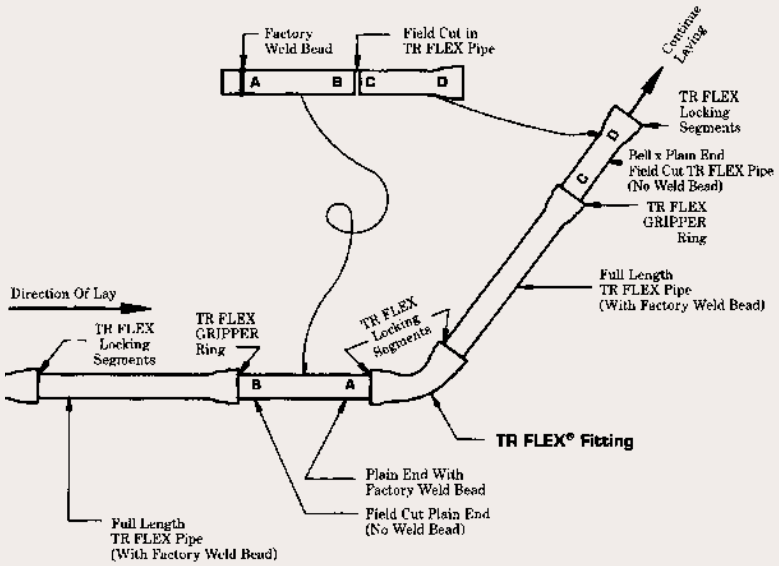
NOTE: *There must be no more than 6 mils nominal coating thickness on the end of the pipe to be restrained with the TR FLEX GRIPPER Ring.*

The TR FLEX GRIPPER Ring should only be used on Ductile Iron Pipe.

TR FLEX GRIPPER® Rings Layout Instructions

The illustration shows how to use TR FLEX GRIPPER Rings in pipe while utilizing fittings. A field cut is made to a TR FLEX® Pipe at the desired location. The spigot end with the factory weld bead (A) is installed into one end of the TR FLEX Fitting and restrained with conventional TR FLEX Locking Segments. The field cut and beveled plain end (B) is installed into the bell of the preceding pipe and restrained with a TR FLEX GRIPPER Ring. A full length TR FLEX Pipe is then installed into the other socket of the TR FLEX Fitting and restrained with TR FLEX Locking Segments. The remaining bell by plain end cut piece is then installed into the socket of the full length TR FLEX Pipe with a TR FLEX GRIPPER Ring. Laying continues with conventional TR FLEX Pipe.

TR FLEX GRIPPER Ring Installation Example



Deflection

If the TR FLEX GRIPPER Ring is not square with the pipe during installation, any subsequent movement of the joint as pressure is applied could result in loosening the ring and possible joint separation.

The joint deflection should be set (as shown in Table 1, page 7) only after the installation is complete.

The precautions noted earlier under TR FLEX Pipe and Fittings Socket Pullout (page 11) also apply to TR FLEX GRIPPER Ring restrained joints.

Installation Tips

Many contractors have found that it is simpler to properly install the TR FLEX GRIPPER Ring in TR FLEX Pipe sockets than in TR FLEX Fitting sockets since it is easier to keep the pipe-to-pipe joint in alignment during assembly and installation. The illustration depicts an example of such an installation.

NOTE: *U.S. Pipe does NOT recommend Gripper Rings in vertical installations greater than 45° and those that choose to do so proceed at their own risk.*

TR FLEX GRIPPER® Ring Installation Instructions

TR FLEX Bell Orientation

Where feasible lay the TR FLEX® Pipe or Fitting bells such that the slots in the bell face are accessible after the joint is assembled. Otherwise provide adequate bell holes to permit access to properly tighten bolts.

4" - 20"

24" - 36"

Clean and Lubricate

Clean the gasket seat and locking segment cavity of the TR FLEX Pipe or Fitting socket and insert the TYTON® Gasket in the recommended manner. DO NOT apply lubricant in the gasket seat of the bell or to the outside of the gasket before inserting the gasket.

Check TR FLEX GRIPPER® Ring

Select the proper size ring. Inspect the ring for any shipping damage. Also ensure that there is no excess coating, dirt, cement or weld spatter in or on the teeth or on the inner diameter of the ring segments.

Insertion of the Ring Segments

The 4"–20" TR FLEX GRIPPER Rings are made in two segments. The 24"-36" rings are made in four segments.

Remove the bolts from the TR FLEX GRIPPER Ring. Position the TR FLEX GRIPPER Ring segments into the bell locking segment cavity so that the segment handles protrude beyond the bell face. At each location where the segment handles are joined, one side is drilled, and the other side is tapped, insert the bolts into the segment handles so that the segments form a loose ring. After removing the bolts, check that the internal treads of the Gripper Ring and the external threads of the bolts are clean. Apply a thin film of pipe lubricant to the threads of the bolt before proceeding with the installation. Be sure to insert the bolts into the drilled side first before engaging the threads in the tapped side.

TR FLEX GRIPPER® Ring Installation Instructions (cont.)

The four segment 30" and 36" TR FLEX GRIPPER® Rings differ from the 24" ring in that two of the segments are joined with a jack screw. With the jack screw it is possible to fully expand the ring segments to provide the maximum assembly clearance for the entering pipe.

To install, remove the three short bolts. Do not remove the long jack screw.

Position the two segments joined with the jack screw into the lower portion of the bell locking segment cavity.

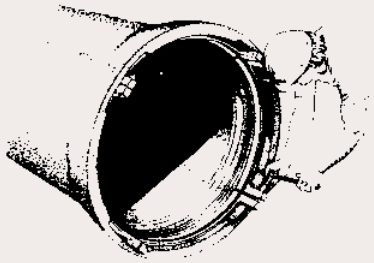
The segment handles should protrude slightly beyond the bell face with the jack screw easily accessible.

TR FLEX GRIPPER® Ring Installation Instructions (cont.)

Install the other two ring segments in the bell and assemble to the initial segments by inserting the bolts into the segment handles to form a loose ring.

Back off the jack screw so that the segments are forced to become fully seated into the bell locking segment cavity.

NOTE: *Prior to inserting the bolts back into the Gripper Ring, check to make sure the threads are clean. Wipe the threads of each bolt with a thin film of the lubricant supplied with the pipe.*



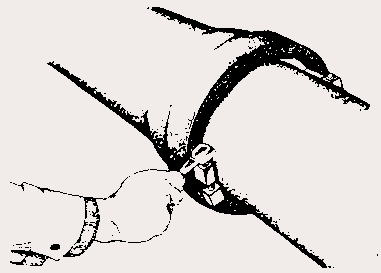
Joint Assembly

Clean the pipe spigot end. Be sure that there are no burrs or sharp edges left from the cutting and beveling operations or any excess coating.

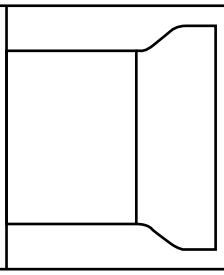
Lubricate the exposed gasket surfaces and the pipe spigot end with TYTON JOINT® Lubricant.
NOTE: *Lubricant should NOT be used under the gasket in the bell socket.*

Assemble the cut pipe into the pipe or fitting bell making sure that edge of the assembly stripe is flush with the bell face. Keep the joint in straight alignment.

TR FLEX GRIPPER® Rings in sizes 4"–20" are equipped with 1/2"-13 x 2" Torque Limiting bolts and sizes 24"–36" with 5/8" - 11 x 3" Torque Limiting bolts. Before re-installing the TORQUE LIMITING bolts, make sure the threads are clean and apply a thin coat of TYTON JOINT Lubricant to the threads.



While keeping the assembled joint in straight alignment, tighten the 1/2" bolts using a common 3/8" 12-point socket wrench until the cap of the bolt shears off. Follow the same procedure for each TORQUE LIMITING bolt.



TR FLEX GRIPPER® Ring Installation Instructions (cont.)

For sizes 24"–36" use a common 7/16" 12-point socket wrench.

After assembly of the 30" and 36" sizes, tighten the jack screw snugly then proceed to tighten the remaining (3)-5/8" TORQUE LIMITING bolts with a 7/16" 12-point socket wrench until the caps of the bolts shear off.

It is important that the joint not be deflected prior to tightening the TR FLEX GRIPPER® Ring. If the TR FLEX GRIPPER Ring is not square with the pipe as the bolts are tightened, any subsequent movement of the joint could result in loosening of the ring and possible joint separation.

Installers may find that it helps to push the Gripper Rings to the back of the lug cavity in order to insure that the ring is square with the pipe spigot before tightening of the bolts.

Extension and Deflection of the Joint

After the installation is complete, the joint should be fully extended by attempting to pull the joint apart. This extension removes any slack from the joint and provides assurance that the TR FLEX GRIPPER Ring has been correctly installed. After extending the joint, the required joint deflection can be set. The joint should be installed with as little deflection as possible to allow for additional deflection in the event there is some movement or settling of the line after installation.

NOTE: *If specifiers or users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile- Iron Pipe Systems, for proper external protection procedures. Polyethylene encased sections of a line will require additional joint restraint since the friction between the pipe and soil is reduced with the use of polyethylene encasement. Refer to the DIPRA's* ***Thrust Restraint Design*** *brochure for additional details on restrained length calculations.*

Notes Regarding the Use of Restrained Joint Pipe

1. Large unbalanced thrust forces can be produced at dead ends, bends, tees or other changes in direction of high pressure and/or large diameter piping systems.

2. Concrete Thrust blocking or other means of thrust restraint is not required to be used with TR FLEX restrained joint when the TR FLEX restrained joint system is used in a designed thrust restraint system. The **Thrust Restraint Design for Ductile-Iron Pipe** published by the Ductile-Iron Pipe Research Association (DIPRA) is one method used to calculate the required length of restraint at a change in direction. This publication is available through your U.S. Pipe Representative or at www.dipra.org.

3. In underground piping systems, an unbalanced thrust force can normally be resisted by providing a designed length of restraint at a change in direction where thrust forces are anticipated. Restrained joint pipe normally must transfer the thrust forces to the soil surrounding the pipeline.

4. Most restrained joints allow for joint take-up after installation. The amount of take-up or slack can vary considerably with the type of joint and installation conditions. Thrust forces produced by internal pressures can result in removal of this joint take-up thereby increasing the length of the restrained section of the line. In any situation or configuration where increases in the line segment length could be detrimental to the pipeline or surrounding structures, the restrained joints should be fully extended during installation.

5. Many contractors are more confident in the reliability of push-on joints if the joint is fully homed. That is not possible when installing a TR FLEX plain end into a TYTON JOINT® bell unless the plain end with the weld bead is cut off and re-beveled as recommended. U.S. Pipe can furnish TR FLEX Pipe without the weld bead to use as a transition piece between restrained and unrestrained portions of the pipeline. Likewise, a TYTON JOINT Pipe can be furnished with a TR FLEX plain end, if desired.

6. An increase in line segment length can also result in additional joint deflection. If an increase in length or other line movement are anticipated, the deflection of the restrained joints should be limited to only a portion of the joint design deflection during the installation of the pipe.

7. In fully extended, totally restrained piping systems, the thrust forces are carried by the piping system, and the resistance to the thrust is not dependent upon the surrounding soil. In situations where there is insufficient space to provide the designed restrained length, or where there are poor soil conditions, the entire section of line should be restrained or other external means of stability or restraint provided.

8. When TR FLEX Pipe is used in casings, it is preferred that it is pulled. Pulling will fully extend the joints and take up the joint slack prior to making end connections. If the pipe must be pushed contact a U.S. Pipe Sales Representative for special instructions. The length of restraint in the casing should not be considered as part of the designed length of the restraint required to provide the soil resistance to the thrust forces.

Notes Regarding the Use of Restrained Joint Pipe (cont.)

9. Above ground lines subject to thrust forces should be fully restrained and extended to remove any slack from the joint. The joint can be extended by pulling out on the pipe after the restrained joint assembly is made. The thrust forces can cause an unexpected increase in length of an above ground line if the slack is not first removed from the joint. When restrained joint pipe are used for bridge crossings or other above ground installations, each length of pipe must be supported in a manner to restrict both vertical and horizontal movement.

10. It is the responsibility of the Purchaser or Consulting Engineer to ensure that proper trench preparation, compaction and pipe installation procedures are followed and that adequate restrained lengths or thrust block designs are provided to resist the unbalanced thrust loads generated by the installed piping systems.

11. In general, restrained joints are more electrically conductive than conventional push-on joints used for Ductile Iron pipe. This increased conductivity can make a restrained section of the line more susceptible to stray current corrosion caused by direct currents from sources such as electrical transit systems or cathodically protected steel structures (steel pipe, underground storage tanks, etc.). If exposure to stray current is anticipated, contact your U.S. Pipe Representative for the recommended method of protection.

12. Vertical Applications with TR FLEX Joints:

Do not use TR FLEX GRIPPER® Rings in buried or aerial vertical installations greater than 45°. A field weld bar or fabricated pipe closure should be used.

A. Joints used in vertical installations greater than 45°, buried or aerial, must have blocking or support provided to permanently keep the joint extended and a support pier provided at both horizontal pipe sections, or bends, adjacent to the portion of vertical pipe in the exposed location. Failure to keep joints extended can result in unwanted line growth or joint separation from dynamic impact loading.

B. Joints used in vertical installations up to 45° must be kept extended and a support pier provided at both horizontal pipe sections, or bends, adjacent to the portion of vertical pipe. A support pier is not needed in installations where the bottom bend is buried. Failure to keep joints extended can result in unwanted line growth or joint separation from dynamic impact loading.

TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

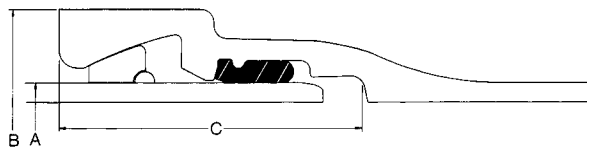
TR FLEX Restrained Joint Pipe and Fittings

Basic Dimensions

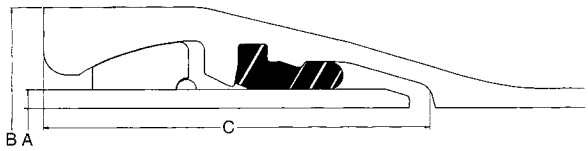
SIZE Inches	WORKING PRESSURE†† psi	A Inches	B PIPE Inches	B FITTINGS Inches	C Inches	NO. OF D.I. LOCKING SEGMENTS	NO. OF RUBBER SEGMENTS RETAINERS	ACCESSORY WEIGHTS* Pounds	MAX. DEFLECTION Degrees	PULLOUT Feet
4	350	4.80	7.00	7.10	4.84	2	1	2	5º	.03
6	350	6.90	9.27	9.39	5.27	2	1	2	5º	.04
8	350	9.05	11.68	11.84	5.82	2	1	3	5º	.04
10	350	11.10	14.12	14.12	6.03	2	1	5	5º	.05
12	350	13.20	16.43	16.45	6.30	4	2	7	5º	.06
14	350	15.30	18.80	19.12	7.75	4	2	12	3 1/4º	.05
16	350	17.40	21.10	21.32	7.95	4	2	14	3 1/4º	.05
18	350	19.50	23.40	23.52	8.19	4	2	17	3º	.05
20	350	21.60	25.68	25.74	8.40	4	2	20	2 1/2º	05
24	350	25.80	30.25	30.14	8.86	8	4	32	2 1/4º	.05
30	250	32.00	36.38	37.18	10.28	8	4	50	1 3/4º	.05
36	250	38.30	43.35	43.86	10.87	8	4	68	1 1/2º	.05

**Accessory weights include segments, gaskets, and rubber retainers.*
†For higher pressure ratings, consult your U.S. Pipe Sales Representative.
†† The TR FLEX Restrained joint has a working pressure rating equivalent to the working pressure rating of the parent pipe with a maximum working pressure rating of 350 psi for 4" through 24" and 250 psi for 30" through 36".

NOTE: These deflections are based on joints with nominal dimensions.



4"- 24" TR FLEX Pipe and Fittings



30" and 36" TR FLEX Pipe and Fittings

Pressure Class TR FLEX Pipe

Nominal Thickness for Standard Pressure Classes of Ductile Iron Pipe

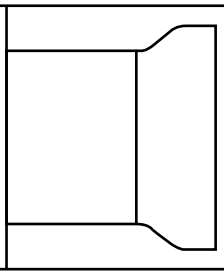
SIZE Inches	OUTSIDE DIAMETER Inches	NOMINAL THICKNESS Inches PRESSURE CLASS*					CASTING TOLERANCES Inches
		150	200	250	300	350	
4	4.80	—	—	—	—	0.25**	0.05
6	6.90	—	—	—	—	0.25**	0.05
8	9.05	—	—	—	—	0.25**	0.05
10	11.10	—	—	—	—	0.26	0.06
12	13.20	—	—	—	—	0.28	0.06
14	15.30	—	—	0.28	0.30	0.31	0.07
16	17.40	—	—	0.30	0.32	0.34	0.07
18	19.50	—	—	0.31	0.34	0.36	0.07
20	21.60	—	—	0.33	0.36	0.38	0.07
24	25.80	—	0.33	0.37	0.40	0.43	0.07
30	32.00	0.34	0.38	0.42	0.45	0.49	0.07
36	38.30	0.38	0.42	0.47	0.51	0.56	0.07

NOTE: *Per ANSI/AWWA C150/A21.50 the thicknesses in above table include the 0.08" service allowance and the casting tolerance by size ranges.*

Dimensions and weights of Special Classes (Thickness Classes) are found on pages 26-29.

** Pressure Classes are defined as the rated water 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 are based on a minimum yield strength of 42,000 and a 2.0 safety factor times the sum of the working pressure and 100 psi surge allowance.*

***Calculated thickness for these sizes and pressure ratings are less than those shown above. Presently these are the lowest nominal thicknesses available in these sizes.*



TR FLEX®

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Pressure Class – Thickness, Dimensions and Weight

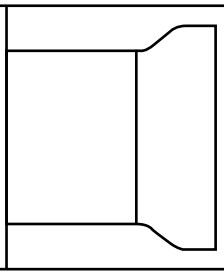
SIZE Inches	PRESSURE CLASS psi	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds
4	350	0.25	4.80	210	11.7	—	—
6	350	0.25	6.90	310	17.2	—	—
8	350	0.25	9.05	415	23.1	—	—
10	350	0.26	11.10	540	30.0	—	—
12	350	0.28	13.20	695	38.6	—	—
14	250	0.28	15.30	835	46.4	915	45.8
14	300	0.30	15.30	970	53.9	1075	53.8
14	350	0.31	15.30	910	50.6	1000	50.0
16	250	0.30	17.40	1015	56.4	—	—
16	300	0.32	17.40	1075	59.7	—	—
16	350	0.34	17.40	1135	63.1	—	—
18	250	0.31	19.50	1180	65.6	—	—
18	300	0.34	19.50	1280	71.1	—	—
18	350	0.36	19.50	1345	74.7	—	—
20	250	0.33	21.60	1400	77.8	—	—
20	300	0.36	21.60	1510	83.9	—	—
20	350	0.38	21.60	1580	87.8	—	—
24	200	0.33	25.80	1690	93.9	—	—
24	250	0.37	25.80	1865	103.6	—	—
24	300	0.40	25.80	1995	110.8	—	—
24	350	0.43	25.80	2125	118.1	—	—
30	150	0.34	32.00	2160	120.0	—	—
30	200	0.38	32.00	2375	131.9	—	—
30	250	0.42	32.00	2590	143.9	—	—
30	300	0.45	32.00	2755	155.1	—	—
30	350	0.49	32.00	2970	165.0	—	—
36	150	0.38	38.30	2935	163.1	—	—
36	200	0.42	38.30	3195	177.5	—	—
36	250	0.47	38.30	3520	195.6	—	—
36	300	0.51	38.30	3780	210.0	—	—
36	350	0.56	38.30	4100	227.8	—	—

NOTE: *Thicknesses and dimensions of 4" through 36" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights.*

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-36 in., +0.08 in., -0.06 in.*

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.



Thickness Class – Thicknesses, Dimensions and Weight

SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds
4	51	0.26	4.80	220	12.2	—	—
4	52	0.29	4.80	240	13.3	—	—
4	53	0.32	4.80	265	14.7	—	—
4	54	0.35	4.80	285	15.8	—	—
4	55	0.38	4.80	305	16.9	—	—
4	56	0.41	4.80	325	18.1	—	—
6	50	0.25	6.90	310	17.2	—	—
6	51	0.28	6.90	345	19.2	—	—
6	52	0.31	6.90	380	21.1	—	—
6	53	0.34	6.90	410	22.8	—	—
6	54	0.37	6.90	440	24.4	—	—
6	55	0.40	6.90	475	26.4	—	—
6	56	0.43	6.90	505	28.1	—	—
8	50	0.27	9.05	445	24.7	—	—
8	51	0.30	9.05	490	27.2	—	—
8	52	0.33	9.05	530	29.4	—	—
8	53	0.36	9.05	575	31.9	—	—
8	54	0.39	9.05	620	34.4	—	—
8	55	0.42	9.05	660	36.7	—	—
8	56	0.45	9.05	705	39.2	—	—
10	50	0.29	11.10	590	32.8	—	—
10	51	0.32	11.10	645	35.8	—	—
10	52	0.35	11.10	700	38.9	—	—
10	53	0.38	11.10	755	41.9	—	—
10	54	0.41	11.10	810	45.0	—	—
10	55	0.44	11.10	860	47.8	—	—
10	56	0.47	11.10	915	50.8	—	—

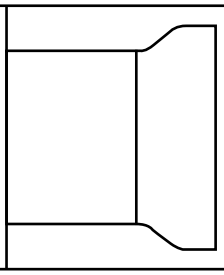
NOTE: *Thicknesses and dimensions of 4" through 36" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights.*

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-36 in., +0.08 in., -0.06 in.*

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.

Table continued on next page.



Thickness Class – Thicknesses, Dimensions and Weight (cont.)

SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds
12	50	0.31	13.20	760	42.2	—	—
12	51	0.34	13.20	825	45.8	—	—
12	52	0.37	13.20	890	49.4	—	—
12	53	0.40	13.20	955	53.1	—	—
12	54	0.43	13.20	1020	56.7	—	—
12	55	0.46	13.20	1080	60.0	—	—
12	56	0.49	13.20	1145	63.6	—	—
14	50	0.33	15.30	960	53.3	1055	52.8
14	51	0.36	15.30	1035	57.5	1140	57.0
14	52	0.39	15.30	1110	61.7	1225	61.3
14	53	0.42	15.30	1185	65.8	1310	65.5
14	54	0.45	15.30	1260	70.0	1390	69.5
14	55	0.48	15.30	1335	74.2	1475	73.8
14	56	0.51	15.30	1410	78.3	1555	77.8
16	50	0.34	17.40	1135	63.1	—	—
16	51	0.37	17.40	1220	67.8	—	—
16	52	0.40	17.40	1305	72.5	—	—
16	53	0.43	17.40	1390	77.2	—	—
16	54	0.46	17.40	1475	81.9	—	—
16	55	0.49	17.40	1565	86.9	—	—
16	56	0.52	17.40	1650	91.7	—	—
18	50	0.35	19.50	1315	73.1	—	—
18	51	0.38	19.50	1410	78.3	—	—
18	52	0.41	19.50	1505	83.6	—	—
18	53	0.44	19.50	1605	89.2	—	—
18	54	0.47	19.50	1700	94.4	—	—
18	55	0.50	19.50	1795	99.7	—	—
18	56	0.53	19.50	1895	105.3	—	—

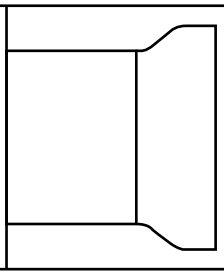
NOTE: *Thicknesses and dimensions of 4" through 36" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights.*

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-36 in., +0.08 in., -0.06 in.*

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.

Table continued on next page.



Thickness Class – Thicknesses, Dimensions and Weight (cont.)

SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	AVG. WEIGHT PER FOOT†† Pounds
20	50	0.36	21.60	1510	83.9	—	—
20	51	0.39	21.60	1615	89.7	—	—
20	52	0.42	21.60	1725	95.8	—	—
20	53	0.45	21.60	1830	101.7	—	—
20	54	0.48	21.60	1940	107.8	—	—
20	55	0.51	21.60	2045	113.6	—	—
20	56	0.54	21.60	2155	119.7	—	—
24	50	0.38	25.80	1910	106.1	—	—
24	51	0.41	25.80	2040	113.3	—	—
24	52	0.44	25.80	2170	120.6	—	—
24	53	0.47	25.80	2295	127.5	—	—
24	54	0.50	25.80	2425	134.7	—	—
24	55	0.53	25.80	2555	141.9	—	—
24	56	0.56	25.80	2685	149.2	—	—
30	50	0.39	32.00	2430	135.0	—	—
30	51	0.43	32.00	2645	146.9	—	—
30	52	0.47	32.00	2860	158.9	—	—
30	53	0.51	32.00	3075	170.8	—	—
30	54	0.55	32.00	3290	182.8	—	—
30	55	0.59	32.00	3505	194.7	—	—
30	56	0.63	32.00	3715	206.4	—	—
36	50	0.43	38.30	3260	181.1	—	—
36	51	0.48	38.30	3585	199.2	—	—
36	52	0.53	38.30	3910	217.2	—	—
36	53	0.58	38.30	4230	235.0	—	—
36	54	0.63	38.30	4550	252.8	—	—
36	55	0.68	38.30	4870	270.6	—	—
36	56	0.73	38.30	5190	288.3	—	—

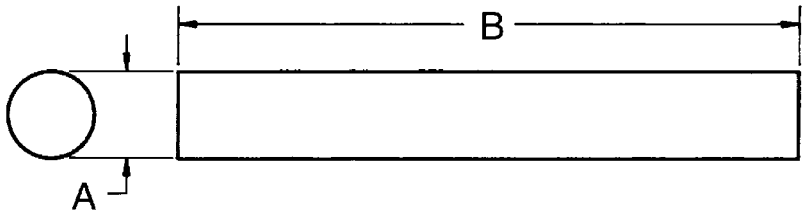
NOTE: *Thicknesses and dimensions of 4" through 36" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights.*

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-36 in., +0.08 in., -0.06 in.*

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.

Rubber Locking Segment Retainers for TR FLEX Pipe and Fittings



SIZE Inches	A DIAMETER Inches	B LENGTH Inches	NUMBER Per Joint
4	5/8	4-3/8	1
6	3/4	6-1/4	1
8	3/4	8-1/4	1
10	7/8	10-3/8	1
12	7/8	7-1/4	2
14	7/8	7-1/2	2
16	7/8	9	2
18	1	10	2
20	1	11	2
24	1	8	4
30	1	9-1/2	4
36	1-1/4	10-1/2	4