THE CITY OF NEW YORK

DEPARTMENT OF DESIGN & CONSTRUCTION

DIVISION OF INFRASTRUCTURE

*Manual for the*

# Inspection of Distribution Water Main Installation

## Training Session No.1:
## Ductile Iron Pipe & Appurtenances Technical Session

November 2007

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## INTRODUCTION

New York City has a water supply system that nearly qualifies as a modern day "Engineering Wonder." Its humble beginnings were brought about by public health concerns facing many expanding communities in the latter half of the 1700's and early 1800's.

The initial system of wells, both public and private, had served the original populace of colonials well but the increasing population forever demanded its expansion. In 1776, the first reservoir was constructed near the present day intersection of Broadway and Pearl Street. Water was pumped into the reservoir from wells near and from Collect Pond and was distributed through hollow logs laid in the major streets. In 1800, the Bank of Manhattan Company, a private concern, sank a well at Centre and Reade Streets, built a reservoir near Chambers Street and installed about 25 miles of wooden mains to distribute water to about 2,000 upper class homes. The ever-increasing population and City's northward expansion on Manhattan Island began to contaminate many of the public and private wells creating a potable water shortage.

As the water became more polluted, outbreaks of intestinal diseases like cholera, typhoid and yellow fever became more frequent. Fire protection was also a major concern. In 1835, the need to build a central water system was addressed by the City when a $12 million expenditure was voted in to dam the Croton River, deliver water through an aqueduct to distribution reservoirs and distribute water throughout the City using pipes. As known today, the Old Croton Aqueduct was completed in 1842. In 1883, a commission was formed to construct a second aqueduct that was placed in service in 1890 while still under construction. The second aqueduct is now appropriately known as the New Croton Aqueduct. Expansion of the Croton System continued as eleven new reservoirs were built and the original Croton Reservoir was expanded with the construction of a high dam to increase storage capacity between 1866 and 1911.

A sustainable potable water source is essential to the development of a growing metropolis. The Croton system allowed the City to grow from a population of 300,000 in 1830 to a population of 2.1 million (Bronx and Manhattan) by 1900. The City's ability to access upstate watersheds and its success in building a water system were one of the key components in consolidating the communities located in the outer boroughs forming its present day borders in 1898. By 1900, Greater New York City had a population of 3.5 million.

In 1905, the State Legislature created the Board of Water Supply to plan and construct facilities to meet future potable water demands. The Board began its task by developing four watershed districts in the Catskills including waters from the Esopus Creek. The Ashokan Reservoir, Catskill Aqueduct, Kensico Reservoir, Hillview Reservoir and City Tunnel No. 1 were completed around 1917 and turned over to the City's Dept. of Water Supply, Gas & Electric for operation and maintenance. The remaining construction of the Catskill System would be completed by 1928. City Tunnel No. 2, also originating from the Hillview Reservoir, would be completed about seven years later.

In 1927, the Board submitted plans to develop the Rondout watershed and tributaries of the Delaware River located within the State of New York. Construction was delayed when the State of New Jersey brought action against the State of New York, the City of New York and the Board of Water Supply in the Supreme Court of the United States. In 1931, The Supreme Court upheld the City's right to impound the headwaters of the Delaware River located in New York State to supplement its water supply. Construction of the Delaware System began in 1937 and was placed in service in several stages. All construction would be completed by 1967.

Construction of City Tunnel No. 3 began in 1970 and is scheduled for completion in 2020. Presently, Stage Two (of four stages) is nearing completion. Once in operation, City Tunnel Nos. 1 & 2 can be taken off line for the first time since 1917 and 1936, respectively, for inspection and repairs.

## INTRODUCTION

The entire system can be divided into four distinctive parts: the watershed, the city tunnels & shaft distribution system, the trunk water main system and the distribution water main system.

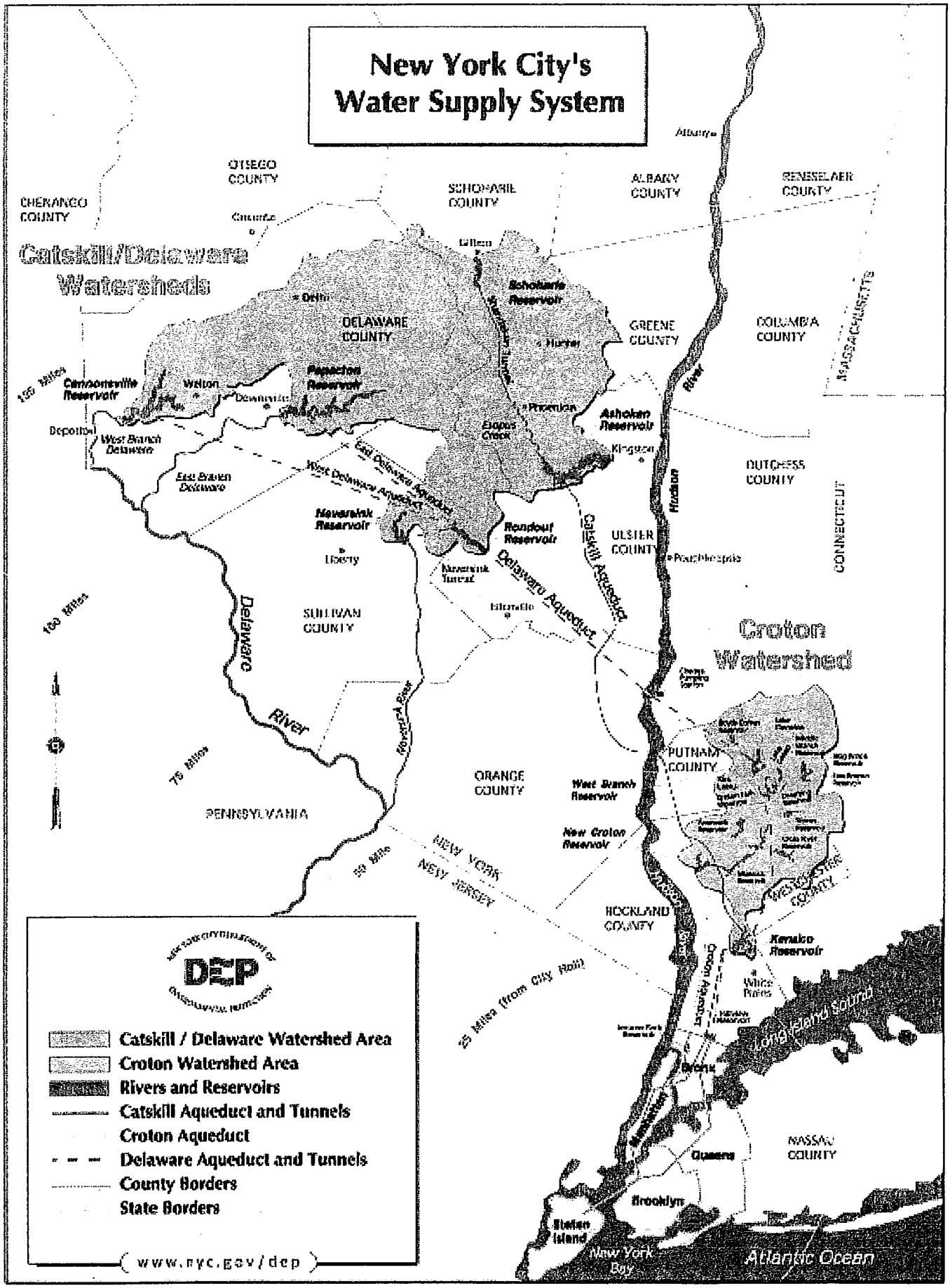
**The Watershed**
The watershed is divided into two reservoir systems with the Croton System and the Catskill / Delaware System located respectively East and West of the Hudson River. The watershed collects runoff in its reservoirs and conveys the water downstream towards the City through a series of aqueducts and/or tunnels. The combined system delivers approximately 1.4 billion gallons of water daily to nearly 9.0 million consumers. The Delaware system provides 50% of the delivery capacity. The Catskill system provides 40% of the delivery capacity and the remaining 10% is provided by the Croton system. Water originating in the Catskill / Delaware system first passes through Kensico Reservoir for some basic treatment and then proceeds south through an aqueduct to Hillview Reservoir. Presently, Hillview Reservoir is the control reservoir balancing flow received through the aqueducts and flow to the City. The water level maintained at Hillview Reservoir determines the water pressure throughout the City. Completion of Stage 3 of the City Tunnel No. 3 project will allow the higher water elevation at Kensico Reservoir to be utilized throughout City Tunnel No. 3's distribution system. Currently, water enters into the City Tunnel Nos. 1, 2 & 3 at Hillview Reservoir, and after more treatment heads into the City.

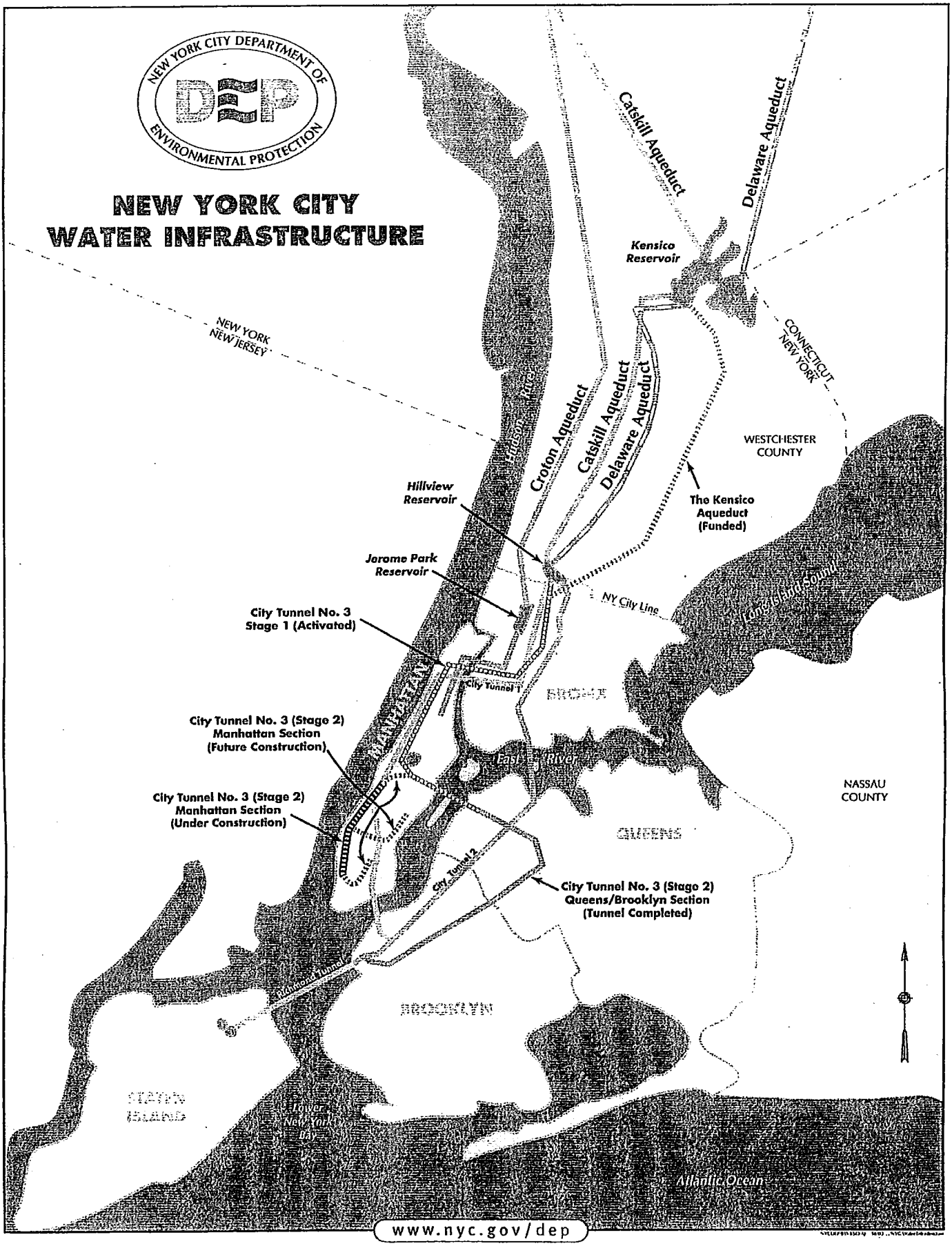
**The Tunnel System**
City Tunnel No. 1 proceeds south from Hillview Reservoir into the Bronx, through Manhattan terminating in Brooklyn at a shaft distribution chamber. City Tunnel No. 2 proceeds south through the Bronx under the East River into Queens then through Brooklyn terminating at a shaft distribution chamber near the end of City Tunnel No. 1. The last shaft of City Tunnel No. 2 is connected to the Richmond Tunnel that supplies water to Staten Island. City Tunnel No. 3 also proceeds south into the Bronx, through Manhattan and then abruptly turns east beneath Central Park heading into Queens and then south into Brooklyn terminating near the Richmond Tunnel's Brooklyn shaft. The three tunnels (ranging 12 to 20 feet in diameter) are cut into the rock strata located below the City. Water is transmitted to the surface through risers into shaft distribution chambers. After the water passes through the shaft distribution chamber it enters the trunk water main system.

**The Trunk Water Main System**
The trunk water main system consists of about 650 miles of mainly large diameter steel pipe ranging in size from 24 to 84-inches in diameter. The trunk main system also contains sections of large diameter pre-stressed concrete embedded cylinder pipe (PCECP), reinforced concrete steel cylinder pipe, cast and ductile iron pipe. Depending on the borough, the water entering the trunk main system may be high pressure or reduced in pressure (intermediate or low) at the shaft distribution chamber. The trunk main system in the Borough of Queens conveys high pressure water from shaft distribution chambers located near its western boundaries to its eastern borders. At intervals, high pressure water is reduced to about 50 psi by passing through a pressure regulating valve into the distribution water main system.

**The Distribution Water Main System**
The distribution water main system is composed of over 5,700 miles of ductile and cast iron water mains ranging from 6 to 20-inches in diameter (sometimes smaller depending on age & location). Distribution mains are located in nearly every City street creating a network. Service connections to homes, apartments and businesses originate at these mains. Service connections are made through corporation stops (taps) or wet connections for larger services. Hydrants connected to these mains provide fire protection.

Specifications and construction practices for the installation of new or rehabilitation of old sections of the distribution water main system will be addressed in greater detail in this manual. Appropriately, this is the last leg of the journey.

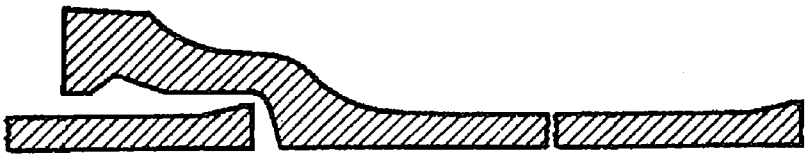

New York City's
Water Supply System
Catskill/Delaware
Watersheds
Croton
Watershed
OTSEGO
COUNTY
CHENANGO
COUNTY
SCHOHARIE
COUNTY
ALBANY
COUNTY
RENSSELAER
COUNTY
DELAWARE
COUNTY
GREENE
COUNTY
COLUMBIA
COUNTY
MASSACHUSETTS
Schoharie
Reservoir
Schoharie Creek
Hudson River
Esopus
Creek
Ashokan
Reservoir
Kingston
Pepacton
Reservoir
Cannonsville
Reservoir
Walton
Downsville
Delhi
Hunter
Phoenicia
Deposit
West Branch
Delaware
East Branch
Delaware
West Delaware Aqueduct
East Delaware Aqueduct
Neversink
Reservoir
Rondout
Reservoir
Catskill Aqueduct
ULSTER
COUNTY
Poughkeepsie
DUTCHESS
COUNTY
CONNECTICUT
Neversink
Tunnel
Liberty
Delaware Aqueduct
Delaware
River
SULLIVAN
COUNTY
Hillsville
100 Miles
75 Miles
Rondout Creek
PUTNAM
COUNTY
ORANGE
COUNTY
West Branch
Reservoir
New Croton
Reservoir
PENNSYLVANIA
NEW YORK
NEW JERSEY
50 Miles
ROCKLAND
COUNTY
WESTCHESTER
COUNTY
Kensico
Reservoir
White
Plains
Croton Aqueduct
25 Miles (from City Hall)
Long Island Sound
Bronx
Queens
NASSAU
COUNTY
Brooklyn
Staten
Island
New York
Bay
Atlantic Ocean
DEP
Catskill / Delaware Watershed Area
Croton Watershed Area
Rivers and Reservoirs
Catskill Aqueduct and Tunnels
Croton Aqueduct
Delaware Aqueduct and Tunnels
County Borders
State Borders
www.nyc.gov/dep


NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DEP
NEW YORK CITY WATER INFRASTRUCTURE
Catskill Aqueduct
Delaware Aqueduct
Kensico Reservoir
NEW YORK
NEW JERSEY
CONNECTICUT
NEW YORK
Croton Aqueduct
Catskill Aqueduct
Delaware Aqueduct
WESTCHESTER COUNTY
Hillview Reservoir
The Kensico Aqueduct (Funded)
Jerome Park Reservoir
NY City Line
Long Island Sound
City Tunnel No. 3 Stage 1 (Activated)
City Tunnel 1
BRONX
City Tunnel No. 3 (Stage 2) Manhattan Section (Future Construction)
East River
City Tunnel No. 3 (Stage 2) Manhattan Section (Under Construction)
NASSAU COUNTY
QUEENS
City Tunnel 2
City Tunnel No. 3 (Stage 2) Queens/Brooklyn Section (Tunnel Completed)
Richmond Tunnel
BROOKLYN
STATEN ISLAND
Lower New York Bay
Atlantic Ocean
www.nyc.gov/dep

## BRIEF HISTORY OF CAST & DUCTILE IRON PIPE DEVELOPMENT

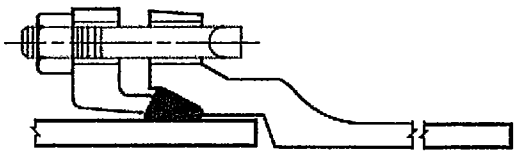
**Gray Cast Iron Pipe:**
Gray cast iron pipe was introduced to the United States over 150 years ago when it was installed in the Philadelphia water systems in 1817. It was primarily chosen for its good machinability and its superior corrosion resistant properties. Gray cast iron pipe would be the chosen material for water distribution pipe until the mid to late 1950's when ductile iron was introduced. Cast iron pipe was originally made with flanged joints (FL) and utilized lead gaskets to provide a watertight seal.

**Bell & Spigot Joint:**
The bell and spigot lead joint was developed in 1875 and was used in the NYC system until the early 1970's. The joint was assembled by caulking yarn or hemp into the base of the bell cavity and pouring molten lead into the remaining space in the bell. Once the lead solidified, the lead would be compacted by caulking forming a watertight seal. The bell & spigot joint configuration is still in use today with a rubber gasket replacing caulking and compacted lead to form a watertight seal.



**Bell & Spigot Lead Joint**

**Mechanical Joint:**
The mechanical joint (MJ) was developed for the gas industry in the late 1920's, but since has been used extensively in the water industry. This joint has standardized dimensions and uses the basic principles of the stuffing box and gland, with a rubber gasket being compressed by the gland. The mechanical joint will be discussed in greater detail later in this manual.



**Mechanical Joint (with Plain Gland, T-Bolts & Gasket)**

**Cement-Mortar Lining:**
The next major development was the introduction of cement-mortar lining in the 1920's. NYC would adopt this standard in the mid 1930's. Prior to the development of cement-mortar lining, gray iron pipe was provided with a hot dip bituminous coating and lining, usually of molten tar pitch. The bituminous linings were generally satisfactory in systems where the water was relatively hard and slightly alkaline (groundwater). Problems occurred in systems conveying soft and acidic waters (surface water) such as rusty or red water and gradual reduction of the flow rate through the pipe. Aggressive water penetrated the pinholes in the tar linings and tuberculation would begin. Tuberculation is a corrosive attack with the formation of tubercles (knob like projections). Excessive amounts of tuberculation can form minute pockets where water can stagnate and become a reservoir for microbes. The microbes will bloom and cause water quality problems when conditions permit.

## BRIEF HISTORY OF CAST & DUCTILE IRON PIPE DEVELOPMENT

**Heavily Turberculated Unlined Cast Iron Pipe**

The protective properties of cement linings are due to two properties of cement. The first is the chemically alkaline reaction of the cement and the second is the gradual reduction in the amount of water in contact with the iron. When the pipe is filled with water, water permeates the pores of the cement lining freeing calcium hydrate. The calcium hydrates reacts with the calcium bicarbonate in the water to make calcium carbonate that precipitates out of water and tends to clog the pores in the cement lining. The initial water passing through the cement lining will dissolve some of the iron which will also react with the calcium hydrate (free lime) to create iron hydroxide which also precipitates out of water and clogs the pores in the lining. Sulfates in the iron also precipitate as calcium sulfates. The clogged lining eventually provides a physical and a chemical barrier to corrosive water.

The use of a seal coat to retard moisture loss during curing in lieu of a moist-curing process was introduced in the 1950's. Later it was found to have a secondary benefit in acting as a barrier retarding the leaching of the cement by soft aggressive water. Leachates from cement can cause an undesirable rise in the pH of the water particularly under low flow conditions. The use of a seal coat was an AWWA requirement until recently when it became an option in 1995 edition of the standards. The primary reason for the option was to help reduce air pollution. The seal-coats are asphaltic paints with a solvent base containing VOCs (volatile organic compounds). All the seal-coats comply with NSF. Only a few locations in the country have sufficiently aggressive waters requiring a seal-coat that reduced its use to an option. The NYC specification for ductile iron pipe requires application seal-coat.

Slight disbondment of the lining from the pipe (and fittings) and cracks can occur due to shrinkage, temperature changes and improper handling. As long as the lining is intact, fissures will generally close themselves (as the concrete swells back to practically its initial volume) and knit back together through a process known as "autogenous healing" when put in contact with water. Any cracks that remain open will subsequently close due to the formation of calcium carbonate.

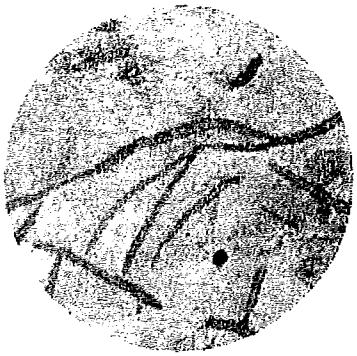
**Ductile Iron:**

The first ductile iron pipe (DIP) was produced experimentally in 1948 and was eventually introduced to the marketplace in 1955. NYC would adopt this standard in the early 1970's. It was an improvement to the cast irons. Minor but significant changes in chemistries and processing result in physical differences at the micro-structure level.

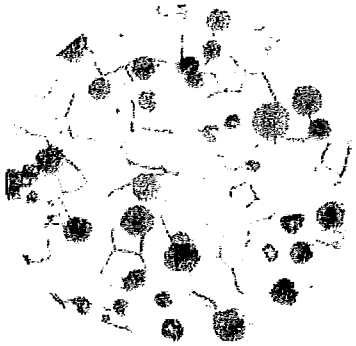
During the solidification phase of the casting process, the carbon (also referred to as graphite) comes out of solution and collects in numerous pools. The shape of these pools of carbon determines the mechanical properties of the iron. In gray iron, the carbon pools are described as being in the form of a flake. They

## BRIEF HISTORY OF CAST & DUCTILE IRON PIPE DEVELOPMENT

are generally an elongated flat form with sharp endpoints. The carbon content and flake form give cast irons good machinability and corrosion resistant properties. However, the flakes break up the continuity of the metal matrix and the sharp endpoints concentrate stresses at a microscopic level. These characteristics limit the tensile strength and ductility of the metal.



**Photomicrograph showing graphite form in gray iron**

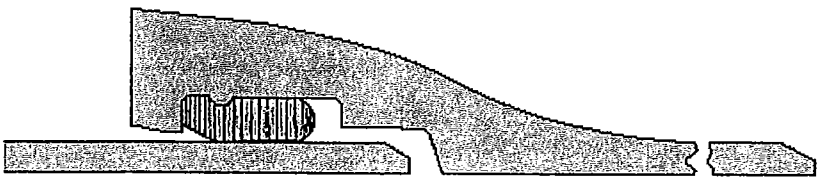


**Photomicrograph showing graphite form in ductile iron**

Ductile iron is produced by adding an inoculant, usually magnesium, to a molten low-sulfur based iron of appropriate composition. The carbon now deposits in spheroidal or nodular forms when the pipe undergoes an annealing process. The continuity of the matrix is now at a maximum and the occurrence of points of stress concentration is reduced. Ductile iron retains all of the cast iron's good qualities, such as machinability and corrosion resistance, but also provides approximately double the strength of cast iron as determined by tensile, beam, ring bending and bursting tests. Its impact strength and elongation are many times greater than those of cast iron. The grade of ductile iron provided is 60-42-10 where 60 ksi is the tensile strength, 42 ksi is the yield strength and 10% is the elongation. Cast irons have Charpy V-notch impact test values of 2-3 ft-lbs, typically. The minimum is 7 ft-lbs for ductile iron.

**Push-On Joint Rubber Gasket System:**

The push on gasket was developed in 1956. NYC would adopt this standard in the early 1970's. This joint consists of a single rubber gasket placed in a groove located inside the socket of the bell end of a piece of pipe. After lubricating the gasket and spigot end of a pipe lightly, the spigot or plain end of the pipe is pushed through the gasket, compressing it and forming a pressure tight seal. Assembly of the joint is simple and fast, can be done under wet trench conditions or even underwater. Several variations of this type of joint are being produced today. The most common joint used in this region is the "Tyton" joint system produced by US Pipe & Foundry Co. Griffin Pipe Products Co. and two McWane Inc. divisions: Clow Water Systems Co. and Atlantic States Cast Iron Pipe Co., are also using the "Tyton" joint system through leasing arrangements.



**Tyton Push-on Joint (w/ plain gasket)**

## OVERVIEW OF PRESENT SPECIFICATIONS

### Ductile Iron Pipe:

**Referenced Standard**

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

**Metallurgy**

The ductile iron shall be ASTM A536 grade 60-42-10, where 60 ksi is the tensile strength, 42 ksi is the yield strength and 10% is the elongation. The minimum Charpy V-notch impact test value is 7 ft-lbs for ductile iron.

**Pipe Thickness Class**

a. Standard outside diameter (OD) for nominal sizes corresponds with mechanical joint dimensions
b. 12-inch and smaller class 56
c. Larger than 12-inch to 24-inch class 55

**Pipe Outside Diameter (OD) & Field Cutting Pipe**

Push-on pipe is manufactured with a standard OD for each nominal pipe size (despite the thickness class) and can be used with mechanical joint fittings. However, not all pipes have fully gauged barrels. Most pipe are gauged for about 2 to 3 feet at the plain end and a short section located beyond the neck of the bell. The manufacturer typically marks fully gauged pipe by painting the bell and striping the plain end or marking the barrel "field cut" to distinguish it from the rest. If you need to cut a pipe that is not marked, a gland (plain, or wedge type retainer) can be slid down the entire length of the pipe barrel as a check. The check will confirm that the pipe barrel is not oversized when successfully completed and should fit into a mechanical joint bell. However, the cut section could be undersized and might not work properly when used with a push-on restraining gasket such as US Pipe & Foundry Co.'s Field-Lok gasket.

**Field Cutting Pipe**

Ductile iron pipe shall be cut only by means of abrasive saws, hacksaws, wheel type cutters, or milling type cutters. The use of "squeeze" type pipe cutters, cutting torches, diamond points and dog chisels shall not be permitted.

### Cement Mortar Lining

**Referenced Standard**

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

**Thickness Requirements for Pipe & Fittings**

Our specification requires cement mortar lining to be double the minimum thickness specified in referenced standard. The following thickness requirements are applicable to pipe and to fittings with nominal diameters greater than 12-inches:

a. 12-inch - 1/8-inch w/ plus tolerance of 1/8-inch
b. 16 thru 24-inch - 3/16-inch w/ plus tolerance of 1/8-inch
c. A bituminous seal-coat is applied to the lining for curing purposes.

**Inspection**

The referenced AWWA standard allows circumferential cracks of any length but limits the length of longitudinal cracks to the diameter of the pipe for pipes with diameters less than 24-inches. For pipe equal to or larger than 24-inch in diameter, longer longitudinal cracks are acceptable if it

can be demonstrated that such cracks will close and heal. Loose areas are permitted as long as the lining remains intact.

**Fusion-Bonded Epoxy Coatings**

**Referenced Standard**

ANSI/AWWA C116/A21.16 - "Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Use".

**Thickness Requirement for Fittings**

Numerous products are covered by this standard. All products must meet requirements established by the FDA for potable water and ANSI/NSF 61, Drinking Water System Components - Health Effects. The manufacturer's recommendations determine the final thickness of the applied product. Basically the product is powder epoxy applied with an electrostatic spray system and is heat or chemically cured. The coating's integrity is holiday tested using a wet sponge or low voltage process. Fittings, with 3-inch through 12-inch diameters, must be lined and coated with a fusion-bonded epoxy meeting this standard. Fittings with diameters larger 12-inches coated with an acceptable fusion-bonded epoxy product are acceptable.

**Inspection**

The fitting are visually inspected any defects found can be repaired at the jobsite using materials and procedures recommended by the coating manufacturer.

**Rubber Gasket Joint Systems:**

**Referenced Standard**

ANSI/AWWA C111/A21.11 - "Rubber Gasket Joints for Ductile-Iron Pressure Pipe & Fittings".

**Rubber Gaskets (Push-on Joint & Mechanical Joint)**

Gaskets are made of synthetic rubber. Therefore, they should be stored in cool place out of direct sunlight and should have no contact with any petroleum-based products. Dried, cracking or flaking gaskets should be discarded.

**Push-on Pipe Joint Systems (Tyton & Fastite)**

A push-on pipe joint utilizes a modified O-ring type synthetic rubber gasket to create a watertight seal between the bell and spigot ends of the pipe. A proprietary gasket groove in the bell end helps prevent the gasket from being dislodged when the spigot end is pushed into place. There were three types of push-on joint systems used in the City recently: "Super Bell-Tite" as manufactured by Griffin Pipe Products Co., "Tyton" as manufactured by US Pipe & Foundry Co. and "Fastite" as manufactured by American Cast Iron Pipe Co. Gaskets for the various types of push-on joint systems are not interchangeable. Presently, the most common push-on joint system, for pipe diameters up to & including 20-inch, used in the City is the "Tyton" joint system. Griffin Pipe Products Co. and two McWane Inc. divisions: Clow Water Systems Co. and Atlantic States Cast Iron Pipe Co., through leasing arrangements with US Pipe & Foundry Co., are also using the "Tyton" joint system to take advantage of a restraining push-on gasket produced by US Pipe & Foundry Co. known as a Field-Lok 350 gasket. For pipe diameters 24-inch and larger, the three aforementioned pipe manufacturers are presently leasing the "Fastite" joint system.

**Push-on Joint Assembly**

The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket shall be flexed inward

and inserted in the gasket recess of the bell. A thin film of gasket lubricant shall be applied to the inside surface of the gasket and the outside of the spigot end. The spigot end of the pipe shall be inserted into the socket with care so as to keep the spigot end from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the Engineer. Pipe that is not furnished with a depth mark or spigot stripe shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field cut pipe lengths shall be filed or ground to duplicate the spigot end of such pipe as manufactured, and thus remove the rough edges of the cut pipe that may damage the gasket. Complete manufacturer assembly instructions for the "Tyton" joint system are available in the Reference Material section of this manual.

**Push-on Joint Restraint Systems**

In conformance with the Bureau's policy, all newly laid ductile-iron pipe up to and including 20-inches in diameter shall have, along their entire length, restrained joints such as "Field-Lok", manufactured by US Pipe and Foundry Co., Birmingham, Alabama, or approved equal.

Joints of water mains affected by unbalanced pressure conditions, caused by valves, fittings and bends in the pipe shall be restrained.

For restraining joints of existing pipe of all diameters, where such joint restraint is required, and for newly laid pipe over 20 inches in diameter, the following methods are acceptable, subject to the Engineer's approval:

1. Field installation of wedge restrained glands and rodding bands with tie rods, as applicable, up to and including 48-inches in diameter.
2. "Field-Lok 350" gasket 4-inches through 24-inches in diameter as manufactured by US Pipe & Foundry Co., Birmingham, Alabama.
3. "Field Lok" gasket for 30-inches to 36-inches in diameter as manufactured by US Pipe & Foundry Co.
4. "Fast-Grip" gasket 4-inches through 20-inches in diameter as manufactured by American Cast Iron Pipe Co.
5. Standard restraint system manufactured integral with the pipe such as:
   a. "TR Flex", including "Gripper Rings," as manufactured by US Pipe and Foundry Co.;
   b. "Snap-Lok", as manufactured by Griffin Pipe Products Co.;
   c. "Flex-Ring and Lok-Ring", as manufactured by American Cast Iron Pipe Co.;
   d. "Super-Lock", as manufactured by Clow Water Systems Corp.;
   e. or approved equal.

**Mechanical Joint System**

A mechanical joint is a bolted joint of the stuffing box type. The joint consists of: (1) a bell that is cast integrally with a fitting (or pipe) with an exterior flange having bolt holes or slots, and a socket with annular recesses for the sealing gasket and the plain / spigot end of the pipe (or fitting); (2) a pipe (or fitting) plain / spigot end; (3) a sealing gasket; (4) a follower gland (plain or wedge type restraint) with bolt holes; and (5) tee-head bolts (T-bolts) and hexagonal nuts. NYC specifications require the T-bolts and nuts to be coated with flouropolymer coating as manufacturer by Tripac Fasteners. Flouropolymer coatings prevent corrosion and reduce friction between the bolt and nut threads. A mechanical joint cross section detail is provided in the Reference Material section of this manual.

## OVERVIEW OF PRESENT SPECIFICATIONS

**Mechanical Joint System Assembly**
The inside of the bell mechanical joint and the outside of the spigot end of the pipe (8-inch length) shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter, and then painted with a soap solution made by dissolving one-half cup of granulated soap in one gallon of water or gasket lubricant such as that used for push-on joint pipe.

a. **Plain Glands** - The gland and then the gasket shall be slipped over the plain end of the pipe. The small side of the gasket and the lip side of the gland shall face the socket. The gasket shall then be painted with soapy water or gasket lubricant such as that used for push-on joint pipe.

   The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care shall be taken to locate the gasket evenly around the joint. The gland shall be moved along the pipe into position for bolting, all of the bolts inserted with the nuts finger tightened. Make any necessary deflections at this time.

   Using a calibrated torque limiting wrench, all of the nuts shall be tightened to a torque of 85 foot-pounds. Nuts spaced 180 degrees apart shall be tightened alternately to produce an equal pressure on all parts of the gland.

b. **Wedge Type Restraint Glands** - Follow the same procedure specified in (a) for plain glands. Tighten the torque limiting twist off nuts in a clockwise direction until all wedges are in firm contact with the pipe barrel. Continue tightening in an alternating manner until all the nuts have been twisted off.

   If removal is necessary, utilize the ⅝-inch hex heads provided. If reassembly is required, assemble the joint in the same manner as described above. Tighten the wedge bolts to the manufacturer's recommended torque (typically 90 foot-pounds) using a calibrated torque limiting wrench.

   The following mechanical wedge type restraint glands have been approved for use:

   1. "MegaLug" Series 1100 up to and including 48-inch diameter as manufactured by Ebaa Iron Inc.;
   2. "Uni-Flange" Series 1400 up to and including 24-inch diameter as manufactured by Ford Meter Box Company, Inc.;
   3. "One-Lok" SLD up to and including 36-inch diameter as manufactured by Sigma Corporation;
   4. "RomaGrip" mechanical joint retainer 3-inch through 12-inch diameter as manufactured by Romac Industries, Inc.
   5. "MJ Field Lok Gasket" and gland up to and including 24-inch diameter as manufactured by US Pipe & Foundry Co.

   Catalog cut sheets and installation instructions for each model can be found in the Reference Material section.

## OVERVIEW OF PRESENT SPECIFICATIONS

**Mechanical Joint Fittings:**

**Referenced Standard**

ANSI/AWWA C110/A21.10 - "Ductile-Iron and Gray-Iron Fittings 3-inch through 48-inch" for ductile-iron fittings only.

**Metallurgy**

The fittings shall be ductile iron ASTM A536 grade 60-42-10 or 70-50-05.

**Mechanical Joint Fittings**

Bends (11¼, 22½, 45 & 90-degrees), 3-ways (tees - run x branch), 4-ways (crosses - run (larger diameter) x branch (smaller diameter)), offsets (size x centerline offset), reducers (large end diameter x small end diameter), caps, plugs & sleeves. See the mechanical joint fitting section for plan view cross-sections of the most commonly used fittings in the Material Reference section. Fittings shall be "all-bell" mechanical joint complete with all accessories for all bells with wedge type restraint glands. All fittings up to and including 16-inch nominal size shall have a minimum pressure rating of 350 psi.

**Mechanical Joint Sleeves**

Sleeves have no pipe stops allowing it to slipover the pipe barrel for closure. Use filler ("dutchman") when connecting to old pipe that may be unrestrained lead joint or push-on pipe.

**Pipe Outside Diameter (OD)**

Cut push-on pipe can be used with mechanical joint fittings when the pipe length has been gauged. Existing CIP especially the lead joint variety had different tolerances and may not fit into the bell of a mechanical joint properly. Pit cast iron pipe (old lead joint pipe) was manufactured in several classifications for a nominal pipe size and each classification had different OD dimensions. Existing pipe should be measured to determine if grinding, transition gaskets or a transition coupling will be needed for connection. Dual purpose fittings are slightly oversized and are used with oversized glands gaskets for connecting new ductile iron to existing cast iron pipe and are painted green to distinguish them from normal sized fittings.

**Flanges for Ductile Iron Pipe & Fittings:**

**Referenced Standard**

ANSI/AWWA C115/A21.15 - "Flanged Ductile-Iron Pipe with Ductile-Iron or Gary Iron Threaded Flanges.

**Flanges**

Flanges shall be ductile iron with "solid flange" dimensions conforming to ASME B1.16.1 Class 125. Bolt holes for insulated flanges shall be 1/8-inch larger to accept a mylar insulating sleeve. Threads shall have an internal taper in accordance to ASME B1.20.1, adapted to ductile iron pipe outside diameters.

**Flange Joint Accessories (Gasket, Bolts, Nuts and Washers)**

Gasket shall be full face, 1/8-inch thick cotton reinforced SBR rubber with a shore durometer of 65. Bolt holes and bolt circle diameter to match ASME B16.1 Class 125 flanges. Hex head bolts nuts and washers shall be coated with flouropolymer coating as manufacturer by Tripac Fasteners. Bolts shall be carbon steel meeting the requirements of the "Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile strength", ASTM A307 Grade B (Heavy Hex). Nuts shall be meet requirements of ASTM A563 Grade A (Heavy Hex). Steel washers shall meet requirements of ASTM F844 (Wide). Bolt head and nut shall be heavy hex series in accordance

## OVERVIEW OF PRESENT SPECIFICATIONS

with ANSI B18.2.1 and ANSI B18.2.2, respectively. Washers shall be in accordance with ANSI B18.22.1, Type A, Table 1B (Wide). All bolts and nuts shall be threaded in accordance with ASME B1.1- Unified Inch Screw Threads, Coarse Thread Series (UNC), Class 2A and 2B, respectively.

**Insulated Flange Joint Accessories (Gasket, Bolts, Nuts and Washers)**
In addition to the above, gasket bolt holes for insulated flanges shall be 1/8-inch larger. Each bolt and stud shall be provided with: a full length mylar insulating sleeve with a wall thickness of 1/32-inch and (two for bolts / one for studs) 1/8-inch thick phenolic insulating washer(s) with an outside diameter 1/32-inch larger than that of the steel washers.

**Polyethylene Encasement**

**Referenced Standard**
ANSI/AWWA C105/A21.5 - "Polyethylene Encasement for Ductile-Pipe Systems"

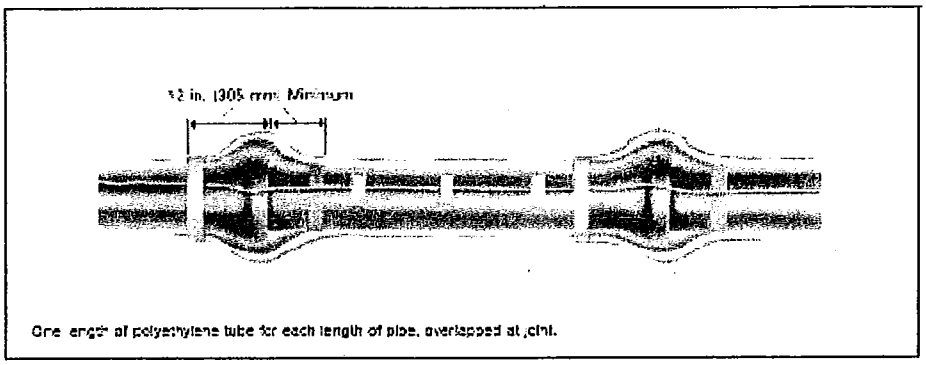
**Evaluating Soil Conditions**
The referenced AWWA standard employs a "Ten" point system in determining the corrosive potential of the soil the new ductile iron water main is to be installed in. The evaluation includes soil resistivity, pH, redox potential, sulfides, moisture, soil type, stray current and prior experience. The specification warns of uniquely severe environments that the polyethylene encasement may not be a viable solution for.

**How Polyethylene Encasement Works**
The 8 mil thick polyethylene wrap provides a physical and moisture barrier between the soil and ductile iron pipe. The plastic is very effective in protecting the pipe from corrosive soils such as landfill cinders and hardpan or caliche that are relatively dry. Polyethylene encasement can be effective in saturated soils consisting of fine particles that trap water by reducing the rate of flow to a minimum. The plastic initially traps a small amount of water against the pipe. The oxygen in the trapped water will be depleted after some surface corrosion takes place on pipe. Corrosion requires oxygen and as long as the water trapped between the plastic and pipe cannot be recharged with oxygen no further corrosion should take place. Tidal conditions in a relatively sandy soil in combination with poorly installed encasement can be devastating to the pipe. If not encased the pipe would come into contact with tidal waters on a cyclical basis (possibly daily for several hours). The encasement can act as a bathtub keeping corrosive waters in contact with the pipe for 24/7 while tidal water regularly replenishes the depleted oxygen by flowing through the encasement's rips and tears. Another thing to be aware of is that this form of protection originated as ductile iron supplanted cast iron as the pipe material of choice. The increased strength of ductile iron allowed for thinner pipe walls while maintaining and even increasing the pipe's rated pressure. Rubber gaskets can also effectively isolate each pipe length. What cast iron lacked in strength was compensated for with increased thickness. With an increased amount of sacrificial material and lead joints to provide continuity throughout the pipeline, the majority of cast iron pipe has probably been ever so slowly rusting away for years without failure and will continue to do so.

**Installation & Inspection**
Our specifications describe an installation procedure that is nearly identical to method "A" of the AWWA standard. The basic system employs a loose fitting 8 mil thick polyethylene tube to be installed over the ductile iron pipe with overlaps (two layers) at the joints and sheets to wrap fittings. The loose fitting plastic is to be drawn tight against the pipe by folding the overlap down and securing with polyethylene tape. Small holes and rips are repaired with tape. Larger damage

## OVERVIEW OF PRESENT SPECIFICATIONS

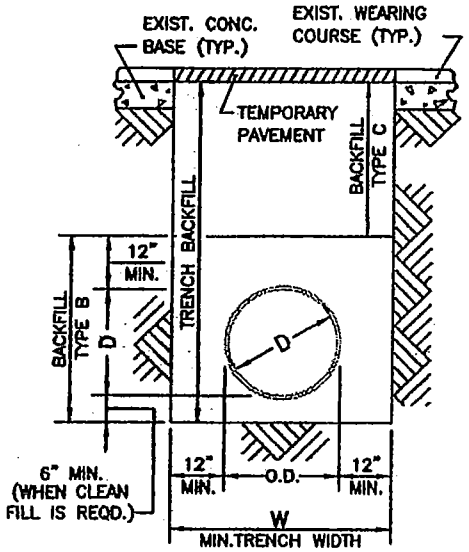
may require using small pieces of polyethylene secured with tape. Care should be exercised when backfilling to prevent damaging the encasement. Taps are installed through the plastic and the opening is secured to the tap with tape. Fittings are encased with sheets of polyethylene. Fittings are laid on the sheet when placed in the trench and the sheet is folded over the fitting. Loose edges are rolled tight against the body and secured with polyethylene tape.




If your contract contains polyethylene wrap items, a quick review of the project's soil borings would be prudent to note the locations where the encasement may be necessary. The Contractor should be instructed to have the material available in case it is needed and a rough plan where it may be needed should be provided. ANSI/AWWA and DIPRA publish an installation video. It would be prudent to obtain a copy and view it with Inspection and the Contractor's personnel prior to commencing such work.

**Bedding & Backfill Requirements**

ANSI/AWWA C600 - "Installation of Ductile Iron Water Main and their Appurtenances" addresses bedding and backfill requirements. AWWA backfill types permit higher loads as they increase in number. Our specification requires a more stringent type 5. It increases compaction levels to 95% Standard Proctor Maximum Density and requires an additional foot of "select granular fill" to be placed and compacted above the pipe. The backfill and compaction of "approved excavated suitable fill," "clean fill" or "processed fill" from one foot above the pipe to grade should be done in accordance with the NYCDOT specifications. The backfill should be deposited in 12-inch lifts and compacted to 95% Standard Proctor Maximum Density.




TRENCH BACKFILLING AND TEMPORARY PAVEMENT

The typical trench cross-section detail defines excavation limits and backfill material zones. Type B backfill is "select granular fill." It shall consist of approved clean earth or sand of low silt and clay content (less than 8% passing the 200 sieve), free of bricks, blocks, excavated pavement materials and debris, stumps, roots and

other organic matter, as well as ashes, oil and other perishable or foreign matter and shall not contain particles larger than one quarter (¼) inch in diameter.

Type C backfill can be "approved excavated suitable fill", "clean fill" or "processed fill" depending on field conditions. "Approved excavated suitable fill" shall be approved earth, free of bricks, blocks, excavated pavement materials and debris, stumps, roots and other organic matter, as well as ashes, oil and other perishable or foreign matter and shall not contain stones larger than six (6) inches in their largest dimension. Stones shall be so distributed that all interstices are filled with fine material. If the excavated material is not suitable for reuse or there is a deficiency of acceptable backfill, the contractor can be ordered to bring in "clean fill." "Clean fill" shall consist of approved clean earth or sand of low silt and clay content (less than 12% passing the 200 sieve), free of bricks, blocks, excavated pavement materials and debris, stumps, roots and other organic matter, as well as ashes, oil and other perishable or foreign matter and shall not contain stones larger than six (6) inches in their largest dimension. Stones shall be so distributed that all interstices are filled with fine material. Processed fill can be used with the Engineer's approval and must meet the requirements of "select granular fill" or "clean fill" depending on the backfill zone the material is to be placed in.

## Gate Valves:

### General

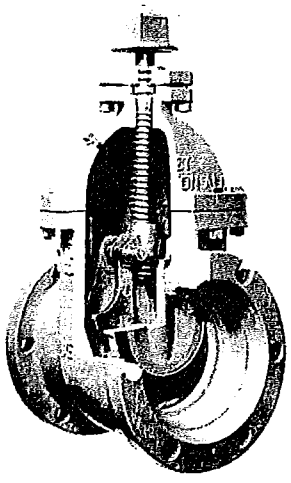
Gate valves are utilized throughout the distribution system to isolate sections of the system for repair or improvement and to establish pressure zones. Two types of valves are presently used in the City water distribution system: double disc gate valves (sizes 3 to 20-inch) and resilient seated wedge gate valves (6-inch hydrant valves & 3 to 12-inch tapping valves). Gate valves are designed for long term use in the fully open or closed position.

Presently, the City is updating the resilient seated wedge gate valve specification to allow the use of 8, 12 & 20-inch valves. The Department of Environmental Protection is testing prototypes of the resilient seated wedge gate valves. Approval of the standard shop drawings will be granted by size and manufacturer. Proof-of-Design testing will be part approval process.

### Double Disc Gate Valves

**Referenced Standard**

The double disc gate valves supplied to the City basically comply with ANSI/AWWA C500 - "Metal Seated Gate Valves for Water Supply Service" with modifications as addressed in our specifications.



**Double Disc Gate Valve w/ Mechanical Joint Ends**

**Specification Highlights**

Double disc gate valves are also referred to as a "Metropolitan Gate Valve" or "Met Valve." The valve body is made of ductile iron conforming to ASTM A536 Grade 70-50-05 or 65-45-12. The discs are either ductile iron or bronze depending on size. The seating surfaces are bronze. The valves shall be manually operated, inside non-rising stem (NRS), double disc with a side seat wedging mechanism. The valve contains a manganese bronze stem sealed with O-rings. The valves open when the 2-inch AWWA nut is rotated clockwise. The number of turns will be 3 turns per inch in nominal diameter plus an additional 2 to 3 turns for seating the discs. The valves ends are typically standard

mechanical joint. Outlet, blowoff, aircock and wet connection or tapping valves are flange by mechanical joint and bypass valves are flange by flange. Flanges are drilled to accept an insulating kit. Since manufacturers build these valves to an established standard, the parts are interchangeable.

Double disc gate valves are rugged valves designed for use in the fully open or closed position. Long term throttling (accidentally being left in a partially open position) can damage the bronze seats and hamper its ability to provide a tight seal when closed. The side action wedging mechanism engages two valve seats simultaneously for a redundant seal while providing easy operation by reducing friction and wear between the valve and disc seating rings.

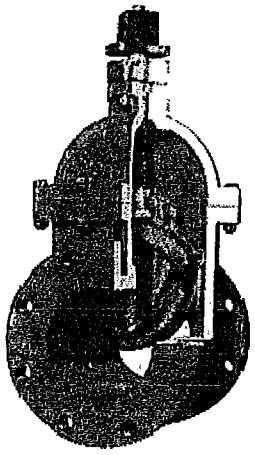
Double disc gate valves are manufactured to City specifications by the following vendors:

M & H Valve Co., Anniston, Alabama;
U.S Pipe and Foundry Co., Inc., Birmingham, Alabama;
Penn-Troy Manufacturing Co., Troy, Pennsylvania;
Sigma Corp., Cream Ridge, New Jersey; or an approved equal.

**Resilient Seated Wedge Gate Valves**

**Referenced Standard**

The resilient seated wedge gate valves supplied to the City basically comply with ANSI/AWWA C509 - "Resilient Seated Gate Valves for Water Supply Service" with modifications as addressed in our specifications.



**Resilient Seated Wedge Gate Valve w/ Flange Ends**

**Specification Highlights**

Resilient seated wedge gate valves are also referred to as "RSW" Valves. The valve body is made of ductile iron conforming to ASTM A536 Grade 70-50-05, 65-45-12 or 60-42-10. The valve gate or wedge shall be made of either ductile or gray cast iron encapsulated with a resilient material. The resilient material shall be permanently bonded to the wedge by vulcanizing. The encapsulated wedge shall seat against a non-corrosive material. The valves shall be manually operated, inside non-rising stem (NRS) with a manganese bronze stem sealed with O-rings. The valves open when the 2-inch AWWA nut is rotated clockwise. The number of turns will be 3 turns per inch in nominal diameter plus an additional 2 to 3 turns for seating the wedge. Hydrant valve ends are standard mechanical joint. Wet connection or tapping valves have a flange and mechanical joint end.

Resilient seated wedge (wet connection/tapping and hydrant) gate valves are manufactured to City specifications by the following vendors:

Mueller Co., Decatur, Illinois;
M & H Valve Co., Anniston, Alabama;
U.S Pipe and Foundry Co., Inc., Birmingham, Alabama;
or an approved equal.

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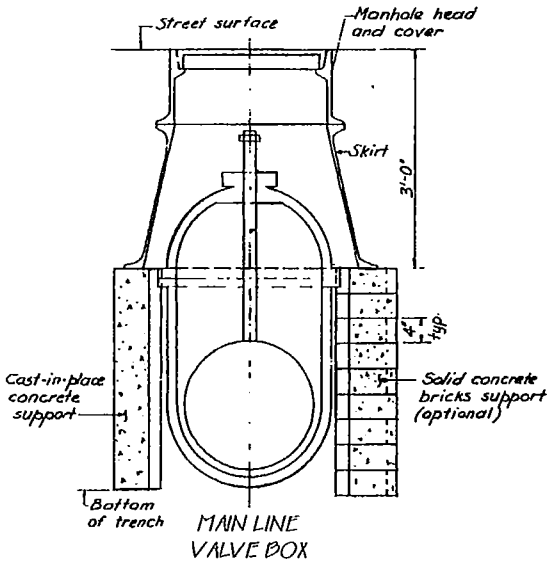
### Valve Box Foundations

Valve box foundations are addressed in Standard Drawing No. 11576-A-Z. Contractors typically use solid concrete blocks to construct valve box foundations. Some contractors may cast their own blocks to use up the "extra" concrete ordered that is normally discarded. Rarely do contractors use cast-in-place concrete to erect valve box foundations as it delays backfilling operations. Care should be exercised when placing valve box skirt so that the bottom does not come into contact with pipe. This prevents transmission of impact forces into the pipe from vehicles riding over the castings. Under no circumstances should the skirt be cut to accommodate a shallow installation. Try utilizing a 6-inch deep manhole frame instead. If that is insufficient the pipe and valve assembly should be lowered. Sand bags are jammed into the opening between the top of the pipe and the bottom of the valve skirt to prevent backfill from migrating into the valve box. Hydrant valve boxes have screw threads to allow for easier adjustment to grade. Minor adjustments between the manhole frame and skirt can be made with steel wedges as long as the remaining annular space is sealed with mortar to prevent backfill from migrating into the valve box. Hydrant valve box casting details are found in Standard Drawing No. 10241-A-Z. Details for standard manhole frames and covers are found in Standard Drawing 13547-B-Z. Valve skirt casting details are found in Standard Drawing No. 10240-A-Z.




### Hydrants, Connection & Layout Details

#### Referenced Standard

The hydrants supplied to the City basically comply with ANSI/AWWA C502 - "Dry Barrel Hydrants" with modifications as addressed in our specifications.

#### Specification Highlights

The City utilizes two types of hydrants: a Dresser type hydrant (D-2-LP) and a Smith type hydrant (S-2-LP). Standard Drawing Nos. 43142-Z and 43250-Z provides assembly details for Dresser and Smith type hydrants, respectively. Smith type hydrants are preferred in historic districts. Although the hydrant types are referred to by their original manufacturers' name, the patterns, as required by City specifications, are open to outside production. Both types of hydrants are a dry barrel design. A dry barrel design allows the barrel of the hydrant to drain when the hydrant is closed. This prevents water accumulating in the hydrant barrel from freezing hindering the hydrant's operation during the winter. The dry barrel design typically features a plug type valve located in the "shoe" of the hydrant or the very bottom of the buried section of the hydrant and a draining mechanism that is open when the hydrant is closed and closed when the hydrant is open. The City approved hydrants are also a "break-away" design. A "break-away" hydrant will separate at a pre-determined point to prevent damage to the buried components of the hydrant if struck with sufficient force. This design allows maintenance to restore a damaged hydrant quickly without excavation by simply replacing the breakaway components and/or replacing the upper portion of the hydrant as needed. The "break-away" hydrants are protected from being struck by 6-inch diameter steel fenders filled with concrete.

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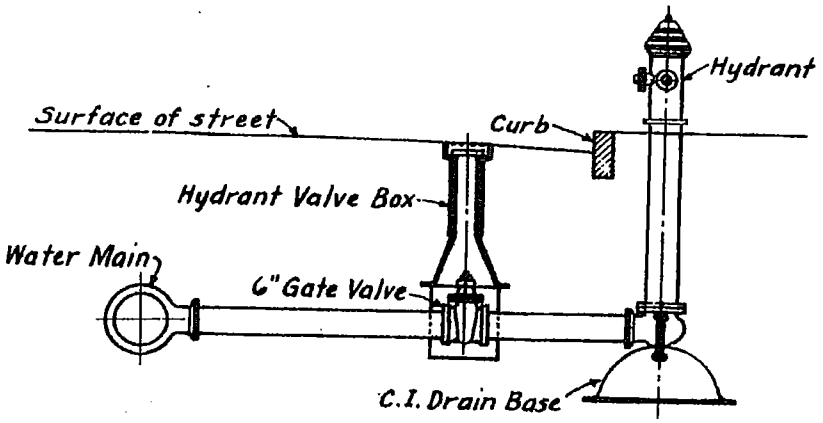
Hydrants open in the clockwise direction and are provided with a standard mechanical joint end and wedge type retainer gland for restraint.

**Connection & Layout Details**
The following standard drawings pertain to the installation of Hydrants and appurtenances:

Drawing No. 15581-B-Z - Standard Hydrant Conn. for Steel & Ductile Iron Mains
Drawing No. 22809-Z - Drain Base Casting Details
Drawing No. 31050-Z - Standard Methods for Hydrant Drainage
Drawing No. 45161-A-Z - Standard Steel Hydrant Fenders Layout Detail




**Cross Section of a Typical Hydrant Set on a Cast Iron Drain Base**

A cast iron drain basin that a hydrant is installed on top of (as shown above) typically provides hydrant barrel drainage. The connection to the drain base is accomplished with a ¾-inch straight coupling (w/ M.I.P thread x flared ends) and a piece of ¾-inch, type K copper tubing that is inserted a minimum of 4-inches into the drain base. When field conditions dictate (hydrant is located in a narrow sidewalk vault roof notch), drainage can be provided by the construction of a blind drain and an extended copper tubing connection. The blind drain is a bottomless concrete box with a separate roof slab and a 0.75 CY volume filled with stone. The blind drain is typically located adjacent to the hydrant branch. Hydrants that are installed in high ground water areas are installed with a drain plug and are marked with the letter "P" next to the size of the main it is connected to. These hydrants are checked more frequently in the winter and are pumped dry after each use during the winter by the Fire Department to prevent freezing.

**Service Connections**

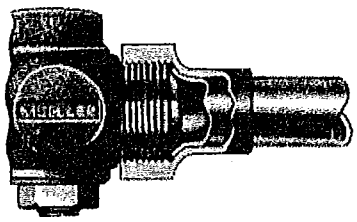
**General**
Water service connection work in the City is governed by a NYC-DEP publication entitled, "Rules and Regulations Governing and Restricting the Use and Supply of Water." ANSI/AWWA C800 - "Underground Service Line & Fittings," addresses most of the components discussed in this section.

**Types of Services (materials)**
A wide variety of materials were used for water services in the past. Among them were lead tubing, copper tubing, galvanized iron threaded pipe, brass and copper threaded pipe, cast and

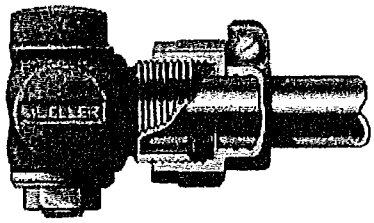
## OVERVIEW OF PRESENT SPECIFICATIONS

ductile iron pipe. Currently under DDC contracts, the materials used for reconnecting or extending services are type K copper tubing for services equal to and less than 2-inches in diameter and ductile iron pipe for services equal to and greater than 3-inches in diameter.

**Couplings (threaded, flared, Lead-Pak)**
Distribution water main replacement work limits the amount of service connection pipe or tubing that will be replaced. If the new water main is installed in the same lane as the old existing main, approximately 3 feet of pipe or tubing will be replaced creating a new "swing joint" or "gooseneck" connecting to the new corporation stop or tap. If the new water main is installed in a different lane, the shortened services are cut and reconnected. Depending on the type material encountered on a shortened service, a new "swing joint" or "gooseneck" may or may not be provided. New service pipe, including a new "swing joint" or "gooseneck," is installed for an extended connection and reconnected. Due to the variety of materials used for existing service connections, red brass couplings of various kinds are used to make reconnections. Flared fittings are used for copper tubing reconnections. Wiping or soldering to reconnect copper to lead tubing is no longer permitted. Lead tubing reconnections are to be made with flared x Lead-Pak couplings. The Lead-Pak end utilizes a single screw clamping mechanism and a pack joint to form a watertight seal.



**Flared End Cross-Section**



**Lead Pak End Cross-Section**

The coupling end must be sized accordingly. For an inside nominal diameter of ¾-inch, lead tubing came in three different outside diameters referred to as strong (A), extra strong (AA) and double extra strong (AAA). Pipe reconnections require the pipe to be cut and new M.I.P.S. (male iron pipe size) threads cut for a flared x F.I.P.S. (female iron pipe size) threaded coupling. It may be necessary to further expose a service looking for a structurally sound piece of pipe to cut new M.I.P.S. threads onto. Under extreme circumstances, the use of a flared x pack joint style coupling utilizing a securing set screw is permitted when the condition of the existing service makes cutting new threads impossible.

Red Brass couplings available in this area are produced by: Mueller Co., Decatur, Illinois; A.Y. McDonald Mfg. Co., Dubuque, Idaho and Ford Meter Box Co., Wabash, Indiana.

**Tapping Water Mains using Corporation Stops**
New water main installation work specifies a minimum pipe diameter of 12-inches in Manhattan and 8-inches in the remaining boroughs. Therefore, all water main tapping involving 2-inch corporation stops or smaller will be direct or not involving the use of a reinforcing service saddle. Ductile iron 8-inch class 56 pipe is sufficiently thick to provide a minimum of four cut threads for a 2-inch corporation stops to be secured directly to the pipe. If tapping a smaller main is required, consult DEP's "Rules & Regulations" to determine if a service saddle is needed. Service saddles can be used to re-install an equal sized tap over a damaged threaded opening.

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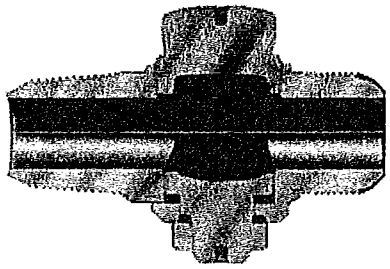
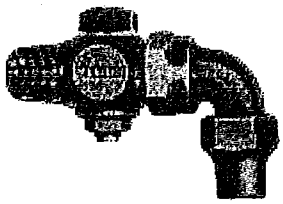
Direct tapping of a water main involves drilling a hole in the pipe and tapping the hole to cut tapered threads conforming to the AWWA taper thread specification found in the ANSI/AWWA C800 Standard. A corporation stop with AWWA tapered threads (also referred to as Mueller "CC" threads), ground key stop valve and a quarter bend or eighth bend coupling with a swivel nut and flared end is installed in the tapped hole. Corporation stops are not to be installed on a fitting or a hydrant branch or within 24 inches of a hub, hydrant branch or dead end. Minimum spacing is 18 inches for ¾ and 1-inch and 24 inches for 1½ and 2-inch corporation stops.



**Corporation Stop w/ AWWA Taper Threads (left end) & Ground Key Valve**

A tapping machine utilizes a combination drill and tapping bit to cut and tap the hole in the pipe. A power pack (electric or pneumatic) is employed to perform the operation quickly in a uniform manner. Corporation stops are normally installed in a live main and the tapping machine utilizes the water to cool the bit and flush out metal chips and debris. DDC work requires the tapping to be performed dry requiring the use of harden drill and tapping bits and the use of an approved cutting grease. In order to prevent contamination, under no circumstances should motor oil, thread bolting paste or any unapproved grease be used to tap a water main. On DDC projects, corporation stops are installed by plumbers working under the supervision of NYC licensed plumbers hired by the contractor.



**Corporation Stop w/ Swivel Nut, 1/4 Bend & Flared End**

The corporation stop is installed on the pipe at a point located between the 1:00 & 2:00 o'clock position or between 10:00 & 11:00 position (on the opposite side of the pipe) pointing toward the property the connection is to serve. The copper tubing swing or gooseneck is formed in the shape of a question mark with the tail end being connected to the existing service. The corporation stops and couplings are made of red brass, a soft alloy. Most are constructed with flat surfaces to facilitate the use of smooth jaw adjustable wrenches to tighten the connections. The teeth of a pipe wrench jaw can cut into the brass and damage the fitting. Over-tightening can also distort the fitting causing it leak and make it susceptible to a stress corrosion failure. The corporation stop's final position should have the centerline of the plug valve parallel to the pipe. This position provides the valve portion of the corporation stop greater protection from damage by directing backfilling shock loads from the service to stronger sections of the tap.

**Corporation Stop Position**

Corporations Stops are produced by: Mueller Co., Decatur, Illinois; A.Y. McDonald Mfg. Co., Dubuque, Idaho and Ford Meter Box Co., Wabash, Indiana.

### Curb Cocks & Curb Valves

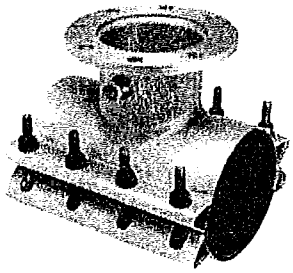
Curb cocks or valves are located between the corporation stop or tapping valve and the house control valve and are typically located near the curb on the sidewalk side. Curb cocks refer to small diameter valves that were typically installed on domestic services. The valve is a ball or

## OVERVIEW OF PRESENT SPECIFICATIONS

plug type that is located in a valve box and operated using a box extension stem that is secured to the valve key with a pin or bolt. Curb valves are gate valves installed in a 6-inch diameter valve box with a round cover. Curb cocks and valves are optional for domestic and commercial service connections. Curb valves are required for all fire service connections.

**Wet Connections**

Wet connections utilizing a wet connection / tapping sleeve and wet connection / tapping valve are used for service connections that are 3-inches and larger.



**Stainless Steel Wet Connection Sleeve**

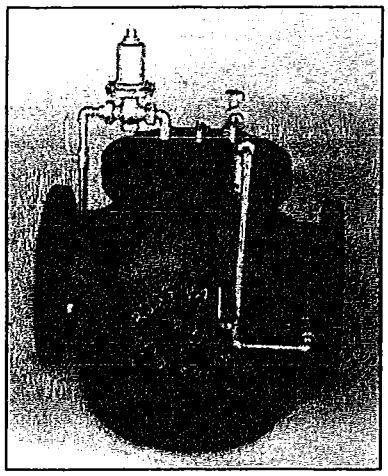
There is a large variety of wet connection or tapping sleeves on the market incorporating the use of u-bolts, straps, split ductile iron mechanical joint sleeves, repair clamp technology to basically secure a branch connection to a piece of pipe. The City specifies a wet connection sleeve that utilizes the technology developed for a stainless steel repair clamp to secure a stainless steel flanged branch connection to the pipe. The wet connection sleeve body is made of heavy gauge stainless steel with reinforced stainless steel armors, stainless steel carriage bolts and a gridded full gasket. This design allows the wet connection sleeve to conform to a range of outside diameters found in a nominal diameter pipe sizes made of cast or ductile iron and slightly misshapen pipe while providing a long service life. Stainless steel wet connection sleeves supplied to the City basically comply with ANSI/AWWA C223 - "Standard for Fabricated Steel & Stainless Steel Tapping Sleeves" with modifications as addressed in our specifications. Stainless steel wet connection sleeves conforming to City requirements are manufactured by: PowerSeal Pipeline Products Division, Wichita Falls, Texas; Mueller Co., Decatur, Illinois; Romac Industries, Seattle, Washington or an approved equal.

Wet connection or tapping valves are flanged x mechanical joint end gate valves of double disc or resilient seat wedge design. The waterway diameter of a wet connection valve is slightly larger than the nominal valve size in order to accommodate a cutting shell without damaging the waterway. The wet connection sleeve is installed on the pipe and the valve mounted on the flange sideways (operating stem parallel to the pipe). The valve is mounted in the sideway position to prevent the valve gate from dropping due to gravity and obstructing flow if the operating mechanism fails or is damaged. Prior to cutting, the installation is tested for leaks. Since the wet connection cutting equipment is expensive and used infrequently, DEP maintenance forces provide the cutting services. DEP's borough tapping division must be contacted and arrangement made for cutting the connections. Adequate lead-time must be provided for arranging cutting services. Normally, wet connection cuts are done dry at the site or in the contractor's yard in the middle of a full-length pipe. If a cut is to be performed in trench, a secure excavation with dimensions as specified in Standard Drawing No. 10200-Z must be provided for the maintenance crew to perform the cutting work.

## OVERVIEW OF PRESENT SPECIFICATIONS

### Regulator Valves

#### General



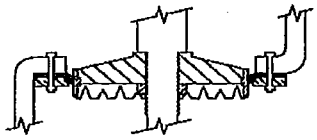
Pressure regulating valves are typically located between the higher-pressure trunk water main system and the low-pressure distribution system. A predetermined pressure change across the valve is set. As demand increases in the distribution system a reduction in the operating pressure would occur. When the reducing pressure exceeds the pre-determined pressure change, the main valve would open to restore pressure. The main valve will remain open until the demand on the system reduces enabling the pressure to recover sufficiently and force the main valve to close. The pressure-regulating valve is installed in a concrete chamber along with isolating gate valves on each side for maintenance issues and isolating backup valves and a bypass system installed adjacent to the chamber.

#### Referenced Standard

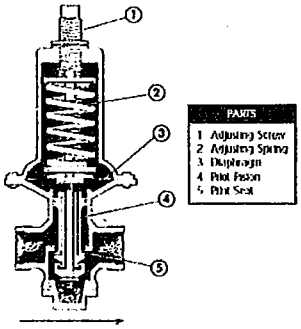
The New York City specification for pressure regulating valves is the standard. The specification references applicable ANSI, AWWA and ASTM standards for ductile iron composition, flange dimensions etc.

#### Specification Highlights

Pressure regulating valves shall be flanged, globe type ductile iron body, full port, single seated and line-pressure operated with a dual pilot control system. The red brass valve piping and control valves shall be installed on the same side of the distribution line near the access ladder of the chamber to facilitate easy operation. The orientation of the equipment is to be verified by construction personnel. The globe type body is made of ductile iron conforming to ASTM A536 Grade 70-50-05 or 65-45-12, or cast iron conforming to ASTM 126 Class B. The valve is full ported so when fully open the maximum pressure drop (head loss) across the valve is not to exceed 20 PSI without chattering or water hammer. The seat is a sliding type with a saw-tooth disc ring that enters a tapered valve bore for closure. A tapered bore creates a cushioning effect when opening and closing by a gradually changing flow area. The saw-tooth disc ring provides a greater range of flow throttling by also gradually changing the flow area over a larger portion of the piston stroke. An indicator rod located on the top cap of the valve body shows the piston position at a glance.



Sliding Seat w/ Saw-tooth Disc Ring & Tapered Valve Bore

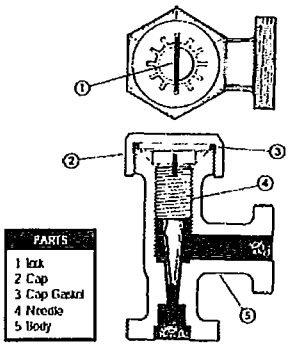



Pilot Valve w/ Internal Sensor

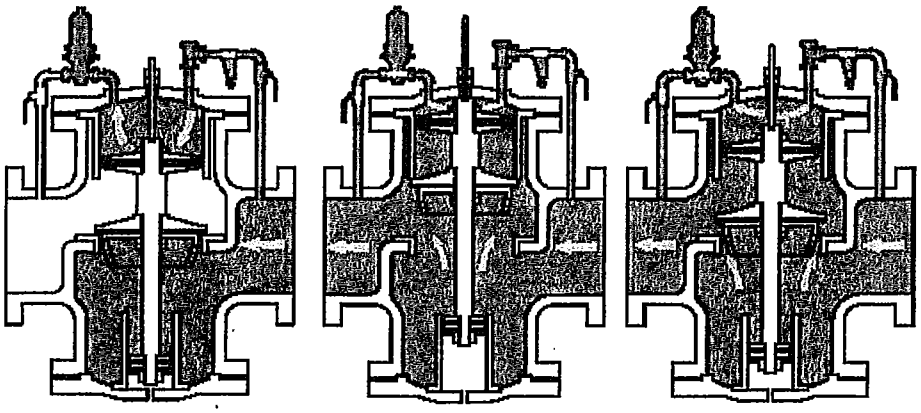
A line-pressure operated valve utilizes water from the high pressure or inlet side of the valve to fill the operating chamber to close the main valve. When water is released from the operating chamber with the high pressure feed closed, the seat rises opening the main valve. The operation of the valve becomes automatic by introducing a pilot valve (bell shaped valve on left side of valve - see previous photo) and a needle valve (resembles three-way with plugged run on the top of the of valve) to the valve's external piping system. A pilot valve has an adjustable internal spring mechanism that flexes a diaphragm downward opening the pilot valve seat. When the downstream

## OVERVIEW OF PRESENT SPECIFICATIONS

pressure, which is communicated to the underside of the pilot valve's diaphragm through the hollow stem, exceeds the spring load, the pilot valve seat closes trapping water in the operating chamber. As the operating chamber fills the piston assembly moves downward forcing the seat closed, slowing and then stopping flow through the main valve. When the downstream pressure falls below the pilot valve setting, the springs flex the diaphragm down opening the pilot valve seat allowing water to escape from the operating chamber to the downstream (low pressure) side of the valve. As water exits the operating chamber the piston assembly rises allowing water to flow to through the main valve. The needle valve is used to control the amount of flow entering the main piston chamber. The needle valve is set so the flow rate entering the main piston chamber cannot exceed the amount leaving the chamber through an open pilot valve or the main valve could never open. The cycle (or balancing act) repeats itself when the pressure on the outlet side reduces sufficiently to allow the pilot valve to open starting the cycle anew.




NEEDLE VALVE



1. Water flows through the external inlet piping and into the operating chamber where it gets trapped.
2. The operating chamber fills up with water and pushes down on the main piston.
3. The main valve closes.

1. More water flows out of the operating chamber through the external discharge piping and out of the discharge side of the main valve than flows in.
2. Pressure on the inlet side of the main valve, encountering decreased resistance pushes the piston up.
3. The main valve opens.

1. The operating chamber balances in a mid open/closed position, exerting some downward pressure on the piston.
2. Pressure on the inlet side of the main valve, encountering some decreased resistance pushes up on the piston.
3. The piston rests in a mid open/closed position, partially opening the valve.

The dual pilot system provides a second pilot valve set at a higher pressure and necessary isolating valves allowing for a quick pressure increase in the distribution system to meet seasonal demand. Strainers are also installed in the control plumbing system to keep debris from clogging up and disrupting the function of the pilot and needle valves. Pressure regulating valves have a rigorous maintenance schedule requiring bi-weekly visits to clear strainers and perform operational tests. Pressure regulating valves are rebuilt in place every two or three years depending on usage. Smooth operation ensures maintenance of constant pressure in the distribution system and prevents damage related to pressure surges.

Pressure regulating valves are manufactured to City specifications by the following vendors:
Golden Andersen Industries Inc., Cranberry Township, Pennsylvania;

## OVERVIEW OF PRESENT SPECIFICATIONS

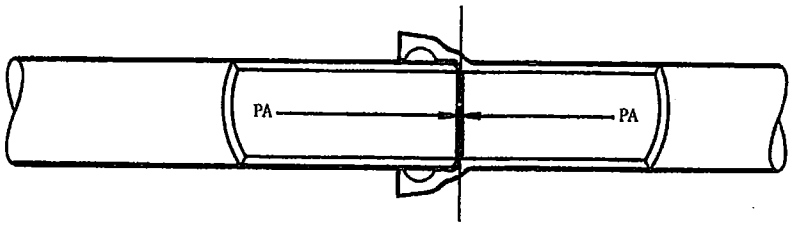
Ross Valve Mfg. Company, Inc., Troy, New York;
Singer Valve Inc., Surrey, British Columbia, Canada; or approved equal.

The listed manufacturers produce pressure-reducing valves in a variety of sizes. All available sizes from a manufacturer may not have been approved. Consult with the specification, DDC & DEP Quality Assurance for an update.

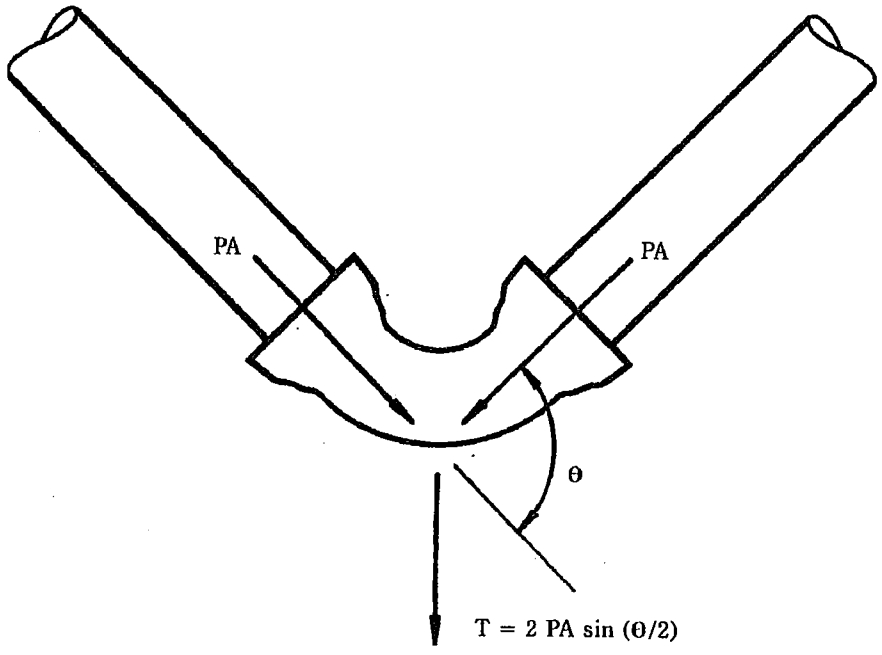
## THRUST RESTRAINT DESIGN

**Thrust Forces:**

At many locations in an underground pipeline, the configuration of the pipeline results in unbalanced forces of hydrostatic or hydrodynamic origin that, unless restrained, can result in joint separation. These unbalanced forces are referred to as thrust forces. Hydrodynamic thrust forces, for the range of pressures and fluid velocities found in distribution water mains, are generally insignificant when compared to hydrostatic thrust forces and are usually ignored. Thrust forces occur at any point in the piping system where the direction or cross-sectional area of the waterway changes. Therefore, thrust forces will be present at bends, reducers, offsets, tees, dead ends (plugs & caps) and closed valves. Balancing thrust forces, to keep the pipeline intact, is accomplished with thrust blocks, restrained joint systems or combinations of these methods.

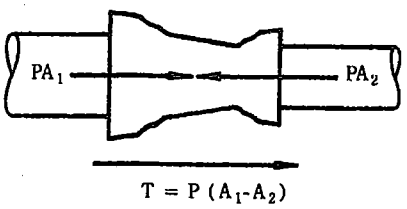



**Internally Balanced Forces at a Straight Pipe Joint**

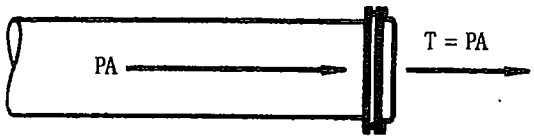



**Thrust Forces at a Bend**

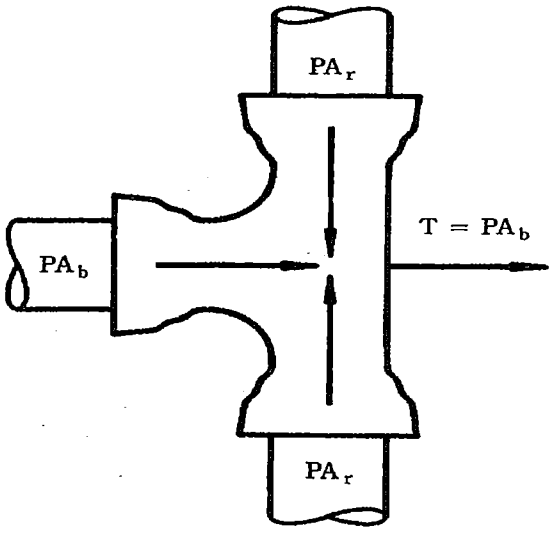
## THRUST RESTRAINT DESIGN



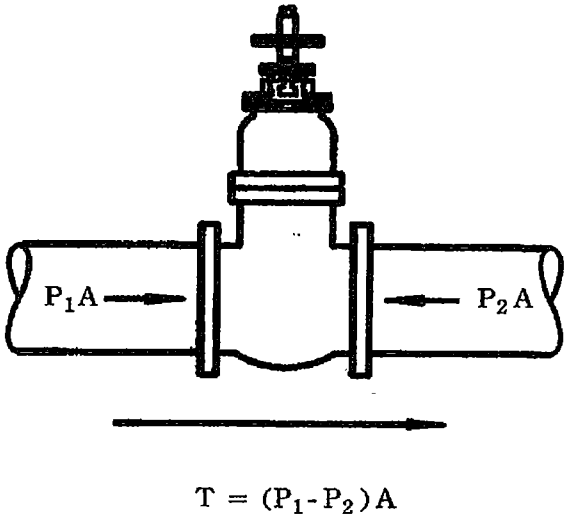

**Thrust Forces at a Reducer**




**Thrust Forces at an End (Cap or Plug)**




**Thrust Forces at a Tee**

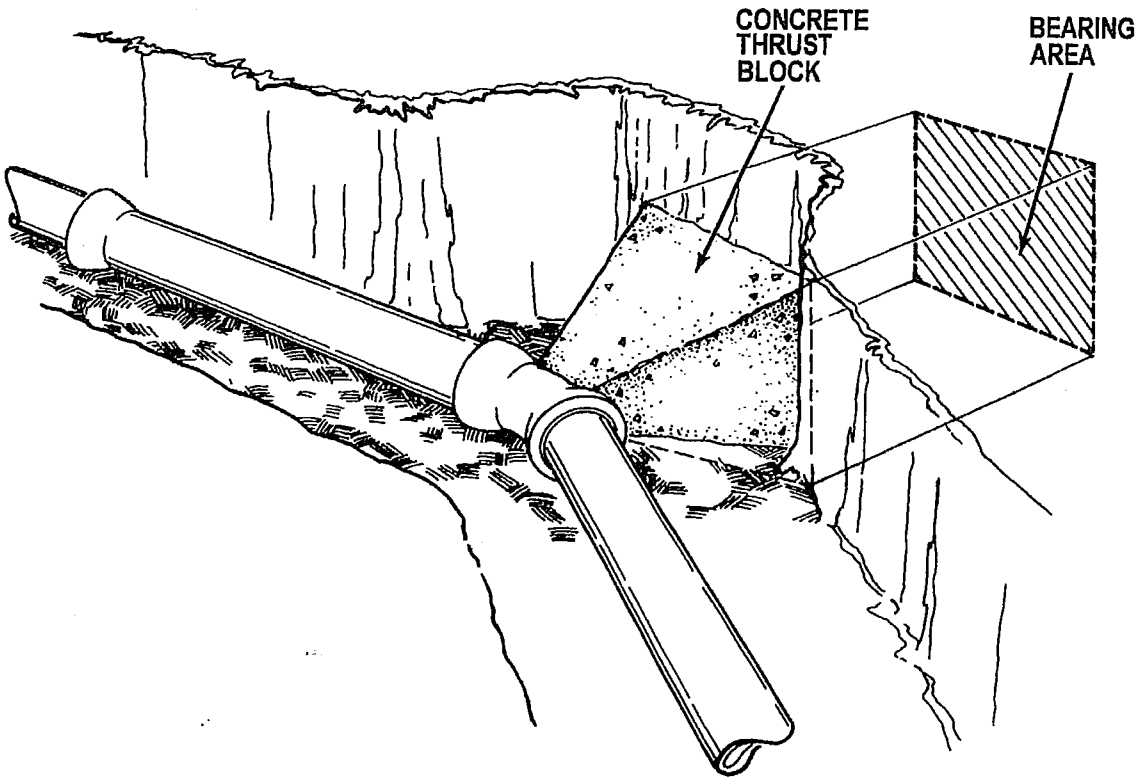



**Thrust Forces at a Closed Valve**

**Thrust Blocks (bearing & gravity):**
Thrust blocks are typically made of good quality concrete and are located where the resultant force of the thrust is focused. Bearing type thrust blocks transmit the thrust force from the fitting to the undisturbed soil. Gravity type thrust blocks rely on weight to counter the thrust forces.

**Disadvantages:**
1. Individually designed because bearing is soil dependent and varies.
2. Formwork & curing time for concrete.
3. Can delay backfilling operations.
4. Can be dislodged when digging near block unknowingly.
5. Takes up space in utility crowded streets.
6. Future extension of the piping system may require removal or modification.

## THRUST RESTRAINT DESIGN




**Bearing Thrust Block**

**Restrained Pipe Length Theory:**
Restrained joint systems function in a manner similar to thrust blocks, insofar as the reaction of the entire restrained unit of piping with the soil balances the thrust forces. The objective is to determine the length of pipe that must be restrained on each side of the focus of the thrust force. This will be a function of pipe size, pressure, cover (depth of soil from grade to top of pipe), and the characteristics of soil surrounding the pipe. The two types of resistant force components that are created in the soil along the restrained pipe unit are frictional and bearing resistance (based on movement).

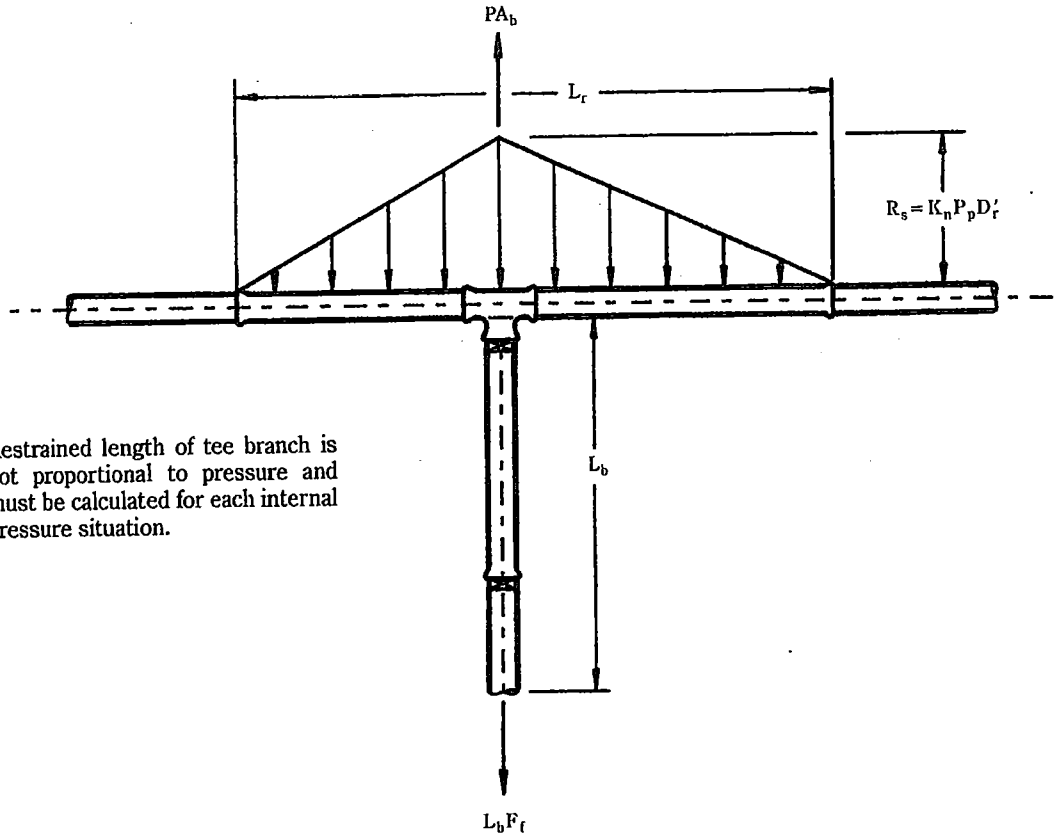
Polyethylene encasement reduces resistant frictional forces by 30%. Therefore, a longer length of polyethylene-encased pipe (when compared to bare pipe) must be restrained to generate an equivalent balancing force.

As with most engineering problems, the exact nature of the interaction of the restrained pipe unit and the soil is extremely complex. The assumptions used in the design procedure to calculate unit frictional and bearing forces are conservative. To this result, a safety factor is also applied generating a conservative design for the calculated restrained lengths.

Conservative lengths of restrained pipe for various bends, reducers, offsets, tees, dead ends (plugs & caps), valves for three ranges of covers are provided in Table 5.02 on page V-10 of the Standard Water Main Specifications (Rev. 7/1/07). A copy of the table can be found at the end of this section. The table is based on 150 PSI of internal pressure, a non-cohesive soil (sand) and a factor of safety of 2.0. Actual pressures in the distribution system average 50 PSI and rarely exceed 100 PSI. The restrained lengths provided for the range of pipe covers are based on the shallowest cover. This provides another safety factor when future work requires an existing street grade to be lowered decreasing cover on the pipe.

## THRUST RESTRAINT DESIGN

Raising road grades increases the cover on the pipe improving frictional forces and the holding power per foot of restrained pipe.




Note: Restrained length of tee branch is not proportional to pressure and must be calculated for each internal pressure situation.

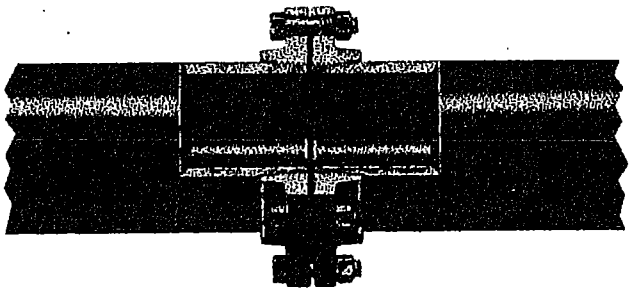
**Frictional forces along Tee Branch & Bearing Resistance Forces along Tee Run & Adjacent Pipe**

The Ductile Iron Pipe Research Association (DIPRA) publishes a thrust restraint design manual that provides a detailed discussion on theory and examples.

**Evolution of Restraint Systems:**

**Flanged Joints:**

Flanges were first integrally cast with cast iron pipe and later threaded on to the pipe ends. Lead gaskets were at first utilized and were later replaced by rubber to provide a watertight seal. The joint provides restraint and is rigid. They are seldom used for underground water mains except for valves and fittings in vault installations. They can be insulated. Because of the joints rigidity, the use of this joint is not recommended where heavy settlement or vibration is likely to occur.

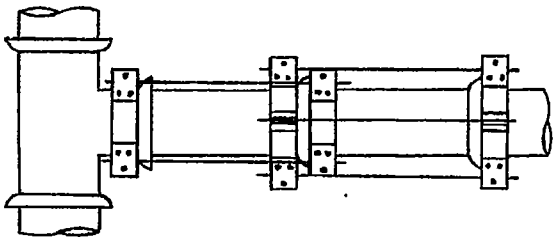


**Typical Flange Joint**

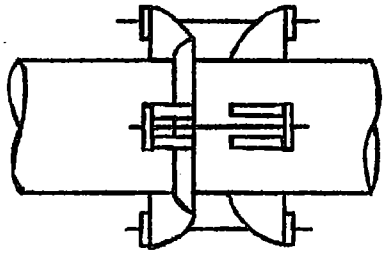
## THRUST RESTRAINT DESIGN

**Tie Rods:**

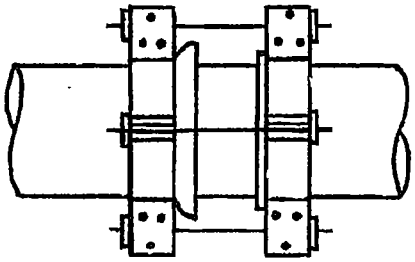
Tie Rods using bands, lugged pipe, retaining beads and combinations was one the first restrained joint systems developed for cast iron bell and spigot pipe. Tie rod systems were used to keep a variety of unrestrained joints (lead joint, mechanical joint w/ plain glands & push-on joints w/ regular gaskets) from separating due to unbalanced forces. Some measure of restraint is provided by a lead joint (shear through the rammed lead ball), but it is unreliable. Lubricants are also used to protect rubber gaskets from damage as they are being compressed to form a watertight seal in both mechanical and push-on joints. The compressed gasket offers some resistance to joint separation, but it is minimal.



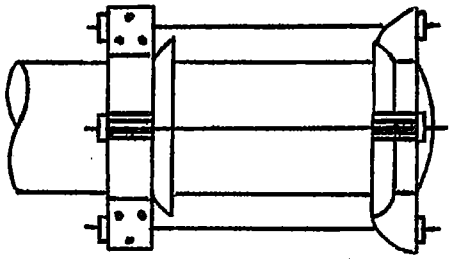
**Offsetting Tie Rods & Bands**



**HPFS - Lugged Cast Iron Pipe**



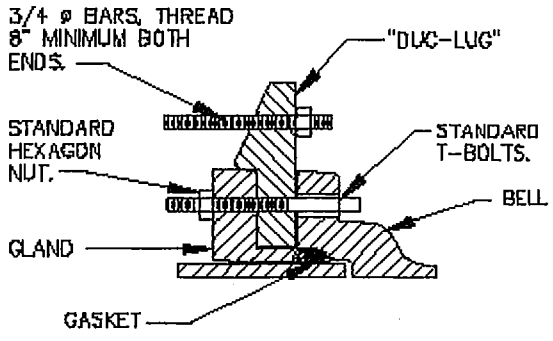
**Rods & Bands with Restraint Bead**



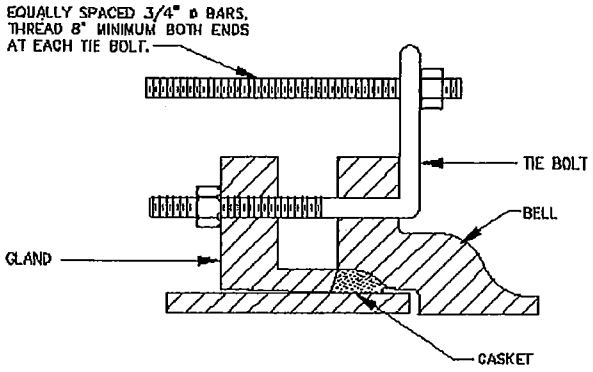
**Rods & Bands with Lug Fittings**

**Restraint for Mechanical Joints:**

A hydrant assembly is the most frequent example of unbalanced thrust forces encountered in distribution water main work. As mechanical joints replaced the use of lead joints for connecting fittings and appurtenances, duc-lugs and tie bolts / 90° eye bolt (modified T-bolt) were used to create a lug or a point to attached a tie rod across a mechanical joint utilizing a plain gland. These restraint methods were developed primarily for hydrant installations. Presently, the use of duc-lugs is limited to pipes with an 8-inch diameter or smaller.



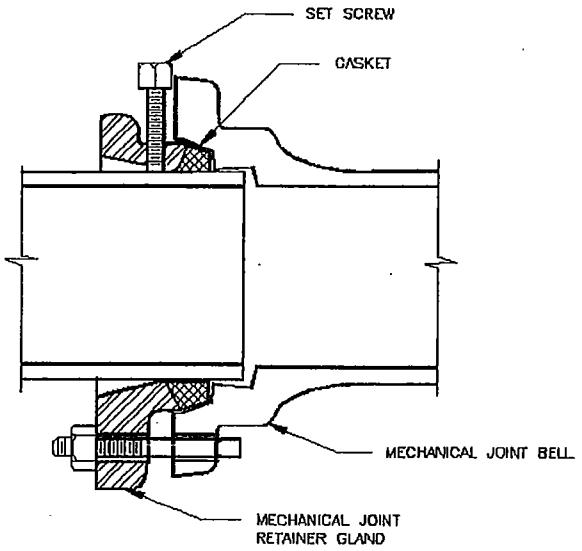

**Duc-Lug Cross-Section**




**Tie-Bolt Cross-Section**

## THRUST RESTRAINT DESIGN

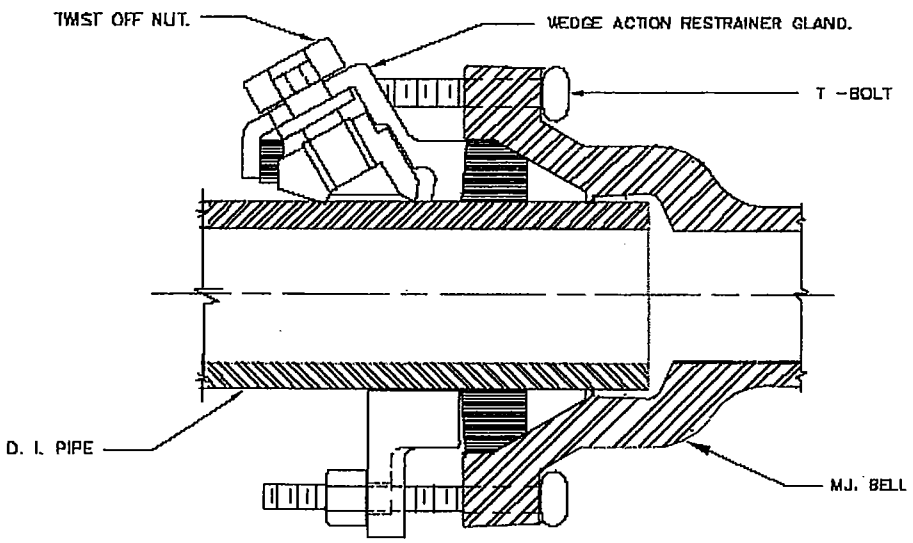
Once ductile iron became the accepted industry standard material for production of water pipe replacing cast iron, it allowed the development and use of retainer glands with set screws to prevent joint separation reducing the use of thrust blocks and tie rods. The increased strength and ductility of ductile iron allows the set screws of a retainer gland to bite into the surface of the pipe (penetrating about between 1/32 to 1/16 of an inch) while distributing the point load preventing damage to the pipe. This restraint system relies on a minute area of penetration that can be subject to corrosion attack. If the joint deflects and the gland was not installed properly (perpendicular to the pipe), the set screws could lose contact with the pipe negating its ability to prevent the joint from separating by allowing the gland to "walk off" the pipe's spigot end. Despite it's widespread use, retainer glands were usually supplemented under extreme unbalanced thrust force conditions and were never accepted by the Ductile Pipe Research Association (DIPRA) as a reliable thrust restraint system.




**Cross-Section View of Mechanical Joint with Retainer Gland**

Wedge type retainer glands are now exclusively used in the City to install mechanical joint fittings and appurtenances. Wedge type retainer glands offer significant improvements over retainer glands with set screws by incorporating a number of individually activated wedges providing a larger contoured contact area with the pipe, the ball & socket joint located between the wedge and activating screw allows the joint to deflect while the wedge maintains contact with the pipe, twist-off nuts to insure proper torque is achieved when activating the wedges and a wedging action that allows the wedge to bite deeper into the pipe at increased pressures to prevent separation. The wedge type retainer gland's ability to maintain restraint through a range of deflections has been successfully proven in earthquake prone areas. Even with all these improvements, the gland is actually simpler to install than its predecessor.

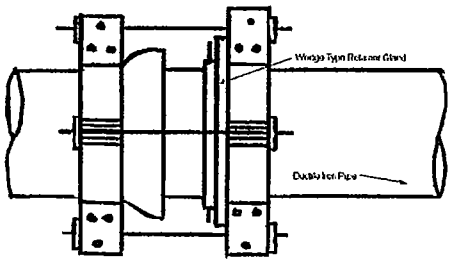
## THRUST RESTRAINT DESIGN




**Cross-Section View of Mechanical Joint w/ Wedge Type Retainer Gland**

**Push-on Pipe Restraint Systems:**

Restraint systems for push-on pipe when it was initially introduced were similar to what was provided for lead joint pipe. Restraint was basically limited to the use of tie rods and thrust blocks. Once ductile iron had replaced cast iron as the material of choice in making pipe, tie rod systems utilizing retainer glands with set screws were introduced (only the spigot end of the joint must be ductile iron). Eventually, the set screw retainer glands were replaced by wedge type retainer glands that provided increased reliability and more holding power. This system is effective in restraining lead and push-on joints and is still used today when tying into existing systems.



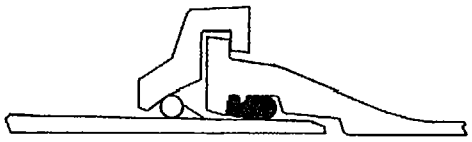
**Tie Rods & Bands with Wedge Type Retainer Gland**

The next development in the restraint of push-on joint involved the manufacture of pipe with an integral restraint system of a boltless nature. The restraint system developed involved a retaining bead or weldment located on the spigot end of the pipe and a shear ring inserted in an oversized bell. The system was designed for the use of full-length pieces of pipe. The field cutting of a piece of pipe would eliminate the retaining bead on the spigot end negating the joint's restraint capabilities. Several of the companies developed a method to restore a cut off retaining bead to be used in conjunction with their restraint system. Of the numerous products available, only US Pipe & Foundry Co.'s Gripper Ring used in conjunction with their TR Flex restraint system has been approved for use. The following push-on pipe integral restraint systems are approved for use in our system: "Flex Ring" and "Lok-Ring," as manufactured by American Cast Iron Pipe Co., Birmingham, Alabama, "Snap-Lok" as manufactured by Griffin Pipe Products Co., Florence, New Jersey, "TR-Flex" including "Gripper Rings" as manufactured by US Pipe and Foundry Co., Birmingham, Alabama and "Super-Lok" as manufactured by Clow Water

Systems Co., Coshocton, Ohio. The three joints shown below are the most commonly found and used in the City's distribution system. Catalog cut sheets and installation instructions can be found in the Reference Material section.

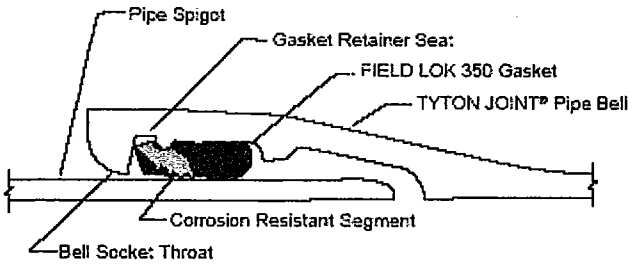
**Snap-Lok by Griffin Pipe Products Co.**

**TR-Flex by US Pipe and Foundry Co.**



**Super-Lok by Clow Water Systems Co.**

In the mid 1980's, US Pipe & Foundry Co. developed a restraining gasket marketed as the Field Lok 350 Gasket. This restraining gasket utilizes stainless steel locking segments vulcanized into a push-on gasket that fits into the socket of a Tyton push-on joint bell and grips the inserted spigot end preventing joint separation. This development eliminated the problem of restraining field cut pipe as this system does not require a restraining bead. The system is less expensive than the integral push-on restraint systems previously discussed and allowed municipalities to restrain entire pipelines. Initially approved for use with pipe of 12-inch diameter and smaller, the product's continued development would eventually extend its approval to 24-inch diameter pipe.




**Field Lok 350 Gasket System**

**Present Specification Restraint Requirements:**

Although present specifications require all newly laid ductile-iron pipe up to and including 20-inches in diameter to have restrained joints, the new main still has to be connected to the existing system. It is at these locations where an understanding of restraint issues and knowledge of old restraint methods can prevent accidental joint separation and the water related damage that can occur from such an event.

Presently, all 20-inch diameter push-on joint pipe and smaller is installed with Field Lok 350 Gasket for restraint. All the mechanical joint bell end fittings are restrained to connecting pipe using a wedge type retainer gland such as MegaLug.

# TABLE 5.02
## TYPICAL MINIMUM LENGTHS OF REQUIRED PIPE RESTRAINT
## LINEAR FEET FOR AVERAGE SOIL CONDITIONS (SAND) AND FOR TEST PRESSURE OF 150-PSI

| DIA. (in) | COVER (ft) | HORIZONTAL BENDS | | | | VERTICAL BENDS | | | | VALVES AND CAPS | REDUCERS | | TEES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 90° | 45° | 22-1/2° | 11-1/4° | 90° | 45° | 22-1/2° | 11-1/4° | | SIZE | LENGTH | |
| 8 | 2 | 24 | 14 | 8 | 4 | 32 | 21 | 13 | 8 | 48 | 8x6<br>8x4 | 21<br>35 | 0 |
| | 4 | 12 | 7 | 4 | 2 | 16 | 12 | 7 | 4 | 24 | 8x6<br>8x4 | 11<br>18 | 0 |
| | 6 | 8 | 5 | 3 | 2 | 11 | 8 | 5 | 3 | 16 | 8x6<br>8x4 | 7<br>12 | 0 |
| 12 | 2 | 35 | 20 | 11 | 6 | 47 | 32 | 20 | 11 | 74 | 12x8<br>12x6 | 41<br>55 | 20 |
| | 4 | 19 | 11 | 6 | 3 | 25 | 18 | 11 | 6 | 37 | 12x8<br>12x6 | 20<br>28 | 0 |
| | 6 | 13 | 8 | 4 | 2 | 17 | 12 | 8 | 4 | 25 | 12x8<br>12x6 | 14<br>18 | 0 |
| 20 | 2 | 55 | 31 | 17 | 9 | 77 | 50 | 30 | 17 | 125 | 20x16<br>20x12 | 45<br>80 | 57 |
| | 4 | 30 | 18 | 10 | 5 | 42 | 30 | 18 | 10 | 63 | 20x16<br>20x12 | 23<br>40 | 10 |
| | 6 | 21 | 12 | 7 | 4 | 28 | 20 | 12 | 7 | 42 | 20x16<br>20x12 | 15<br>27 | 0 |
| 24 | 2 | 65 | 36 | 20 | 10 | 91 | 59 | 35 | 20 | 151 | 24x20<br>24x16 | 46<br>84 | 76 |
| | 4 | 36 | 21 | 12 | 6 | 49 | 36 | 21 | 12 | 75 | 24x20<br>24x16 | 23<br>42 | 19 |
| | 6 | 25 | 15 | 8 | 4 | 34 | 23 | 15 | 9 | 50 | 24x20<br>24x16 | 15<br>28 | 0 |
| 30 | 2 | 78 | 42 | 23 | 12 | 111 | 70 | 42 | 23 | 190 | 30x24<br>30x20 | 68<br>106 | 99 |
| | 4 | 44 | 25 | 14 | 8 | 61 | 45 | 25 | 14 | 95 | 30x24<br>30x20 | 34<br>53 | 32 |
| | 6 | 31 | 18 | 10 | 5 | 42 | 29 | 18 | 11 | 63 | 30x24<br>30x20 | 23<br>35 | 9 |
| 36 | 2 | 89 | 48 | 26 | 14 | 130 | 81 | 47 | 26 | 228 | 36x30<br>36x24<br>36x20 | 70<br>127<br>158 | 124 |
| | 4 | 52 | 29 | 16 | 9 | 72 | 54 | 29 | 17 | 114 | 36x30<br>36x24<br>36x20 | 35<br>64<br>80 | 45 |
| | 6 | 36 | 21 | 12 | 6 | 50 | 34 | 21 | 12 | 76 | 36x30<br>36x24<br>36x20 | 23<br>42<br>53 | 18 |
| 48 | 2 | 110 | 58 | 31 | 16 | 164 | 99 | 57 | 31 | 306 | 48x36<br>48x30 | 134<br>187 | 165 |
| | 4 | 66 | 36 | 20 | 11 | 94 | 72 | 37 | 21 | 153 | 48x36<br>48x30 | 67<br>93 | 69 |
| | 6 | 47 | 27 | 15 | 8 | 66 | 44 | 27 | 15 | 102 | 48x36<br>48x30 | 45<br>62 | 34 |

## REFERENCE MATERIAL

### Referenced AWWA/ANSI Standards

**Ductile-Iron Pipe and Fittings**

**C104/A21.4** - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
**C105/A21.5** - Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
**C110/A21.10** - Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. thru 48 In. for Water and Other Liquids
**C111/A21.11** - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
**C115/A21.15** - Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
**C116/A21.16** - Protective Fusion Bonded Epoxy Coatings for the interior and Exterior of Ductile-Iron & Gray-Iron Fittings for Water Supply Service
**C151/A21.51** - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

**Valves and Hydrants**

**C500** - Standard for Metal-Seated Gate Valves for Water Supply Service (Includes addendum C500a-95.)
**C502** - Standard for Dry-Barrel Fire Hydrants
**C509** - Standard for Resilient-Seated Gate Valves for Water Supply
**C550** - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

**Pipe Installation**

**C600** - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
**C602** - Standard for Cement-Mortar Lining of Water Pipelines-4 In. and Larger In Place

**Service Lines**

**C223** - Fabricated Steel and Stainless Steel Tapping Sleeves
**C800** - Standard for Underground Service Line Valves and Fittings

### NYC Department of Environmental Protection
### Water Main Material Specifications**

**Section 2.01** - Specifications for Ductile Iron Pipe & Accessories
**Section 2.02** - Specifications for Ductile Iron Fittings & Accessories
**Section 2.03** - Standard Specification for Butterfly Valves 24-inch to 72-inch w/ Manual Actuators
**Section 2.04** - Standard Specification for Pressure Reducing Valves 8 thru 30-inch Nominal Pipe Size
**Section 2.05** - Standard Specification for Resilient-Seated 3 thru 20-inch Gate Valves w/ Various End Connections & 3 thru 12-inch Tapping Valves
**Section 2.06** - Standard Specification for Double Disc 3 thru 20-inch Gate Valves w/ Various End Connections for Water Supply System
**Section 2.07** - Standard Specification for Iron Castings
**Section 2.08** - Standard Specification for Dry Barrel Fire Hydrants & Extension Kits
**Section 2.09** - Standard Specifications for Stainless Steel Tapping Sleeves w/ Branch Connections for Flanged Tapping Valve or Mechanical Joint Tapping Valve
**Section 2.10** - NYC Specification for Corporation Stops and Quarter Bends

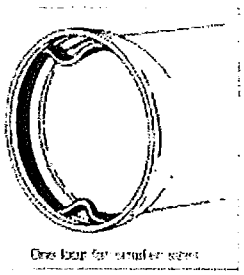
** The listed specifications are maintained by NYC-DEP. The specifications are posted on NYC-DDC for your use and convenience. Check with DEP-BWSO / Office of the Chief of Water Main Failure Analysis, at 59-17 Junction Blvd., 3rd Floor-Low Rise, Flushing, NY 11373, for the latest revisions.

## REFERENCE MATERIAL

# Assembly of a US Pipe & Foundry Co. Tyton Joint (page TP-2)

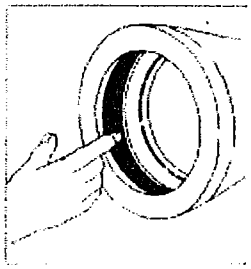
**CAUTION:** The inside of the socket, the gasket, and the plain end to be inserted must be kept clean throughout the assembly. Joints are only as water-tight as they are clean. If the joint is somewhat difficult to assemble, inspect for proper gasket positioning, adequate lubrication, and foreign matter in the joint.

### Figure 1. Insertion of Gasket



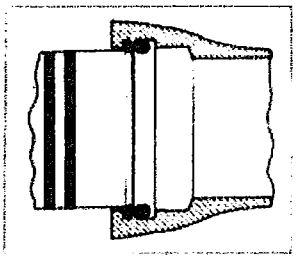
All foreign matter in the socket must be removed, i.e., mud, sand, cinders, gravel, pebbles, trash, frozen material, etc. The gasket seat should be thoroughly inspected to be certain it is clean. Foreign matter in the gasket seat may cause a leak. The gasket must be wiped clean with a clean cloth, flexed, and then placed into the socket with the rounded bulb end entering first. Looping the gasket in the initial insertion will facilitate seating the gasket heel evenly around the retainer seat. Smaller sizes require only one loop. For larger sizes, additional loops may be required: 42" through 54", four to six loops; 60" and 64", six or more loops. When installing TYTON JOINT Pipe in sub-freezing weather, the gaskets, prior to their use, must be kept at a temperature of at least 40°F by suitable means, such as storing in a heated area or keeping them immersed in a tank of warm water. If the gaskets are kept in warm water, they should be dried before placing in the pipe socket.

### Figure 2. Application of Lubricant



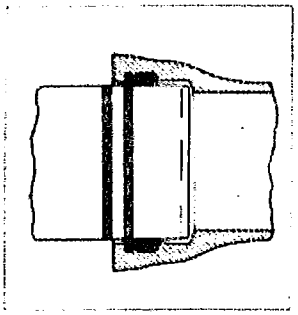
A thin film of TYTON JOINT® Lubricant should be applied to the inside surface of the gasket, which will come in contact with the plain end of the pipe. Spray-on lubricants should not be used as it may not provide sufficient lubricity. The plain end of the pipe must be cleaned of all foreign matter on the outside from the end to the stripes. Frozen materials may cling to the pipe in cold weather and must be removed. A thin film of lubricant is applied to the outside of the plain end for about 3" back from the end. Do not allow the plain end to touch the ground or trench side after lubricating since foreign matter may adhere to the plain end and cause a leak.

### Figure 3. Initial Entry of Plain End in Socket



The plain end of the pipe should be aligned and carefully entered into the socket until it just makes contact with the gasket. This is the starting position for the final assembly of the joint. Note the two painted stripes on the plain end.

### Figure 4. Completely Assembled Joint



Joint assembly should be completed by forcing the plain end of the entering pipe past the gasket (which is thereby compressed) until the plain end makes contact with the bottom of the socket.* Note that the first painted stripe will have disappeared into the socket and the front edge of the second stripe will be approximately flush with the bell face. If assembly is not accomplished with the application of reasonable force by the methods indicated, the plain end of the pipe should be removed to check for the proper positioning of the gasket, adequate lubrication, and removal of foreign matter in the joint.

*NOTE: When using FIELD LOK 350® Gaskets or pipe with special linings, assemble the joint until the inside edge of the first painted stripe (or the assembly mark) is flush with the bell face.

# Assembly of a US Pipe & Foundry Co. Tyton Joint (page TP-3)

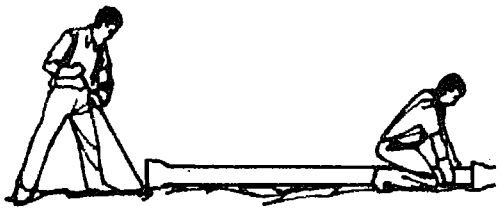
Procedures outlined in figures 1-3 on page TP 2, showing the assembly of TYTON JOINT® Pipe, should be followed before proceeding with the methods shown below.

## Backhoe Method of Assembly

A backhoe may be used to assemble pipe of intermediate and larger sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to carefully push the pipe until fully seated. A timber header should be used between the pipe and the backhoe bucket to avoid damage to the pipe. *Caution:* Avoid "slamming" the pipe home to prevent damage to lining material inside the bell at the back of the socket

## Crowbar Method of Assembly

Smaller sizes of pipe may be assembled using a crowbar as a lever and pushing against the face of the bell.



## Come-along Method of Assembly

Installers may prefer to use come-alongs to assemble pipe of all sizes. Two (2) 3/4 ton chain hoists, 24 feet of chain and two (2) bell choker slings for 4"-24" sizes or two (2) 1 1/2 ton (minimum) chain hoists for 30"-64" sizes.

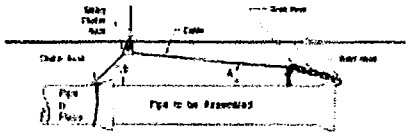
## Alternate Method of Assembly

The most common field method of assembling larger diameter TYTON JOINT Pipe is to use a backhoe to push against the face of the bell end of the pipe to be assembled. Occasionally, there are installations where a backhoe cannot be located in line with the pipe and it is, therefore, difficult to develop enough axial force to assemble the pipe. In such cases, it may be possible to use the method described below to assemble the pipe from the side of the trench.

With this method, the weight of the pipe is used to provide the axial force required for assembly. In general, a choker chain or cable is hooked around the bell of the previously laid pipe. The spigot end of the pipe to be assembled is first inserted as far as possible into the bell end of the previously laid pipe. The end of the choker is then hooked into the bell end of the pipe to be laid.

One such rigging is made from a long cable with a choker on one end and a chain grab hook on the other end with a sliding choker hook between the two other hooks. A second section of the rigging is a shorter chain with a wide throat hoisting hook on one end. The cable is first "choked around the bell of the previously laid pipe using the fixed choker hook. The chain is hooked into the bell end of the pipe to be laid. The cable is hooked to the chain with the grab hook. The connected length of the rigging can thus be adjusted with the connection between the cable grab hook and the chain. The pipe assembly is made by lifting up on the sliding choker hook.

Note: This method <u>should not</u> be employed when installing FIELD LOK 350® Gaskets since alignment of the joint cannot be assured. For the proper installation practice, refer to U.S. Pipe Brochure (BRO-080), *FIELD LOK 350® Gasket Joint Restraint for 4"-24" Ductile Iron Pipe For Water, Wastewater, Fire Protection and Industrial Applications.*



**A few rules of thumb:**

1. Angle 'A' should be no greater than 15 degrees.
2. Angle 'B' should be from 45 to 60 degrees.
3. The sliding choker hook should be located from 2 to 8 feet from the bell of the previously laid pipe.
4. Trial assembly may be made to get a "feel" for the correct amount of slack to be left in the rigging and the proper location of the sliding choker hook.

**A few precautions:**

1. The smaller the angle 'A', the larger will be the assembly force and the tension in the rigging. The assembly force and the tension will generally range from 2 to 10 times the weight of the pipe being assembled. These forces are at a maximum when the assembly is bottomed out and lift is still being applied to the rigging. To minimize the loads on the rigging, it is recommended that the assembly be made slowly and the assembly stopped as soon as the joint is bottomed out.
2. The rigging should be properly designed to accommodate the diameter, length, and weight of the pipe on the job and the loads previously described.

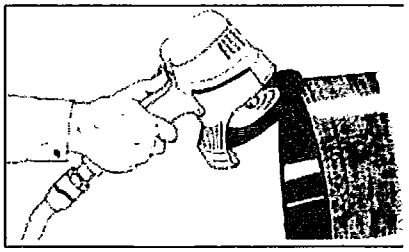
## REFERENCE MATERIAL

# Assembly of a US Pipe & Foundry Co. Tyton Joint (page TP-4)

## Field Cut Pipe

Figure 11.

When pipe are cut in the field, the cut end may be readily conditioned so that it can be used to make up the next joint. The outside of the cut end should be beveled with a portable grinder about 1/4 - inch at an angle of about 30 degrees (Figure 11). This operation removes any sharp, rough edges which otherwise might damage the gasket.



When Ductile Iron pipe 14" and larger is to be cut in the field, the material should be ordered as "GAUGED FULL LENGTH." Pipe that is "gauged full length" is specially marked to avoid confusion. The ANSI/AWWA 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 1. In the field a mechanical joint gland can be used as a gauging device. When necessary, pipe may be rounded in accordance with U.S. Pipe's Brochure, *Recommended Methods For Rounding The Cut Ends Of Out-Of-Round 14-Inch And Larger Diameter Ductile Iron Pipe.*

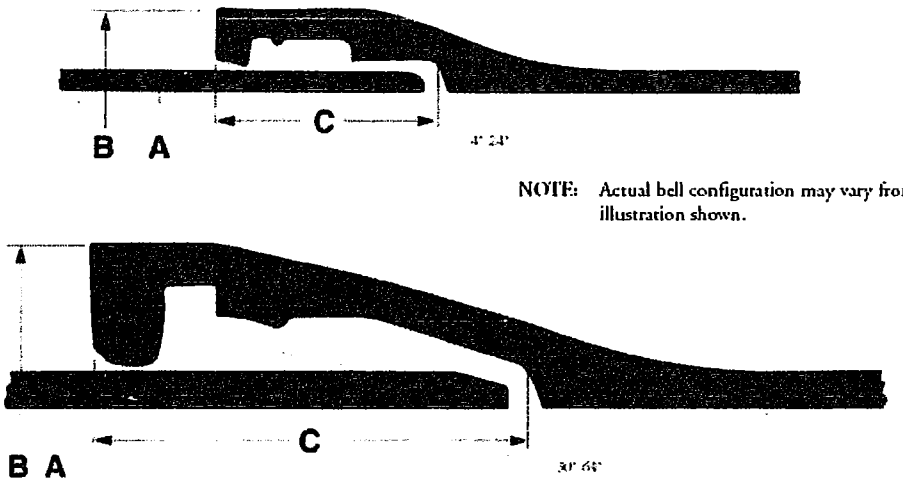
Table 1. Suitable Pipe Diameters for Field Cuts and Restrained Joint Field Fabrication.

| Nominal Pipe Size In. | Min. Pipe Diameter In. | Max. Pipe Diameter In. | Min. Pipe Circumference In. | Max. Pipe Circumference In. |
|---|---|---|---|---|
| 4 | 4.74 | 4.86 | 14 29/32 | 15 9/32 |
| 6 | 6.84 | 6.96 | 21 1/2 | 21 7/8 |
| 8 | 8.99 | 9.11 | 28 1/4 | 28 5/8 |
| 10 | 11.04 | 11.16 | 34 11/16 | 35 1/16 |
| 12 | 13.14 | 13.26 | 41 9/32 | 41 21/32 |
| 14 | 15.22 | 15.35 | 47 13/16 | 48 7/32 |
| 16 | 17.32 | 17.45 | 54 13/32 | 54 13/16 |
| 18 | 19.42 | 19.55 | 61 | 61 13/32 |
| 20 | 21.52 | 21.65 | 67 19/32 | 68 |
| 24 | 25.72 | 25.85 | 80 13/16 | 81 7/32 |
| 30 | 31.94 | 32.08 | 100 11/32 | 100 25/32 |
| 36 | 38.24 | 38.38 | 120 1/8 | 120 9/16 |
| 42 | 44.44 | 44.58 | 139 5/8 | 140 1/16 |
| 48 | 50.74 | 50.88 | 159 13/32 | 159 27/32 |
| 54 | 57.46 | 57.60 | 180 17/32 | 180 31/32 |
| 60 | 61.51 | 61.65 | 193 1/4 | 193 11/16 |
| 64 | 65.57 | 65.71 | 206 | 206 7/16 |

Above table based on ANSI/AWWA C151/A21.51 guidelines for push-on joints.

## REFERENCE MATERIAL

### Bell Dimensions of a US Pipe & Foundry Co. Tyton Joint



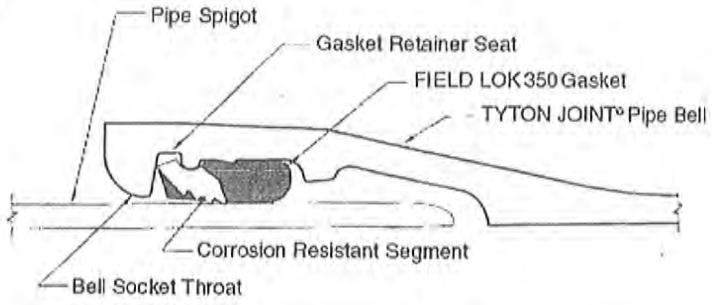

| Size | A Pipe O.D. | Dimensions of Bells* | |
|---|---|---|---|
| | | B Bell O.D. | C Socket Depth |
| 4 | 4.80 | 6.52 | 3.15 |
| 6 | 6.90 | 8.66 | 3.38 |
| 8 | 9.05 | 10.82 | 3.69 |
| 10 | 11.10 | 12.91 | 3.75 |
| 12 | 13.20 | 15.05 | 3.75 |
| 14 | 15.30 | 17.62 | 5.00 |
| 16 | 17.40 | 19.74 | 5.00 |
| 18 | 19.50 | 21.86 | 5.00 |
| 20 | 21.60 | 23.98 | 5.50 |
| 24 | 25.80 | 28.16 | 5.95 |
| 30 | 32.00 | 35.40 | 6.55 |
| 36 | 38.30 | 41.84 | 7.00 |
| 42 | 44.50 | 49.36 | 7.90 |
| 48 | 50.80 | 55.94 | 8.60 |
| 54 | 57.56 | 63.38 | 9.40 |
| 60 | 61.61 | 67.38 | 10.10 |
| 64 | 65.67 | 71.56 | 10.65 |

*Subject to manufacturing tolerances. Dimensions in inches.

## Assembly of a Tyton Joint using a US Pipe Co. Field Lok 350 Gasket (page. FL-2)

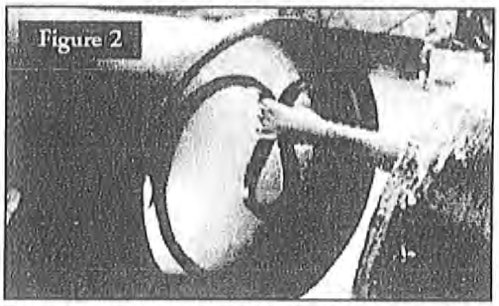
It is important that the inside of the socket, the gasket and the pipe spigot end be kept clean throughout the assembly operation to ensure leak-free joints.

**Figure 1**



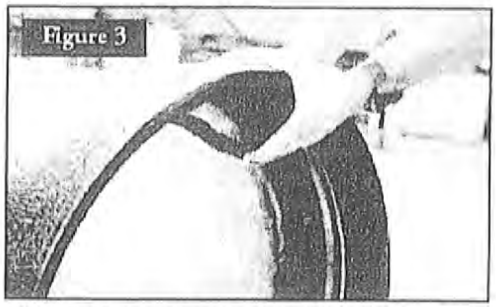

*Socket Configuration. Actual socket configuration may vary from illustration.*

**Figure 2**



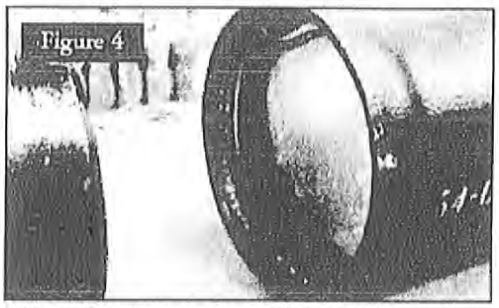
*Loop the gasket for insertion and place in the socket with the heel of the gasket in the retainer seat of the socket.*

**Figure 3**



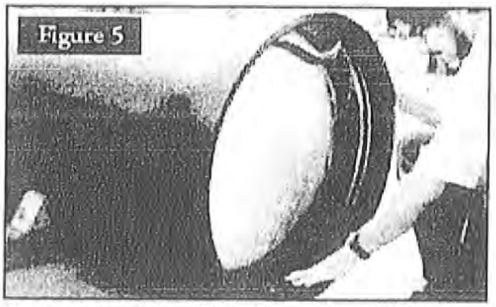
*After inserting the gasket, seat it by pushing in the existing loop. However, in some cases it may be required to utilize two loops to properly seat the gasket.*

**Figure 4**



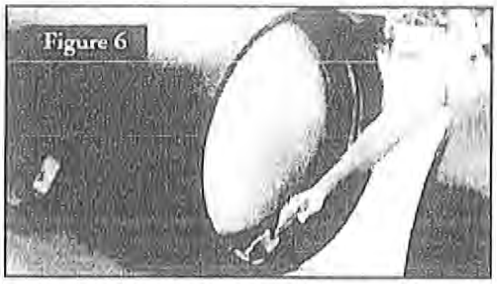
*When two loops are required they should be as equal as possible and located at approximately the twelve and six o'clock positions.*

**Figure 5**



*The two loops are then pushed into place completing the insertion.*

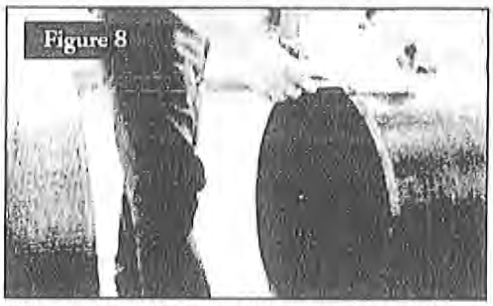
## Assembly of a Tyton Joint using a US Pipe Co. Field Lok 350 Gasket (page. FL-3)



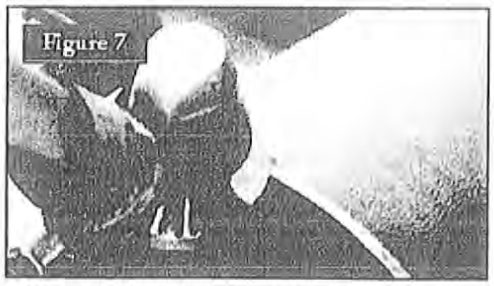

*Apply a thin film of TYTON JOINT® Lubricant to the exposed surface of the gasket that will come into contact with the entering pipe spigot. Only TYTON JOINT Lubricant should be used.* CAUTION: The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.

**Suitable Pipe Diameters for Field Cuts and Restrained Joint Field Fabrication.**
**Table 1**

| Nom. Pipe Size In. | Min. Pipe Diameter In. | Max. Pipe Diameter In. | Min. Pipe Circum. In. | Max. Pipe Circum. In. |
|---|---|---|---|---|
| 4 | 4.74 | 4.86 | 14 7/8 | 15 9/32 |
| 6 | 6.84 | 6.96 | 21 15/32 | 21 7/8 |
| 8 | 8.99 | 9.11 | 28 1/4 | 28 5/8 |
| 10 | 11.04 | 11.16 | 34 11/16 | 35 1/16 |
| 12 | 13.14 | 13.26 | 41 9/32 | 41 21/32 |
| 14 | 15.22 | 15.35 | 47 13/16 | 48 7/32 |
| 16 | 17.32 | 17.45 | 54 13/32 | 54 13/16 |
| 18 | 19.42 | 19.55 | 61 | 61 13/32 |
| 20 | 21.52 | 21.65 | 67 19/32 | 68 1/32 |
| 24 | 25.72 | 25.85 | 80 25/32 | 81 7/32 |




*When cut pipe, which have no assembly strips, are to be assembled, the spigot insertion depth should be marked on the spigot to ensure that the joint is fully assembled. When deflection is required at the joint, the spigot should not be completely homed. Normal socket depth dimensions are shown in Table 2.*




*When pipe is cut in the field, the cut end may be readily conditioned so that it can be used to make up the next joint. The outside of the cut end (or any pipe without a bevel) should be beveled about 1/4-inch at an angle of about 30 degrees and the leading edge should be rounded. This can be done quite easily with a portable grinder. The operation removes any sharp, rough edges which otherwise might damage the gasket.*

Note: THICK COATINGS OR TAPE WRAP - The FIELD LOK 350® Gasket should not be used on pipe and fittings which have thick coatings or tape wrap on the outer diameter of the pipe. In general, if the peen pattern is not visible on the pipe surface, the coating may be too thick for proper penetration of the teeth of the FIELD LOK 350 Gasket. The thick coating should be removed from the end of the pipe or fitting before assembly. The coating must be no more than 6 mils thick on the plain end of the pipe or fitting.

When it is known that field cuts will be made, several lengths can be ordered as "GAUGED FULL LENGTH". U.S. Pipe "GAUGED FULL LENGTH" pipe are marked with a green stripe on the bell face. The ANSI/AWWA standard for Ductile Iron pipe requires factory gauging of the spigot end. Accordingly, pipe selected for field cutting should be measured at the location of the intended cut and must be within the tolerances shown in Table 1.

**Assembly Mark and Deflection: Table 2**

| Pipe Size | Location of Assembly Mark ** | Maximum* Joint Deflection In Degrees | Deflection In Inches 18 ft. Lengths | Approximate Radius In Feet of Curve Produced by Succession of Joints - 18 ft. Lengths |
|---|---|---|---|---|
| 4 | 2 3/4 | 5 | 19 | 205 |
| 6 | 2 15/16 | 5 | 19 | 205 |
| 8 | 3 1/4 | 5 | 19 | 205 |
| 10 | 3 5/16 | 5 | 19 | 205 |
| 12 | 3 5/16 | 5 | 19 | 205 |
| 14 | 4 9/16 | 4 | 15 | 257 |
| 16 | 4 9/16 | 4 | 15 | 257 |
| 18 | 4 9/16 | 4 | 15 | 257 |
| 20 | 5 1/16 | 2.5 | 9.5 | 412 |
| 24 | 5 1/2 | 2.5 | 9.5 | 412 |

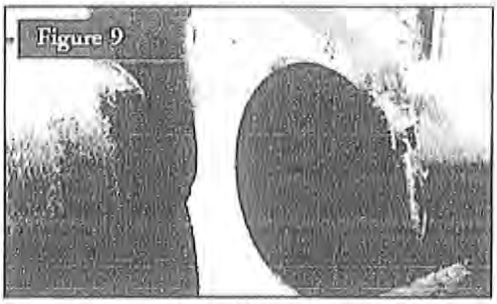
* The pipe to be installed must be kept in straight alignment with the previously installed pipe or fitting during assembly. Joint deflection may be made upon completion of the assembly.

** For full deflection application, insert spigot no deeper than the first assembly stripe.

## REFERENCE MATERIAL

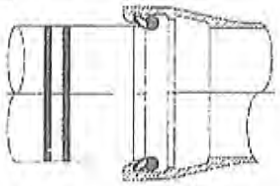
# Assembly of a Tyton Joint using a US Pipe Co. Field Lok 350 Gasket (page. FL-4)

**Figure 9**



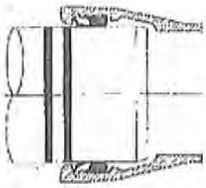
*6 " to 7 " of the spigot should be cleaned and a thin coat of TYTON JOINT® Lubricant applied.*

**Figure 10**



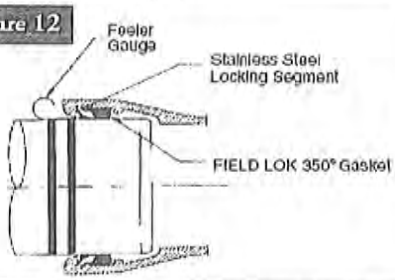
*Insert the end of the pipe into the socket until it contacts the gasket. Keep the pipe in alignment during assembly*

**Figure 11**



*Assemble the joint until the stripe closest to the plain end has the edge farthest from the plain end, flush with the bell face. It is not homed as deeply as with TYTON® Gaskets. Carefully reverse the assembly force to ensure that the joint is properly restrained. NOTE: If the pipe is inserted too far into the socket, it will not be possible to fully deflect the joint. See Table 2, Page FL-3.*

**Figure 12**




*A feeler gauge can be inserted into the socket to verify the proper installation of the joint (or to determine if the joint has been assembled with a FIELD LOK 350 Gasket). After assembly, the joint may be deflected up to the number of degrees shown in table on page FL-3.*

## Special Notes Regarding the use of FIELD LOK 350® Gaskets

1. Do not use FIELD LOK 350 Gaskets® to provide electrical joint conductivity for thawing purposes. Such use may damage the gaskets.

2. Use FIELD LOK 350 Gaskets only in push-on joints which have the trademark TYTON® or TYTON JOINT®. Use in other joints may result in unsatisfactory performance.

3. FIELD LOK 350 Gaskets are not intended for above ground installation applications. For further assistance please contact your U.S. Pipe Sales Representative.

4. Do not use FIELD LOK 350 Gaskets with corroded pipe, gray cast iron pipe, or the plain ends of PVC pipe. U.S. Pipe has not conducted tests with these products and, therefore, cannot recommend or warrant the use of the FIELD LOK 350 Gasket with them.

5. Always make sure that the gasket is properly placed in the socket with the bulb or thickest portion of the gasket being deepest in the socket.

6. Use in casings: Pipelines restrained with FIELD LOK 350 Gaskets may be installed in straight casings by pulling, not pushing, the line through the casing. FIELD LOK 350 Gaskets should not be installed in the carrier pipe within a casing. Assembly of the joints must be controlled, such as with centering bands or cable hoists, to prevent fully "homing" the spigot to the base of the socket to allow for joint deflection. When it is necessary that the pipeline be pushed through a casing, TR FLEX® Pipe is recommended.

7. FIELD LOK 350 Gaskets should not be used in a pipeline installed by Horizontal Directional Drilling methods.

8. Do not reuse FIELD LOK 350 Gaskets.

9. Do not use FIELD LOK 350 Gaskets with TYTON Plugs since it is not possible to remove the plug after the joint is assembled.

10. Although disassembly of joints restrained with FIELD LOK 350 Gaskets is possible, the use of TR FLEX Pipe and Fittings is recommended if disassembly of the joints is planned or anticipated.

11. If the maximum joint deflection is necessary, do not push the pipe to the bottom of the socket.

12. For cold weather assemblies, keep the temperature of the FIELD LOK 350 Gaskets above 40° F.

13. Approximately twice as much assembly force may be required to assemble a FIELD LOK 350 Gasket joint as is required for a conventional TYTON Gasket push-on joint.

14. If FIELD LOK 350 Gaskets are used in vertical installations, provisions must be made to keep the joint extended and not allow the teeth to become disengaged from the pipe. Failure to keep vertical joints extended can result in joint separation.

## Assembly of a Tyton Joint using a US Pipe Co. Field Lok 350 Gasket (page. FL-5)

### The Backhoe Method of Assembly

A backhoe may be used to assemble pipe of all sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to push the pipe until fully seated. Keep pipe in alignment to avoid damage to or dislodging of the gasket. A timber header should be used between the pipe and backhoe bucket to avoid damage to the pipe. Avoid "slamming" the pipe home to prevent damage to the lining material inside the bell at the back of the socket.

### The Come-along Method of Assembly

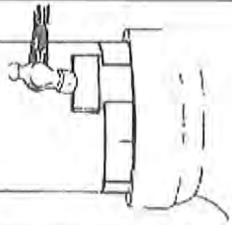
Some installers may prefer to use come-alongs to assemble TYTON JOINT® Pipe with FIELD LOK 350® Gaskets.

### DISASSEMBLY for All Sizes

Figure 13

While wearing gloves to protect hands, insert an extractor shim into the carrying anvil (slotted and curved steel block) and apply lubricant over the leading edge of the shim. Commencing at the bottom of the joint, drive the shim under the gasket by striking the anvil. Pry the anvil off the shim and insert a new shim.

Figure 14



Continue driving shims under the gasket around the whole circumference of the joint. Keep the gap between the shims to a minimum. Insert the final shim so that it is overlapped by the shims on either side.

Use a backhoe to force joint separation. Reuse of the gasket is not recommended.

For disassembly for Sizes 14" - 24", follow the same procedure shown in Figures 13 and 14 and use a backhoe to force joint separation. Reuse of the gasket is not recommended.

Figure 15

*While wearing gloves to protect hands, insert an extractor shim into the carrying anvil (slotted and curved steel block) and apply lubricant over the leading edge of the shim. Commencing at the bottom of the joint, drive the shim under the gasket by striking the anvil. Pry the anvil off the shim and insert a new shim.*

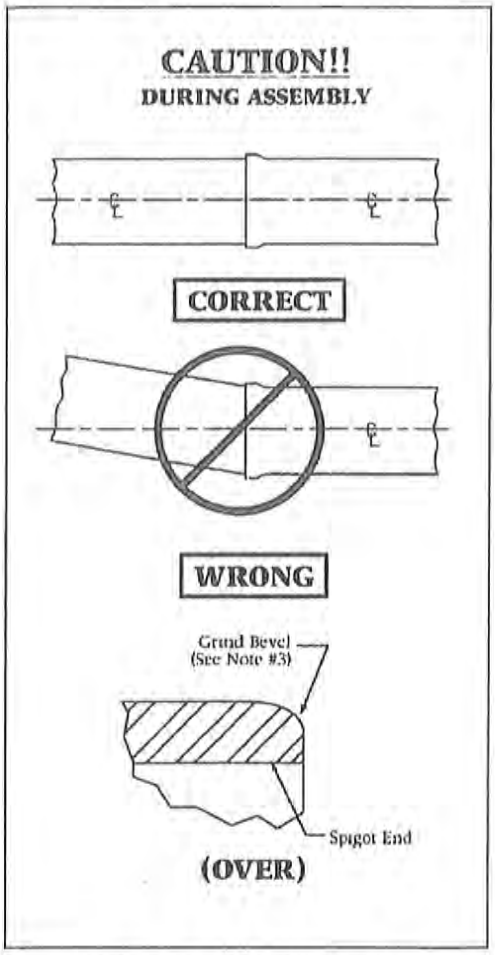
Figure 16

*Continue driving shims under the gasket around the whole circumference of the joint. Keep the gap between the shims to a minimum. Insert the final shim so that it is overlapped by the shims on either side. After all shims have been properly installed, the joint can be separated by pulling, using a cable and a backhoe or other equipment. Reuse of the gasket is not recommended.*

## REFERENCE MATERIAL

## Assembly of a US Pipe Co. Field Lok 350 Gasket Jt. - Shipping Tag Instructions (pg. FL-6)

FIELD LOK 350 Gaskets will have a tag attached to them with gasket assembly instructions and a "CAUTION!!" notice. The information printed on the tag is as follows:




### FIELD LOK 350® Gasket Assembly Instructions

1. For cold weather assemblies, keep the temperature of the FIELD LOK 350® Gaskets above 40°F.

2. For cut pipe, select pipe with diameters or circumferences at the cut location which conform to the table given below.

3. For cut pipe, assure that a tapered bevel similar to the one furnished with the pipe is ground onto the end of the pipe. (See illustration on reverse side.)

4. Measure the socket depth and make a mark on the pipe spigot that distance from the end of the pipe. This mark will indicate when the joint is fully "home".

5. Keep the joint in straight alignment during assembly, especially when handling fittings. Do not fully "home" the joint if joint deflection is required. Set the joint deflection after the assembly is made.

6. Approximately twice as much assembly force may be required to assemble a FIELD LOK 350® Gasket restrained joint than is required for a conventional TYTON® Gasket push-on joint.

7. Check for correct positioning of the FIELD LOK 350® Gasket by inserting a feeler gauge in the space between the bell and the pipe OD in several locations around the socket to assure that the gasket is in proper position in the socket.

| Nom. Pipe Size | Circumference | | Diameter | |
|---|---|---|---|---|
| | Maximum | Minimum | Maximum | Minimum |
| 4 | 15 9/32 | 14 7/8 | 4.86 | 4.74 |
| 6 | 21 7/8 | 21 15/32 | 6.96 | 6.84 |
| 8 | 28 5/8 | 28 1/4 | 9.11 | 8.99 |
| 10 | 35 1/16 | 34 11/16 | 11.16 | 11.04 |
| 12 | 41 21/32 | 41 9/32 | 13.26 | 13.14 |
| 14 | 48 7/32 | 47 13/16 | 15.35 | 15.22 |
| 16 | 54 13/16 | 54 13/32 | 17.45 | 17.32 |
| 18 | 61 13/32 | 61 | 19.55 | 19.42 |
| 20 | 68 1/32 | 67 19/32 | 21.65 | 21.52 |
| 24 | 81 7/32 | 80 25/32 | 25.85 | 25.72 |

## Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 2-8)

AMERICAN DUCTILE IRON PIPE

### AMERICAN Fastite® Joint for Ductile Iron Pipe
**ANSI/AWWA C111/A21.11**
**Standard Dimensions**

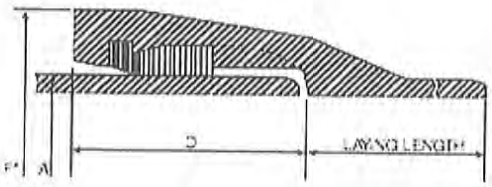



Table No. 2-2

| 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.
See Section 3 for additional information on ductile iron pipe.
See Sections 4 and 7 for information on Fastite fittings.

# Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 2-10)

AMERICAN DUCTILE IRON PIPE

## AMERICAN Fastite® Joint Pipe Assembly Instructions

The AMERICAN Fastite Joint is a push-on type joint meeting all the rigorous requirements of AWWA C111. The ANSI/AWWA C600 Standard covers in detail the installation of ductile iron water mains, including assembly instructions for push-on joint pipe.

Field-cutting of AMERICAN Ductile Iron Pipe can be easily performed, thus eliminating the necessity for factory-made special lengths of Fastite pipe. The plain end of Fastite pipe cut in the field requires little or no preparation for assembly into the socket of a mechanical joint fitting. Where a cut pipe is to be assembled into a Fastite socket, the required beveling or rounding of the plain end can be easily accomplished by the use of a portable grinding wheel or other suitable apparatus. Methods of cutting ductile iron pipe are described in Section 3.

The AMERICAN Fastite Joint requires only one joint component, the rubber gasket*, which when properly installed, fits snugly in the gasket recess in the bell socket. A special lubricant supplied with the pipe is applied to the plain end and the inside surface of the gasket before assembly. The pipe end is tapered or rounded to provide self-centering of the plain end in the gasket and ease of assembly. A circumferential stripe on the plain end provides a visual indication for checking the proper insertion of the joint. The stripe, shown in the photographs illustrating assembly methods, substantially disappears into the bell when the plain end is fully inserted into the socket with the two lengths of pipe in alignment. Joints can then be safely deflected up to the extent shown in Table No. 2-3. In deflected joints, the stripe will typically be visible to some extent after assembly.

Easier assembly is effected if the pipe is suspended an inch or so off the bottom of the trench during the jointing operation.

The following instructions should be followed in order to properly assemble the joints and to fully realize the maximum speed and ease of assembly of the Fastite Joint:

1. Clean socket and plain end thoroughly, removing mud, gravel, or any other matter that might cause the front of the gasket to protrude into the path of the entering spigot.

2. Insert gasket fully into the gasket recess of the socket, large end of the gasket entering first. Gasket may be installed with one or two V-shaped folds as shown (Photo 1). After the gasket is in place at the bottom, the top of the gasket is positioned fully into the gasket recess. Gaskets and lubricant to be installed in very cold weather should be warmed first (as by storage in a heated equipment cab or pick-up, etc.) for optimum assembly.

3. Apply a thin film of regular AMERICAN Fastite Joint Lubricant to the rounded or tapered spigot end of the pipe, the immediate outside pipe surface between the stripe and the nose of the pipe (Photo 2), and also to the inside surface of the gasket. Special AMERICAN Fastite Joint Lubricant intended specifically for underwater or very wet installations can be supplied when requested.

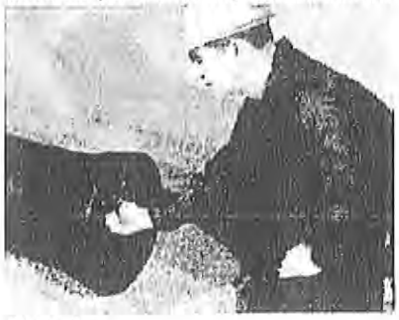


Photo 1

Photo 2

*Gaskets not used immediately should be stored in a cool location, out of direct sunlight.

REFERENCE MATERIAL

## Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 2-11)



**Caution:** If a spigot end contacts the ground or trench side after lubrication, any adhering dirt or rocks should be cleaned off and the area re-lubricated prior to assembly.

4. Insert the plain end in the socket. For optimum assembly it is preferable that the entering pipe be in reasonably straight alignment; however, the Fastite Joint may be assembled if necessary with the pipe deflected within its rated deflection. (Exception: If Fast-Grip gaskets are being used, straight alignment must be maintained.) Push the plain end into the socket using any of the applicable assembly methods described hereinafter. If the joint cannot be assembled with a moderate force, remove the pipe and check for the cause of the difficulty, such as improper positioning of gasket, insufficient or wrong type lubricant, dirt under or behind the gasket, dirt adhering to the pipe, or any other cause which would result in obstruction or increased friction between pipe end and gasket surface. For assurance of proper assembly, a thin automotive, blade-type feeler gauge can also be used if desired for quick and easy probe confirmation of correctly installed axial gasket position around the joint.

### AMERICAN Pipe Assembly Mechanisms

In general, Fastite joints or other Fastite gasketed pipes may be readily pushed or pulled together without the need for complicated tools or substantial manpower. This is most often accomplished with the procedures discussed on page 2-14. In general, the joints of AMERICAN push-on pipes are purposefully "tight", and most joints require an assembly force of about 100 to 200 pounds or more of assembly force per inch of pipe diameter (i.e. a 12" joint might require about 12 x 100 or 1,200 pounds of assembly force).

In pulling operations, simply wrap a sound wire rope choker cable or nylon sling around the barrel of the entering pipe. Secure the thimble eye or other end loop of the choker to a suitably anchored pulling device (e.g. backhoe, come-along, etc.). Use the mechanism to pull the cable taut in the assembly direction (Photo 3). Continue pulling the cable in a smooth, continuous motion until the joint is in the fully assembled position. If desired for special conditions, AMERICAN can furnish suitable, simple come-alongs and choker cables for manpower assembly of most **4"-24"** pipes. (See Figure 1 and specify pipe sizes involved).

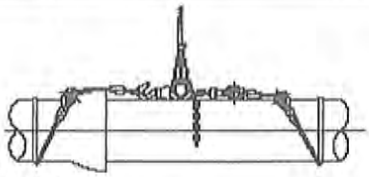


**Figure 1**

The joints may normally be disassembled in a similar manner, reversing the direction of the pull with the choker cable (Photo 4). It is also sometimes helpful to use rebating or wiggling deflection to aid in the disassembly of push-on joint pipes, particularly when pipes have been installed for some time prior to removal.

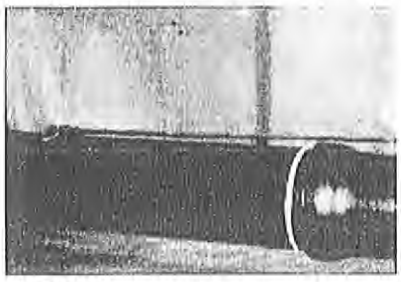


**Photo 3**

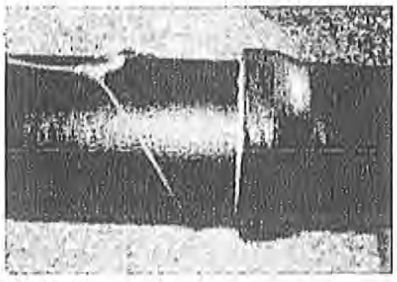


**Photo 4**

## Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 2-14)

AMERICAN DUCTILE IRON PIPE

# AMERICAN Fastite® Joint

### Common Assembly Methods

In seeking ways to take even greater advantage of the cost-reducing features of the Fastite Joint, utility contractors have developed other methods of assembling this joint without special tools. The following methods are described for the information of the user, who may elect to use them at his discretion, keeping in mind that these methods may not be effective for all installations and under all field conditions.

**Spade or Crowbar Method**

This is applicable to the smaller sizes of AMERICAN Fastite Joint Pipe, and consists of centering the lubricated end of the entering pipe in the gasket and then pushing against the bell face of the entering pipe with a spade or crowbar driven into the ground in front of the bell face. This method requires the trench bottom to be fairly firm soil. The method may not be effective in a rocky trench or with a trench that is soft, muddy or sandy. A wooden block between the bell face and the pry bar may increase the leverage. Easier assembly is effected if the pipe is suspended an inch or so off the bottom of the trench.

Spade or Crowbar Method

**Backhoe and Heavy Equipment Methods**

These methods are usually applicable to the intermediate and larger sizes of AMERICAN Fastite Joint Pipe where the bar method might not be effective. It consists of centering the end of the entering pipe in the gasket as the pipe to be assembled is suspended from the backhoe. Then it can be pulled into the adjoining socket with the pipe sling by moving the backhoe arm toward the previously assembled pipe. In other instances, the pipe may be assembled by placing the backhoe or other earth mover bucket or blade against the bell face of the entering pipe and pushing it into the socket. When pushing against the bell face, care should be taken to avoid very small contact areas and possible damage to the pipe bells or spigots. Wood cushions between the backhoe bucket and the pipe are particularly effective in preventing damage.

Backhoe and Heavy Equipment Methods

## Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 3-26)

AMERICAN DUCTILE IRON 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.

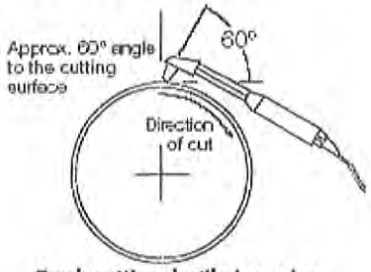
**Cutting ductile iron pipe with torch.**

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

# Assembly of an American Cast Iron Pipe Co. Fastite Joint (pg. 3-27)



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.

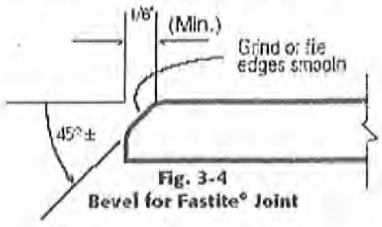



**Fig. 3-4**
**Bevel for Fastite® Joint**

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

## Assembly of a Fastite Joint using an ACIPCO Fast-Grip Gasket (page. 9-2)

AMERICAN DUCTILE IRON PIPE

### AMERICAN Fast-Grip® Gasket

American Fast-Grip gaskets have been proven to be a superior field-adaptable method of restraining 4"-30" ductile iron pipe and fittings.

The restraint provided by the patented* AMERICAN Fast-Grip® gasket is due to the development of wedging action between pairs of high-strength stainless steel elements spaced around the gasket. The outer metal element acts as a bearing member for the wedge-shaped inner element which has sharp teeth on its inner surface for gripping the spigot.

Because of the wedging design utilized, the force between the spigot and the socket of the joint is essentially constant at any given pressure thrust regardless of the "tightness" or "looseness" of the joint fit or the joint deflection.

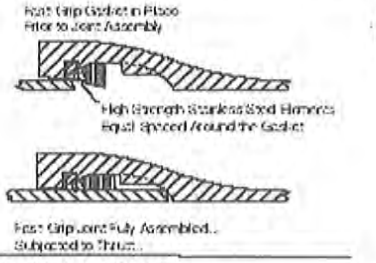
Fast-Grip gaskets are suitable for an allowable working pressure of 350 psi for 4"-18"** pipe and 250 psi for 20" and 24"** sizes. The 30" size is suitable for a 150 psi working pressure. The joint has a maximum allowable deflection of 5° in the 4"-12", 4° in the 14", 3° in the 16"-24", and 2 1/2° in the 30" size. Proof-of-design tests have confirmed that the joints are capable of restraining dead-end thrust of two or more times the rated working pressure, as applicable. These tests were accomplished with the joints in both straight alignment and at the maximum rated deflection.

The Fast-Grip gasket has the same basic shape as AMERICAN's Fastite® gasket, so it can be used in any 4"-30" standard Fastite pipe or fitting socket. The gasket rubber is standard SBR*** which meets all the material requirements of ANSI/AWWA C111/A21.11.

All bell Fastite fittings manufactured per ANSI/AWWA C153/A21.53 are available for use with the Fast-Grip gasket in the 4"-16" sizes. Fastite**** fittings per ANSI/AWWA C110/A21.10 or C153/A21.53 are available in 18"-30" sizes. When they are available on the jobsite, AMERICAN's Flex-Ring® fittings may also be used with the Fast-Grip gasket.

The Fast-Grip gasket is Underwriters Laboratories listed and Factory Mutual approved for use in Fastite or Flex-Ring sockets with Fastite plain ends in all sizes 4"-16". The UL listing and FM approvals apply to all pressure classes and special thickness classes of ductile iron pipe.

In addition to the positive restraint achieved, Fast-Grip gaskets offer ergonomically friendly advantages compared to other restrained joints for fittings and pipe requiring bolts, lugs, segments, wrenches, etc. Joints can easily be assembled with current tools and methods used for many years in the assembly of standard Fastite joints. Assembly and disassembly instructions follow.




* U.S. Patent No. 5,037,751

** Because the pressure rating of the joint cannot exceed that of the pipe, the 350 psi rating for 14"-18" sizes and the 250 psi rating for 24" sizes are limited by the pressure class of pipe with which they are used. For example, an 18" Fast-Grip gasket used with Pressure Class 250 pipe would carry a rating of 250 psi instead of 350 psi. Contact AMERICAN for higher working pressure applications.

*** Contact AMERICAN if other types of rubber are required.

**** Contact AMERICAN for the availability of fitting plain ends.

## Assembly of a Fastite Joint using an ACIPCO Fast-Grip Gasket (page. 9-3)

AMERICAN DUCTILE IRON PIPE

# AMERICAN Fast-Grip® Gasket

### Assembly Instructions

Assembling pipe and fitting joints using Fast-Grip gaskets is simple. It is very similar to the assembly of Fastite joints shown in Section 2. Fast-Grip gaskets may be used in lieu of standard Fastite gaskets in the bells of Fastite and Flex-Ring joint pipe and fittings where easy, field-adaptable restraint is desired.

**1. Cleaning of Socket and Spigot**

Clean the socket and plain end thoroughly, removing any mud, sand, gravel, ice, frozen material, or other matter that could prevent a proper joint seal. Material in the gasket grooves may cause the gasket to protrude into the path of the entering spigot. Therefore, **it is important that all joint recesses be kept clean during insertion of the gasket and assembly of the joint to prevent gasket dislodgment and/or subsequent leakage.**

**2. Placement of Gasket**

Wipe the gasket clean. After flexing one or more "loops" in the gasket, insert the gasket in the gasket recess of the socket with the large sealing end of the gasket toward the rear of the socket. The center of the gasket loops should be positioned between tooth locations. Press the gasket into the mating socket recesses, so the metal-carrying retainer end of the gasket is seated completely and uniformly in the socket groove. **Take care that no gasket loops or bulges protrude into the path of the entering pipe spigot.** In extremely cold weather conditions, gaskets should be warmed before installing. (One way to keep gaskets warm is to keep them in a truck or heated vehicle cab until they are ready to be used.)

**Incorrect**

**Incorrect**

**Incorrect**

**Correct**

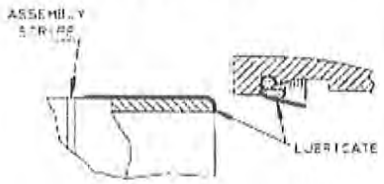
## Assembly of a Fastite Joint using an ACIPCO Fast-Grip Gasket (page. 9-4)

AMERICAN DUCTILE IRON PIPE

# AMERICAN Fast-Grip® Gasket

### Assembly Instructions — Continued

**3. Lubrication of the Joint**




With a clean brush, apply a liberal amount of regular Fastite lubricant completely **over the end of the pipe, the spigot radius,** and the outer surface of the pipe up to the assembly stripe. Also apply lubricant completely over the exposed inner surface of the gasket. AMERICAN supplies an extra 10% of lubricant to be used with the Fast-Grip joints to ensure ease of assembly. Use **only lubricant provided by AMERICAN.** For underwater conditions, special AMERICAN underwater lubricant is recommended and is available upon request.

**4. Initial Placement of Bevel End into Socket**

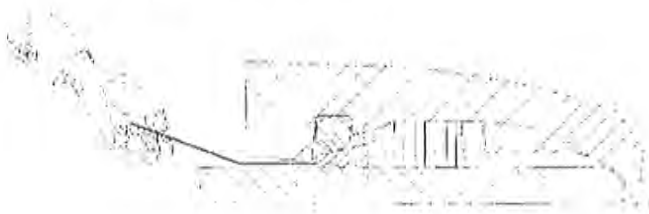
The spigot end of the pipe should be in reasonably straight alignment before it is placed into the socket. Center the spigot in the gasket so it makes firm and even contact with the inner surface of the gasket. Do not place pipe spigot in socket while in a substantially deflected position.

**5. Complete Assembly of Plain End into Socket**

For 4"-18" sizes, simply push the bevel end into the bell until it contacts the rear of the socket. Desired joint deflection may then be set.

If the joint is to be deflected less than 2 1/4° for 20", 1 3/4° for 24", and 1° for 30", simply push the pipe spigot until it contacts the back of the socket and deflect. If the joint is to be deflected greater than these amounts, push the pipe spigot into the bell (while in straight alignment) only until the leading edge of the factory-applied yellow assembly stripe is even with the face of the bell. The desired deflection up to the maximum may then be set.

Abnormal joint assembly loads or behavior, such as unexplained exposure of the assembly stripe outside the bell, may indicate improper cleaning, gasket insertion, spigot placement, or lubrication. In any joint assembly, a thin feeler gauge **passed between the bell and spigot all around the assembled joint can be used to confirm correct gasket placement. (See figure below.)** Any joint with apparent problems should be disassembled and corrected before filling and testing the pipeline. (See Disassembly Instructions.)



## Assembly of a Fastite Joint using an ACIPCO Fast-Grip Gasket (page. 9-5)

AMERICAN DUCTILE IRON PIPE

# AMERICAN Fast-Grip® Gasket

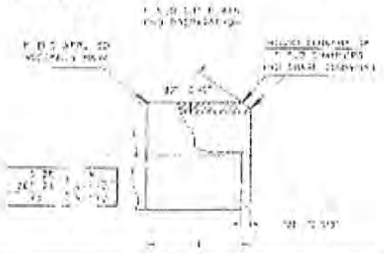
### Assembly Instructions — Continued

**Field-Cut Pipe**

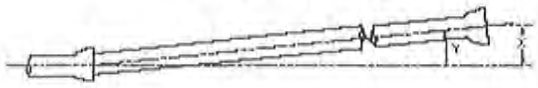
When pipe is cut in the field, the cut end must be properly prepared prior to assembly. In 24" and larger sizes, the ordering and use of a few select pipes that have been "gauged full length" at the factory should be considered when field cuts are anticipated.

Using a portable grinder or other suitable device, place an approximately ⅜" - to ½" - long smooth assembly chamfer or bevel on the outside end of the pipe. This bevel should make an angle of 30-40° with the axis of the pipe. **Care should be taken to ensure that all corners are rounded and no sharp edges remain that might damage or dislodge the gasket.**

If deflection greater than 2 1/4°, 1 3/4°, and 1° is required for 20", 24", and 30" field-cut pipe, respectively, place an assembly mark on the spigot as shown. The spigot should be inserted into the bell during assembly only until the mark becomes even with the bell face. Spigot insertion to the field-applied assembly mark will result in a space between the spigot and the back of the socket.



**Allowable Joint Deflection for 4"-30" Fastitet Ductile Iron Pipe with Fast-Grip Gaskets**




| Size in. | Nominal Laying Length ft. | Maximum Recommended Deflection | |
|---|---|---|---|
| | | X Offset per 20' Length (in.) | Y Deflection Angle |
| 4 | 20 | 21 | 5° |
| 6 | 20 | 21 | 5° |
| 8 | 20 | 21 | 5° |
| 10 | 20 | 21 | 5° |
| 12 | 20 | 21 | 5° |
| 14 | 20 | 17 | 4° |
| 16 | 20 | 12 | 3° |
| 18 | 20 | 12 | 3° |
| 20' | 20 | 12 | 3° |
| 24' | 20 | 12 | 3° |
| 30' | 20 | 10 | 2 1/2° |

† Allowable deflection for Flex-Ring sockets with Fast-Grip gaskets is the same as above for Fastite.
' Allowable deflection for 20", 24", and 30" Fastite AWWA C110 fitting joints with Fast-Grip gaskets 2 1/4°, 1 3/4°, and 1°, respectively.

**Assembly of Fittings**

Pipe and fittings joints can be easily assembled with current tools and methods used for many years in the assembly of Fastite joints. A line of "assembly yokes" and associated rigging for 4"-16" sizes are available that allow easy assembly of fitting configurations, such as 90° bends, etc. Field rigging for larger-sized fitting assemblies can normally be accomplished with common grab chains, wire rope choker cables, etc. as per photographs in Section 4.

REFERENCE MATERIAL

## Assembly of a Fastite Joint using an ACIPCO Fast-Grip Gasket (page. 9-6)

AMERICAN DUCTILE IRON PIPE

### AMERICAN Fast-Grip® Gasket

**Assembly Instructions—Continued**

*Fast-Grip gasketed joints requiring a particular orientation (such as with bends) should be assembled in the intended service position. In some instances, this may be accomplished more easily by first assembling the bend on a pipe above the trench. The jointed bend and pipe may then be lowered (orienting as required) and assembled into place.* **Relative rotation of joint members to one another after assembly is not recommended as it could cause damage or leakage.**

See Push-On Fittings Assembly Instructions in Section 4.

### Disassembly Instructions

Fast-Grip gasket joints may normally be disassembled if required. Disassembly kits, consisting of a steel shim holder and special high-strength steel disassembly shims, are required for this operation and are available from AMERICAN. For easier disassembly of a joint that has been subjected to separating thrust or movement, first push the spigot back into the rear of the socket to "unwedge" the teeth.

Using gloves to protect hands from sharp edges, insert a shim fully into the groove in the shim holder.

Starting at the bottom of the joint, carefully drive the disassembly shim past the gasket between the outside of the spigot and the gasket by striking the holder with a hammer. Remove the holder from the shim, and progressively place other shims in this manner all around the joint.

Shims should be in contact with one another to ensure all teeth are disengaged from the spigot. Overlapping of some shims may be required to dislodge all teeth. After all shims are in place, pull or jack the spigot out of the socket. Very tight joints may have to be separated by cutting pipe. The reuse of Fast-Grip gaskets after disassembly is not advised.

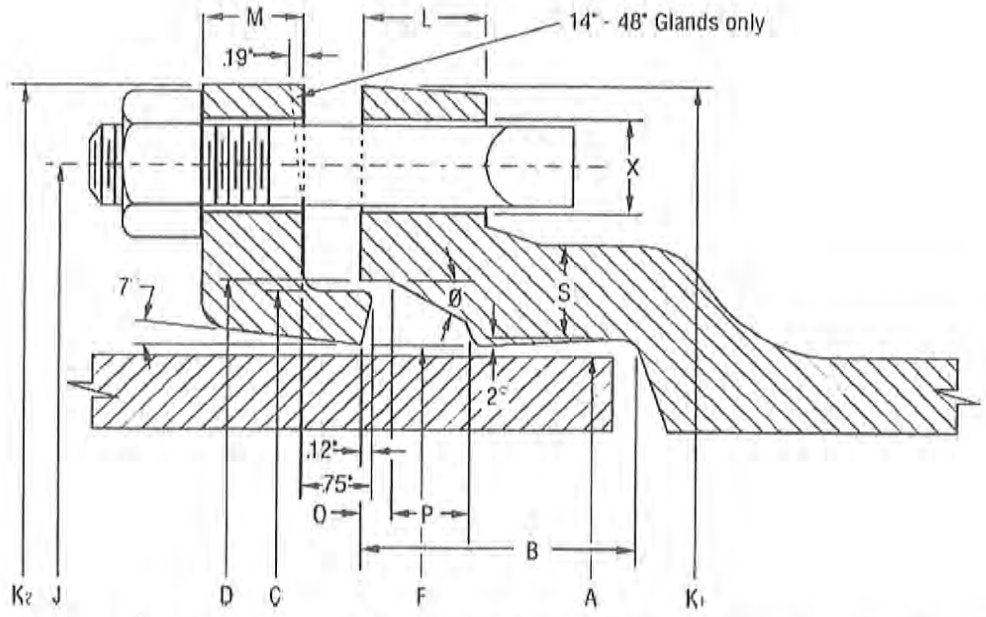
**Joint Extension After Installation**

The Fast-Grip gasket locking mechanism is activated by relative movement between the spigot and socket. The joint thus allows for movement, joint take-up, and substantial flexibility after installation. Joints may be extended after assembly to minimize joint take-up in test or service and for further assurance of correct joint locking. This may be accomplished by pulling or jacking the spigot away from the socket until firm resistance is encountered. This will not prevent proper joint deflection. In vertical applications such as exposed risers, standard (weld bead) Flex-Ring joints that also should be effectively extended and braced in original installation are recommended instead of Fast-Grip gaskets.

In most underground installations, including most restrained bend locations, joint take-up is advantageous in that increased thrust resisting soil forces are generated. Also, expansion and contraction due to temperature variations may be accommodated without excessive stress in the pipe members. The amount of joint take-up or line movement in buried restrained pipelines is substantially limited by the surrounding soil. Therefore, system security and safety is maximized by filling and testing restrained sections of pipelines after backfilling.

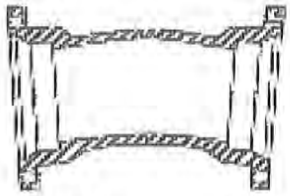
In any application where axial movement may be undesirable, such as certain bridge crossings, certain other exposed piping applications, or certain connections of restrained pipe sections at angles to rigid piping, special provisions, including effective joint extension, may be necessary to control unacceptable pipeline movement. Depending on job conditions and restrained pipe length, cumulative joint take-up can be substantial, particularly in exposed or unburied piping applications.

## Standard Mechanical Joint Dimensions

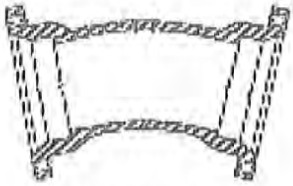



| Size | A | B | C | D | E | ø | X | J | K1 | | K2 | L | M | O | P | Q | | Bolts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Centrifugal pipe | Ft cast pipe and fittings | | | | | | Centrifugal pipe | Ft cast pipe and fittings | Number | Size | Length |
| 3 | 3.95 | 2.00 | 4.84 | 4.50 | 4.05 | 25° | 3/4 | 6.19 | 7.62 | 7.63 | 7.69 | .94 | .62 | .31 | .62 | .47 | .62 | 4 | 3/8 | 3 |
| 4 | 4.40 | 2.00 | 5.12 | 5.00 | 4.50 | 25° | 7/8 | 7.00 | 9.06 | 9.12 | 9.12 | 1.00 | .78 | .31 | .78 | .66 | .66 | 4 | 3/4 | 3-1/2 |
| 6 | 6.90 | 2.00 | 8.00 | 8.12 | 7.00 | 25° | 7/8 | 9.00 | 11.00 | 11.12 | 11.12 | 1.06 | .88 | .31 | .78 | .82 | .72 | 6 | 3/4 | 3-1/2 |
| 8 | 9.05 | 2.00 | 10.17 | 10.27 | 9.15 | 25° | 7/8 | 11.19 | 13.31 | 13.37 | 13.37 | 1.12 | 1.00 | .31 | .78 | .66 | .78 | 8 | 3/4 | 4 |
| 10 | 11.10 | 2.00 | 12.22 | 12.34 | 11.20 | 25° | 7/8 | 14.00 | 15.62 | 15.69 | 15.62 | 1.19 | 1.00 | .31 | .78 | .72 | .82 | 8 | 3/4 | 4 |
| 12 | 13.20 | 2.00 | 14.32 | 14.44 | 13.30 | 25° | 7/8 | 16.25 | 17.81 | 17.94 | 17.62 | 1.25 | 1.00 | .31 | .78 | .78 | .88 | 8 | 3/4 | 4 |
| 14 | 15.30 | 3.00 | 16.42 | 16.58 | 15.44 | 25° | 7/8 | 18.75 | 20.25 | 20.51 | 20.25 | 1.31 | 1.25 | .31 | .78 | .81 | .91 | 12 | 3/4 | 4 |
| 16 | 17.40 | 3.00 | 18.62 | 18.64 | 17.64 | 25° | 7/8 | 21.00 | 22.50 | 22.58 | 22.50 | 1.38 | 1.31 | .31 | .78 | .91 | .97 | 12 | 3/4 | 4-1/2 |
| 18 | 19.50 | 3.00 | 20.82 | 20.74 | 19.64 | 25° | 7/8 | 23.25 | 24.75 | 24.83 | 24.75 | 1.44 | 1.38 | .31 | .78 | .97 | 1.03 | 12 | 3/4 | 4-1/2 |
| 20 | 21.60 | 3.00 | 22.72 | 22.84 | 21.74 | 25° | 7/8 | 25.50 | 27.00 | 27.09 | 27.00 | 1.50 | 1.44 | .31 | .78 | 1.03 | 1.12 | 16 | 3/4 | 4-1/2 |
| 24 | 25.80 | 3.00 | 26.92 | 27.04 | 25.84 | 25° | 7/8 | 30.00 | 31.50 | 31.61 | 31.50 | 1.62 | 1.56 | .31 | .78 | 1.03 | 1.22 | 16 | 3/4 | 5 |
| 30 | 32.00 | 4.00 | 33.28 | 33.46 | 32.17 | 20° | 1-1/8 | 36.81 | 39.12 | 39.12 | 39.12 | 1.81 | 2.00 | .38 | 1.00 | 1.22 | 1.50 | 20 | 1 | 5-1/2 |
| 36 | 38.10 | 4.00 | 39.38 | 39.76 | 38.47 | 20° | 1-1/8 | 42.75 | 46.00 | 46.00 | 46.00 | 2.00 | 2.00 | .38 | 1.00 | 1.38 | 1.62 | 24 | 1 | 5-1/2 |
| 42 | 44.20 | 4.00 | 45.78 | 45.96 | 44.67 | 20° | 1-3/8 | 50.62 | 53.12 | 53.12 | 53.12 | 2.00 | 2.00 | .38 | 1.00 | 1.48 | 1.98 | 28 | 1-1/4 | 6 |
| 48 | 50.30 | 4.00 | 52.00 | 52.20 | 50.97 | 20° | 1-3/8 | 57.00 | 59.00 | 59.00 | 59.00 | 2.00 | 2.00 | .38 | 1.00 | 1.61 | 2.22 | 32 | 1-1/4 | 6 |

## Mechanical Joint Fittings

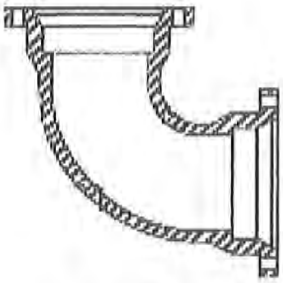


11 ¼ Degree Bend

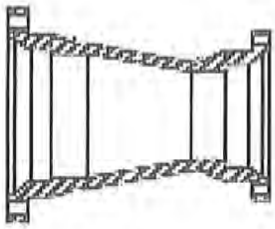


22 ½ Degree Bend

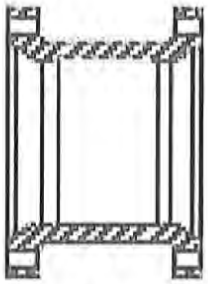
45 Degree Bend



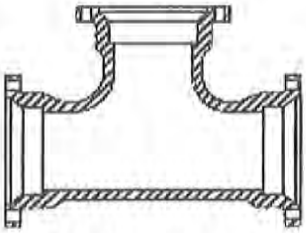
45 Degree Bend



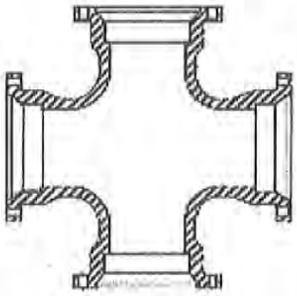
Reducer
(Larger Size x Smaller Size)



Sleeve

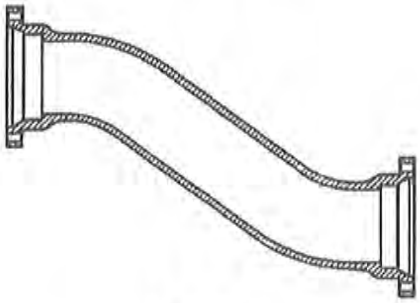


3-Way or Tee
(Run Size x Branch Size)



4-Way or Cross
(Larger Run Size x Smaller Run Size)

Cap



Offset
(Size x Offset Distance)

Plug

# Assembly of a Mechanical Joint using a Plain Gland

1. Clean the socket and the plain end. Lubrication is recommended for proper assembly of all mechanical joints. Lubrication and additional cleaning should be provided by brushing both the gasket and plain end with soapy water or pipe lubricant just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end followed by the gasket with the narrow edge of the gasket toward the plain end.

2. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

3. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand-tighten the nuts. Make deflection after joint assembly but before tightening the bolts.

4. Tighten the bolts to the normal range of bolt torque as indicated in the adjacent table while maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the approximate range of torque. In large (30" - 48") sizes, five or more repetitions may be required. The use of a torque wrench will facilitate this procedure.

## Installation Tips for Mechanical Joint Pipe

### Lubrication

This is very important with mechanical joints (pipe and fittings) to ensure a leak-free assembly. Once the gasket is placed over the plain end of the pipe and prior to assembly, the gasket must be lubricated. This step is sometimes omitted because the mechanical joint appears to assemble easily without lubricant. After tightening of the bolts with no gasket lubrication, the gasket will tend to slowly flow into place with time, resulting in loosening of the bolts from their proper torque. This happens because the gasket has not properly seated due to friction from lack of lubrication. The lubricant allows the gasket to easily and fully "flow" into the wedge shaped gasket seat under compression from the gland during the initial assembly. When the bolts are then properly tightened, the gasket will be fully seated in the proper position and the bolts will remain tight.

### Joint Deflection

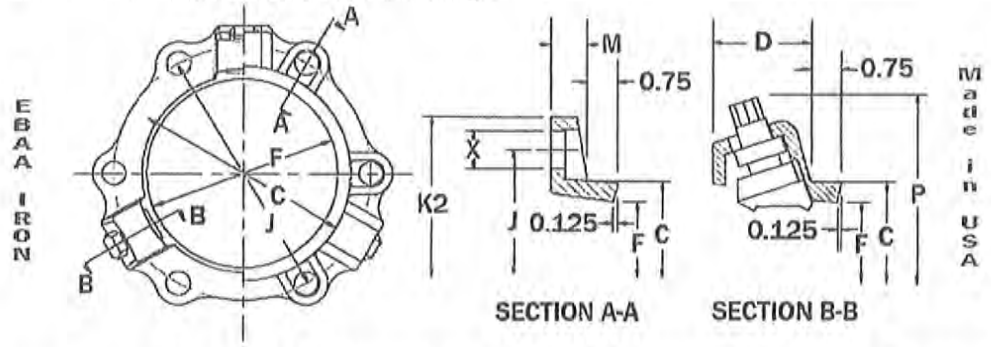
Mechanical joint pipe should be assembled with little or no deflection of the joint. Following assembly, the joint can be deflected as necessary. If the joint is assembled in the deflected condition, the gasket may not be evenly seated and can also be damaged during assembly.

### Restraint

A common misconception is that mechanical joint pipe are sometimes thought to be restrained joint pipe because bolts and nuts are involved in their installation. However, the mechanical joint does not provide any restraint. The mechanical joint can only be properly restrained by using it in conjunction with a restraining gland.

# EBBA IRON SALES, INC.: MegaLug Series 1100

## Series 1100 Submittal Reference Drawing




| Nominal Pipe Size | Series Number | C | D | F | M | P (with Nuts Off) | X | J | K2 | Wedge Qty | Bolt Qty | Weight LBS | Press Ratings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1103 | 4.48 | 2.27 | 4.06 | 0.62 | 9.06 | 0.750 | 6.19 | 7.69 | 2 | 4 | 6.1 | 350 |
| 4 | 1104 | 5.92 | 2.27 | 4.90 | 0.75 | 9.90 | 0.875 | 7.50 | 9.12 | 2 | 4 | 7.6 | 350 |
| 6 | 1106 | 8.02 | 2.27 | 7.00 | 0.88 | 12.00 | 0.875 | 9.50 | 11.12 | 3 | 6 | 11.8 | 350 |
| 8 | 1108 | 10.17 | 2.31 | 9.15 | 1.00 | 14.15 | 0.875 | 11.75 | 13.37 | 4 | 6 | 14.9 | 350 |
| 10 | 1110 | 12.22 | 2.37 | 11.20 | 1.00 | 16.20 | 0.875 | 14.00 | 15.62 | 6 | 8 | 23.9 | 350 |
| 12 | 1112 | 14.32 | 2.37 | 13.30 | 1.25 | 18.30 | 0.875 | 16.25 | 17.88 | 8 | 8 | 31.2 | 350 |
| 14 | 1114 | 16.40 | 2.69 | 15.44 | 1.50 | 20.94 | 0.875 | 18.75 | 20.25 | 10 | 10 | 49.7 | 350 |
| 16 | 1116 | 18.50 | 2.69 | 17.54 | 1.56 | 22.90 | 0.875 | 21.00 | 22.50 | 12 | 12 | 56.4 | 350 |
| 18 | 1118 | 20.60 | 2.69 | 19.64 | 1.63 | 25.00 | 0.875 | 23.25 | 24.75 | 12 | 12 | 63.6 | 250 |
| 20 | 1120 | 22.70 | 2.69 | 21.74 | 1.69 | 27.10 | 0.875 | 25.50 | 27.00 | 14 | 14 | 71.0 | 250 |
| 24 | 1124 | 26.90 | 3.20 | 25.94 | 1.81 | 32.64 | 0.875 | 30.00 | 31.50 | 16 | 16 | 128.7 | 250 |
| 30 | 1130 | 33.29 | 3.20 | 32.17 | 2.25 | 38.87 | 1.125 | 36.88 | 39.12 | 20 | 20 | 190.7 | 250 |
| 36 | 1136 | 39.59 | 3.20 | 38.47 | 2.25 | 45.17 | 1.125 | 43.75 | 46.00 | 24 | 24 | 226.5 | 250 |
| 42 | 1142 | 45.79 | 4.56 | 44.67 | 3.88 | 55.57 | 1.375 | 50.62 | 53.48 | 28 | 28 | 518.9 | 250 |
| 48 | 1148 | 52.09 | 4.56 | 50.97 | 3.88 | 61.87 | 1.375 | 57.50 | 60.36 | 32 | 32 | 608.3 | 250 |

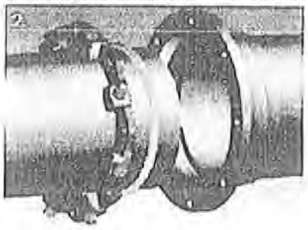
Note: Dimensions are in inches and are subject to change without notice.

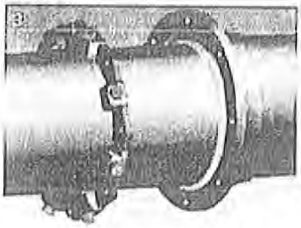
## Important Notes

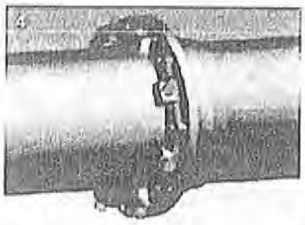
- The 1100 Series should not be used on plain end fittings.
- For test pressures above the rated pressures shown, contact EBAA for recommendations, such as tandem restraint for high pressure applications.
- If you experience the need to install the 1100 Series in an unconventional manner please consult our engineering department.
- The 1100 Series is intended for use on ductile iron pipe. The restraint can be used on grey iron pipe if the pipe is not severely corroded and is in sound condition and has an outside diameter that can be accommodated. For more information on the use of the MEGALUG restraint on grey iron pipe ask for Connections Bulletin DI-1.
- EBAA Seal Gaskets are provided with the 30" through 48" MEGALUG restraints. These are required on the above referenced sizes to accommodate the pressure ratings and safety factors shown.
- Extra length T-bolts are provided with the 42" and 48" sizes to facilitate easier assembly of the mechanical joint.
- All MEGALUG components are made of ductile iron. The wedges are heat treated to a hardness range of 370 to 470 BHN.
- LISTINGS AND APPROVALS Sizes 3" through 24" are listed by Underwriters Laboratories, Inc. Category HJKF "Fittings, Retainer Type," with a deflection angle of 5 degrees (3" through 12") and 2-1/2 degrees (14" through 24".) The listing file number is EX2836. Sizes 3" through 12" are Factory Mutual approved.

# EBBA IRON SALES, INC.: MegaLug Series 1100

## Installation Instructions



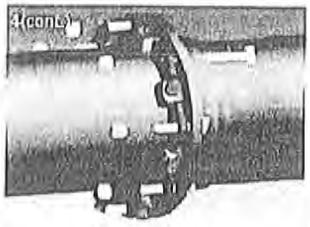



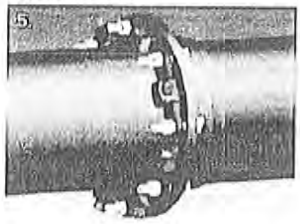

1. The Series 1100 Megalug® joint restraint is designed for use on ductile iron pipe conforming to ANSI/AWWA C151/A21.51 (all thickness classes) when restraining mechanical joint pipe or fittings.

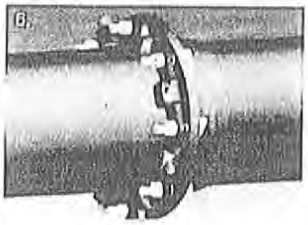
* 2. Clean the socket and the plain end. Lubrication and additional cleaning should be provided by brushing both the gasket and the plain end with soapy water or approved pipe lubrication meeting the requirements of ANSI/AWWA C111/A21.11, just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket.

* 3. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

* 4. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening bolts.




* 5. Tighten the bolts to the normal range of bolt torque (45-60 ft-lbs for 3", 75-90 ft-lbs for 4" through 24", 100-120 ft-lbs for 30" and 36", and 120-150 ft-lbs for 42" and 48") while at all times maintaining approximately the same distances between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque. The use of a torque indicating wrench will facilitate this procedure.

* 6. Tighten the torque limiting twist off nuts in a clockwise direction (direction indicated by arrow on top of nut) until all wedges are in firm contact with the pipe surface. Continue tightening in an alternating manner until all of the nuts have been twisted off.

7. If removal is necessary, utilize the 5/8" hex heads provided. If reassembly is required, assemble the joint in the same manner as above, tighten the wedge bolts to 90 ft-lbs. If the Series 1100 restraint is removed from the pipe, be sure that all of the collar bolts and wedges are in place before the restraint is reassembled.

* These steps are requirements of AWWA. AWWA Standards, C600, Sec. 3.4.2

## Ford Meter Box Co., Inc.: Uni-Flange Series 1400

# Uni-Flange® Series 1400

Wedge Action Retainer Gland for Ductile Iron Pipe

WORKING PRESSURE - 3" THROUGH 16" 350 PSI
- 18" THROUGH 36" 250 PSI

Ductile iron wedge actuating screw, with the Auto-Tork® break-away head design, insures proper torque during installation.

Finish is shop coat that is suitable for most field applied coatings.

Wedges are ductile iron and heat treated to a hardness of 370 BHN minimum.

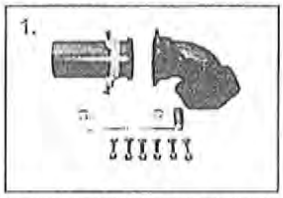
Gland body is of High Strength Ductile Iron per ASTM A536, Grade 65-45-12. Compatible with all mechanical joints conforming to ANSI / AWWA C111 / A21.11.

Color Code:
Black for ductile iron pipe

The Uni-Flange Series 1400 offers a minimum 2:1 safety factor at the full rated pressure of the device, in all sizes, when tested in dead-end situations.

3" THROUGH 36" SIZES - 100% DUCTILE IRON CONSTRUCTION
MADE IN USA

## Uni-Flange Series 1400 Installation Instructions

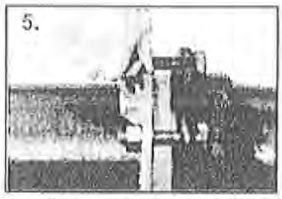



1. Clean the socket and plain end. Lubricate gasket and plain end with approved pipe lubricant meeting AWWA C111. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the tapered edge of the gasket toward the plain end.

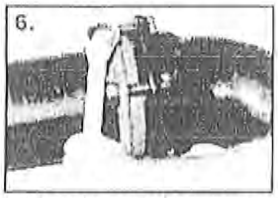

2. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.


3. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Hand tighten the Auto-Tork® actuating screws to center the gland around the pipe. Insert T-bolts and hand tighten nuts. With the gland positioned and centered around the pipe, loosen the Auto-Tork® actuating screws and continue to tighten the T-bolts. Set deflection after joint assembly but before tightening bolts (max. deflection is 5°).


4. Tighten the T-bolts to the same torque recommended in AWWA C111 (45-60 ft-lb on 3", 75-90 ft-lb on 4" - 24" sizes, 100-120 ft-lb on 30" - 36" sizes). Tighten in an alternating manner, (12 o'clock, 6 o'clock, 9 o'clock, 3 o'clock) maintaining the same gap between the gland and the face of the MJ bell at all points around the MJ socket. Repeat the process until all bolts are within the approximate torque range. Use of a torque wrench is recommended.




5. After correct assembly of the mechanical joint, bring all wedges in contact with the pipe surface by turning the Auto-Tork® actuating screws in a clockwise direction until contact is made and screw is "hand tight."




6. Tighten each Auto-Tork® actuating screw by turning approximately 180 degrees (1/2 turn), alternating among screws until the break away heads twist off.

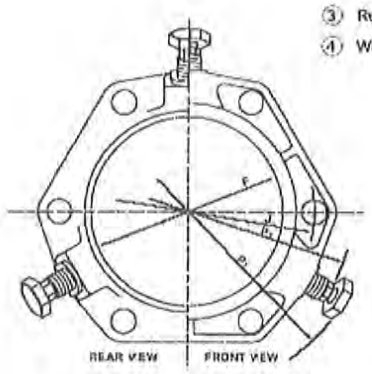
**Note:** The Series 1400 can be re-used or re-installed after the Auto-Tork® screw heads have been twisted off. In this case, tighten the hex head of the wedge actuating screw to 75 - 110 ft-lb.

## Ford Meter Box Co., Inc.: Uni-Flange Series 1400

# Uni-Flange® Series 1400

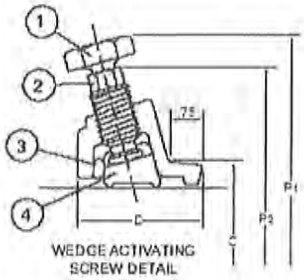
Information - Wedge Action Retainer Gland for Ductile Iron Pipe

① Auto-Torke® break-away head, 1-1/4" across the flat (same as 3/4" heavy hex nut).
② 5/8" hex-head, operating screw.
③ Rubber spacer (positions wedge during assembly).
④ Wedge





GLAND BODY DETAIL




WEDGE ACTIVATING SCREW DETAIL

### Series 1400 Retainer Gland for Ductile Iron Pipe

| Nom. Pipe Size | Pipe O.D. (Inches) | Catalog Number | Pressure Rating (PSI) | No. of Wedges | Approx. Weight (Lbs.) | P1* | P2** | C | D | F | M | J | No. of Bolt Holes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3" | 3.96 | UFR1400-D-3 | 350 | 2 | 6.0 | 11.04 | 9.06 | 4.84 | 2.65 | 4.06 | 0.68 | 6.19 | 4 |
| 4" | 4.80 | UFR1400-D-4 | 350 | 2 | 7.5 | 11.9 | 10.0 | 5.92 | 2.65 | 4.90 | 0.88 | 7.50 | 4 |
| 6" | 6.90 | UFR1400-D-6 | 350 | 3 | 11.0 | 14.0 | 12.1 | 8.02 | 2.65 | 7.00 | 0.88 | 9.50 | 6 |
| 8" | 9.05 | UFR1400-D-8 | 350 | 4 | 14.5 | 16.2 | 14.3 | 10.17 | 2.65 | 9.15 | 1.10 | 11.75 | 6 |
| 10" | 11.10 | UFR1400-D-10 | 350 | 6 | 23.0 | 18.2 | 16.3 | 12.22 | 2.75 | 11.20 | 1.10 | 14.00 | 8 |
| 12" | 13.20 | UFR1400-D-12 | 350 | 8 | 28.5 | 20.3 | 18.4 | 14.32 | 2.75 | 13.30 | 1.10 | 16.25 | 8 |
| 14" | 15.30 | UFR1400-D-14 | 350 | 10 | 46.0 | 22.9 | 20.9 | 16.40 | 3.00 | 15.44 | 1.50 | 18.75 | 10 |
| 16" | 17.40 | UFR1400-D-16 | 350 | 12 | 52.0 | 25.0 | 23.0 | 18.50 | 3.00 | 17.54 | 1.50 | 21.00 | 12 |
| 18" | 19.50 | UFR1400-D-18 | 250 | 12 | 69.0 | 28.1 | 25.8 | 20.60 | 3.05 | 19.64 | 1.65 | 23.25 | 12 |
| 20" | 21.60 | UFR1400-D-20 | 250 | 14 | 76.0 | 30.2 | 27.9 | 22.70 | 3.10 | 21.75 | 1.70 | 25.50 | 14 |
| 24" | 25.80 | UFR1400-D-24 | 250 | 16 | 90.0 | 34.4 | 32.1 | 26.90 | 3.20 | 25.94 | 1.85 | 30.00 | 16 |
| 30" | 32.00 | *** UFR1400-D-30 | 250 | 20 | 221.0 | 40.6 | 38.6 | 33.29 | 3.55 | 32.17 | 2.25 | 36.88 | 20 |
| 36" | 38.30 | *** UFR1400-D-36 | 250 | 24 | 230.0 | 46.9 | 44.9 | 39.59 | 3.76 | 38.47 | 2.25 | 43.75 | 24 |

All dimensions in inches unless otherwise stated.
* Maximum O.D. of gland on pipe before break-away heads have been removed (as received).
** Maximum O.D. of gland on pipe after wedges have been actvated and break-away heads have been removed.
*** 30" and 36" sizes include a Uni-Seal gasket.

Note: 4" - 12" oversized 1400 Retainer Glands are available for Class C and D gray cast iron (Color Coded Gray). To order these oversized units, add "-XL" to the end of the catalog number. Example: UFR1400-D-6-XL.

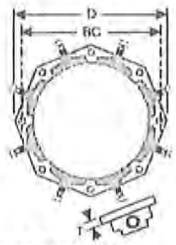
## REFERENCE MATERIAL

### SIGMA CORPORATION: One-Lok

One Lok™

SIGMA

| Size | Item No. | Wt. | Pipe O.D. | Dimensions | | | Bolts and Inserts | | | Packaged with T-Bolts, Nuts and MJ Gasket | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | B.C. | D | T | No. | Size | Torque | Item No. | Wt. | Bolt Qty. | Bolt Size |
| 3 | SLD3 | 6.5 | 3.96 | 6.19 | 7.69 | 0.62 | 2 | 7/8 | 80-90 | SLDP3 | 9 | 4 | ⅝ x 3 |
| 4 | SLD4 | 10 | 4.80 | 7.50 | 9.12 | 0.75 | 4 | 7/8 | 80-90 | SLDP4 | 14 | 4 | ¾ x 3½ |
| 6 | SLD6 | 12 | 6.90 | 9.50 | 11.12 | 0.88 | 3 | 7/8 | 80-90 | SLDP6 | 18 | 6 | ¾ x 3½ |
| 8 | SLD8 | 20 | 9.05 | 11.75 | 13.37 | 1.00 | 6 | 7/8 | 80-90 | SLDP8 | 27 | 6 | ¾ x 4 |
| 10 | SLD10 | 26 | 11.10 | 14.00 | 15.62 | 1.00 | 8 | 7/8 | 80-90 | SLDP10 | 35 | 8 | ¾ x 4 |
| 12 | SLD12 | 34 | 13.20 | 16.25 | 17.88 | 1.00 | 8 | 7/8 | 80-90 | SLDP12 | 39 | 8 | ¾ x 4 |
| 14 | SLD14 | 45 | 15.30 | 18.75 | 20.25 | 1.25 | 10 | 7/8 | 80-90 | SLDP14 | 54 | 10 | ¾ x 4½ |
| 16 | SLD16 | 56 | 17.40 | 21.00 | 22.50 | 1.31 | 12 | 7/8 | 80-90 | SLDP16 | 65 | 12 | ¾ x 4½ |
| 18 | SLD18 | 60 | 19.50 | 23.25 | 24.75 | 1.38 | 12 | 7/8 | 80-90 | | | | |
| 20 | SLD20 | 75 | 21.60 | 25.50 | 27.00 | 1.44 | 14 | 7/8 | 80-90 | | | | |
| 24 | SLD24 | 140 | 25.80 | 30.00 | 31.50 | 1.56 | 16 | 7/8 | 80-90 | | | | |
| 30 | SLD30 | 226 | 32.00 | 36.88 | 39.12 | 2.00 | 20 | 1.0 | 110-120 | | | | |
| 36 | SLD36 | 307 | 38.30 | 43.75 | 46.00 | 2.00 | 24 | 1.0 | 110-120 | | | | |
| 42 | SLD42 | 460 | 44.50 | 50.62 | 53.38 | 2.00 | 28 | 1.0 | 110-120 | | | | |
| 48 | SLD48 | 610 | 50.80 | 57.50 | 60.26 | 2.00 | 32 | 1.0 | 110-120 | | | | |




Pressure Ratings DI Pipe:
350 psi 3" through 16"
250 psi 18" through 48"

Dimensions in inches. Weights in pounds
Torque values are minimum recommended torque in ft. lbs.

UL Sizes 3" - 16" are UL Listed for 350 psi on DI Pipe and 250 psi sizes 18" - 36"

FM Sizes 4" - 12" are FM Approved for 350 psi on DI Pipe

**Sample Specification:** Restraint for standard mechanical joint fittings shall be incorporated in the design of the follower gland and shall utilize multiple lugs that act against the pipe, increasing the restraint as the line pressure increases. The assembled joint shall maintain the maximum flexibility and deflection of all nominal pipe sizes after burial. Restraining glands shall be manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12. Lug inserts shall be manufactured of ductile iron, heat treated to a hardness of 370 BHN minimum. Dimensions of the glands shall be consistent with the standardized mechanical joint bell and T-head bolts conforming to the requirements AWWA C111/ANSI A21.11 and AWWA C153/ANSI 21.53 through 24" (latest revision). Twist off nuts shall be incorporated in the design of the lug-activating screws to insure proper visual torque. The mechanical joint restraining device shall have a water working pressure rating of 250 psi minimum and provide no less than a safety factor of 2:1. Restraint shall be UL listed in applicable sizes. Restraining device shall be SIGMA One-Lok or approved equal.

### One-Lok Installation Instructions

Note: this product is designed for use on Ductile Iron Pipe - not to be used on plain-end fittings

1. Clean fitting socket and pipe end. Lubricate gasket and pipe end with soapy water (or approved pipe lubricant meeting AWWA C111). Install One-Lok restrainer on the pipe with the lip extension facing the pipe end, followed by the gasket, tapered side toward end of pipe.
2. Insert pipe into the fitting outlet and seat the gasket firmly and evenly into the gasket cavity. Maintain a straight joint during assembly.
3. Push the One-Lok gland toward the fitting and center it around the pipe with the lip evenly against the gasket. Insert the T-bolts and hand-tighten the nuts. If deflection is required, make up after joint assembly but before tightening T-bolts.
4. Tighten T-bolts in an alternating manner maintaining an even gap between the gland and the fitting face at all points around the socket. Repeat until all the T-bolts are within the recommended torque value of AWWA C111/C600.
5. Following proper assembly of the mechanical joint, hand tighten all wedges until complete contact is made with the pipe.
6. Tighten each wedge bolt in a clockwise direction, alternating between the bolts until all the break-off tops have been removed. Never tighten a wedge bolt more than 180 degrees before moving to the next bolt.

## REFERENCE MATERIAL

# ROMAC INDUSTRIES, INC.: RomaGrip

ROMAC INDUSTRIES, INC.
1-800-426-9341

## RomaGrip™ Pipe Restraint

**Material Specifications**

**Gland:** Ductile iron meeting or exceeding ASTM A 536, Grade 65-45-12.

**Gaskets:** A standard MJ gasket is used with this fitting. See ANSI/AWWA C111/A21.11 for gasket specs.

**Restraining Bolt:** 7/8 - 9 roll thread, Ductile iron, meeting or exceeding ASTM A 536.

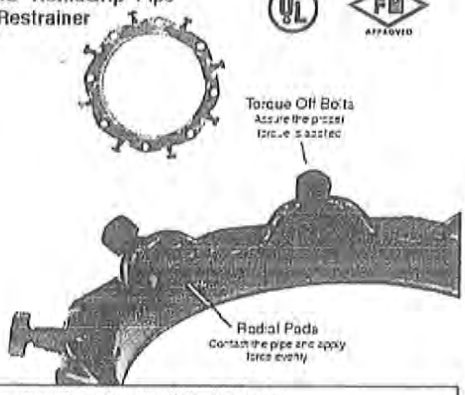
**Restraining Lugs:** Ductile iron, meeting or exceeding ASTM A 536. Heat treated using a proprietary process.

**Coatings:** Shop coat applied to the casting for corrosion protection in transit.

**Use:** Ductile Iron Pipe 3 - 24", IPS size STD steel pipe 3 - 12" with transition gasket.

**Not for use on PVC pipe or plain end mechanical joint fittings.**

12" RomaGrip Pipe Restrainer




**ROMAGRIP Accessory Pack** (RomaGrip, Gasket, Bolts and Nuts)

| NOM. PIPE SIZE | CATALOG NUMBER | T- BOLTS QUANTITY: SIZE | WEIGHT (ea.) | LIST PRICE (ea.) | CRATE QUANTITY |
|---|---|---|---|---|---|
| 3" | 3" RGAP | 4: 5/8" x 3" | 9# | $36.43 | 54 |
| 4" | 4" RGAP | 4: 3/4" x 3 1/2" | 11# | 40.87 | 96 |
| 6" | 6" RGAP | 6: 3/4" x 4" | 15# | 49.06 | 72 |
| 8" | 8" RGAP | 6: 3/4" x 4" | 20# | 69.05 | 48 |
| 10" | 10" RGAP | 8: 3/4" x 4" | 34# | 99.68 | 30 |
| 12" | 12" RGAP | 8: 3/4" x 4" | 42# | 135.15 | 32 |
| 14" | 14" RGAP | 10: 3/4" x 4 1/2" | 58# | 204.07 | - |
| 16" | 16" RGAP | 12: 3/4" x 4 1/2" | 66# | 251.06 | - |
| 18" | 18" RGAP | 12: 3/4" x 4 1/2" | 74# | 342.25 | - |
| 20" | 20" RGAP | 14: 3/4" x 4 1/2" | 92# | 417.85 | - |
| 24" | 24" RGAP | 16: 3/4" x 5" | 104# | 492.40 | - |

**ROMAGRIP** (RomaGrip ONLY)

| NOM. PIPE SIZE | CATALOG NUMBER | T- BOLTS QUANTITY: SIZE | WEIGHT (ea.) | LIST PRICE (ea.) | BANDED QUANTITY |
|---|---|---|---|---|---|
| 3" | 3" RG | - | 7# | $26.30 | 5 |
| 4" | 4" RG | - | 8# | 28.01 | 5 |
| 6" | 6" RG | - | 10# | 32.64 | 5 |
| 8" | 8" RG | - | 15# | 50.27 | 5 |
| 10" | 10" RG | - | 27# | 74.40 | 3 |
| 12" | 12" RG | - | 35# | 109.32 | 3 |
| 14" | 14" RG | - | 48# | 144.69 | - |
| 16" | 16" RG | - | 54# | 206.96 | - |
| 18" | 18" RG | - | 62# | 293.19 | - |
| 20" | 20" RG | - | 78# | 365.66 | - |
| 24" | 24" RG | - | 88# | 448.83 | - |

## ROMAC INDUSTRIES, INC.: RomaGrip

ROMAC INDUSTRIES, INC.

# INSTALLATION INSTRUCTIONS

Read installation instructions first before installing. Check parts to ensure that no damage has occurred during transit and that no parts are missing. Also check the diameter of the pipe and the range marked on the restrainer to ensure you have the proper size.

# Style RomaGrip Mechanical Joint Retainer

FOR DUCTILE IRON PIPE 3"-24" &
FOR STEEL PIPE 3"-12" (with transition gasket and minimum thickness schedule 40)

**NOTE: Not for use on polyethylene pipe, plain end mechanical joint fittings or PVC pipe.**

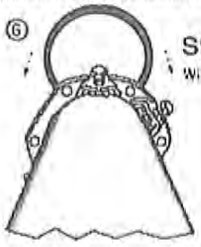
**Step 1** • Check the parts to insure that no damage has occurred during transit and that no parts are missing.

**Step 2** • Clean pipe end for a distance of at least 2" past where the gland will sit.

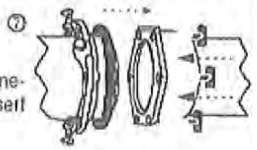
**Step 3** • Check area where gasket will seat to make sure there are no dents, projections, gouges, etc., that will interfere with the gasket seal.


**Step 4** • Place gland on pipe

**Step 5** • Lubricate the gasket and pipe surface with soapy water or other suitable gasket lubricant.

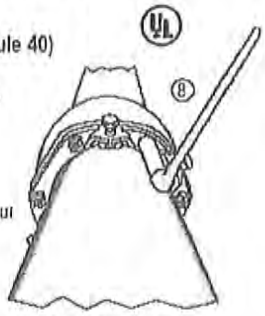



**Step 6** • Stretch gasket over pipe with beveled edge toward the bell.




**Step 7** • Insert pipe in mechanical joint fitting and insert bolts.

**Step 8** • Tighten T-bolts evenly, alternating to diametrically opposite positions at approximately 20 ft-lbs increments to the recommended torque for your size RomaGrip.

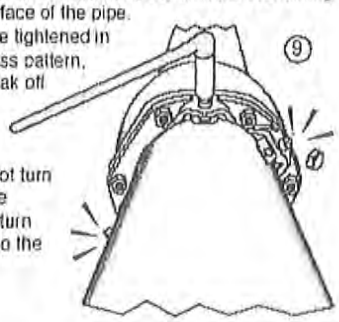



| Recommended Torque: |
|---|
| 3" RomaGrip - 45-65 ft-lbs. |
| 4 - 24" RomaGrip - 75 - 90 ft-lbs. |

| Note: |
|---|
| 90 ft-lbs. torque = 12" wrench w/90 lbs. force |

For best results, wait 10 minutes and retighten bolts to proper torque.

**Step 9** • Tighten the restrainer bolts until the restraining pads touch the surface of the pipe. The bolts should be tightened in a uniform criss-cross pattern, until the heads break off above the notch.




NOTE: Do not turn a bolt more than one turn before alternating to the next bolt.

**Step 10** • Pressure test for leaks before backfilling.

# US Pipe & Foundry Co.: MJ FIELD LOK Gaskets

Proven joint restraint technology.

No learning curve — installs just like a standard mechanical joint gasket and gland.

No more need for time-consuming thrust blocks or heavy lug-type restraints.

No loose wedges or torque-off control nuts to get lost or broken.

Can be disassembled just like a standard mechanical joint.

Suitable for potable water and wastewater applications.

The state-of-the-art MJ FIELD LOK® Gland is designed for maximum strength and easy product identification.

MJ FIELD LOK Gaskets are provided as part of a kit that also includes the MJ FIELD LOK Gland, nuts and bolts.

### *Series DI (4"–24")*

- *Can be used on any Pressure Class or Special Thickness Class Ductile Iron pipe up to 350 psi.*
- *Stainless steel locking segments provide proven joint restraint technology.*

### *Series PV (4"–12")*

- *Can be used on any Thickness Class of AWWA C900 PVC pipe.*
- *Pressure rated at a 2:1 safety factor, based on the pressure rating of the pipe on which it is installed.*
- *Can be used on C909 PVC pipe and has the same rating as the pipe that it is installed on.*
- *Ductile Iron locking ring provides proven joint restraint technology.*

### *(4"–24")*

- *Highly engineered to provide the strength and rigidity necessary for restrained joint applications.*
- *Installs just like a standard mechanical joint gland.*
- *All Ductile Iron components are manufactured to ASTM A536 Grade 70-50-05.*

MJ FIELD LOK® Gaskets are designed to seal and restrain a centrifugally cast Ductile Iron or PVC pipe (C900 or C909) with Ductile Iron pipe spigot diameters in either a Ductile Iron pipe or a Ductile Iron fitting bell.

MJ FIELD LOK Gaskets are available to fit mechanical joints conforming to *ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.*

If Ductile Iron pipe with a lower pressure rating than the gasket is used, then the lower pressure rating will apply to the MJ FIELD LOK Gasket also.

MJ FIELD LOK Gaskets require 90 ft-lb of bolt torque for 4"–8" gaskets, and 120 ft-lb of bolt torque for 10"–24" gaskets. Most common 1/2" drive air powered impact wrenches are capable of applying these torques.

U.S. Pipe does not recommend that the joints be deflected after the bolts have been tightened.

Bolts: The standard MJ FIELD LOK Gasket kit comes with T-Head bolts/nuts to be used with C153 MJ Bell Flanges. Kits with bolts/nuts to be used with C110 MJ Bell Flanges may be provided if noted on the order. Bolts made of special materials such as Stainless Steel or Flourocarbon Coated Steel may also be furnished separately upon request.

MJ FIELD LOK Gaskets are suitable for either potable water or wastewater applications.

MJ FIELD LOK Gaskets are NSF 61 Approved.

*Series DI* Gaskets are UL Listed for 350 psi in 4"–16" sizes and 250 psi in 18"–24" sizes; and FM Approved, with a rating of 175 psi in 4"–12" sizes.

MJ FIELD LOK Gaskets *Series DI* products are not recommended for use with cast iron pipe, plastic pipe, oversize pipe, metric pipe, or for use as a 'transition' gasket, or pipe with an O.D. coating of any kind that is thicker than 5 mils.

MJ FIELD LOK Gaskets *Series PV* products are not recommended for use with cast iron pipe, Ductile Iron pipe, oversize pipe, metric pipe, or as a 'transition' gasket. *Series PV* Gaskets should not be used on any pipe with an O.D. coating of any kind that is thicker than 5 mils.

# US Pipe & Foundry Co.: MJ FIELD LOK Gaskets

*Series DI*

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 4.80 | DI04 | 5 | 350 | 3 | 7.3 |
| 6 | 6.90 | DI06 | 5 | 350 | 4 | 10.9 |
| 8 | 9.05 | DI08 | 5 | 350 | 6 | 13.5 |
| 10 | 11.10 | DI10 | 3 | 350 | 9 | 18.5 |
| 12 | 13.20 | DI12 | 3 | 350 | 13 | 19.7 |
| 14 | 15.30 | DI14 | 2 | 350 | 18 | 26.9 |
| 16 | 17.40 | DI16 | 2 | 350 | 24 | 31.8 |
| 18 | 19.50 | DI18 | 1.5 | 250 | 30 | 49.8 |
| 20 | 21.60 | DI20 | 1.5 | 250 | 36 | 59.7 |
| 24 | 25.80 | DI24 | 1.5 | 250 | 52 | 81.3 |

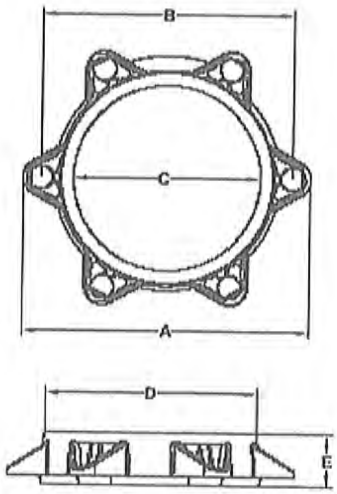
*Series PV*

| | | | | | |
|---|---|---|---|---|---|
| 4 | 4.80 | PV04 | 150 | 200 | 7.8 |
| 6 | 6.90 | PV06 | 150 | 200 | 11.8 |
| 8 | 9.05 | PV08 | 150 | 200 | 14.8 |
| 10 | 11.10 | PV10 | 150 | 200 | 20.1 |
| 12 | 13.20 | PV12 | 150 | 200 | 21.6 |

**MJ FIELD LOK® Gland**

*(See illustration at right.)*

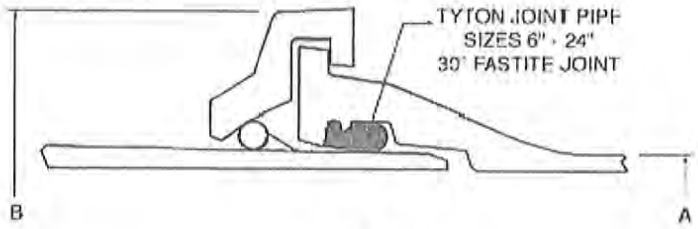
| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 3.3 | 8.88 | 7.50 | 4.90 | 5.92 | 1.75 |
| 6 | 5.0 | 10.87 | 9.50 | 7.00 | 8.02 | 2.00 |
| 8 | 7.2 | 13.13 | 11.75 | 9.15 | 10.17 | 2.25 |
| 10 | 10.2 | 15.38 | 14.00 | 11.20 | 12.22 | 2.25 |
| 12 | 11.0 | 17.63 | 16.25 | 13.30 | 14.32 | 2.25 |
| 14 | 17.2 | 20.13 | 18.75 | 15.44 | 16.40 | 2.51 |
| 16 | 25.0 | 22.38 | 21.00 | 17.54 | 18.50 | 2.75 |
| 18 | 38.0 | 24.75 | 23.25 | 19.64 | 20.60 | 3.14 |
| 20 | 46.0 | 27.00 | 25.50 | 21.74 | 22.70 | 3.20 |
| 24 | 64.0 | 31.50 | 30.00 | 25.94 | 26.90 | 3.57 |




Joint restraint for mechanical joint pipe and fittings shall be the MJ FIELD LOK® Gasket. The restraint system shall be completely integral to the gasket, requiring only standard mechanical joint assembly techniques. The restraining system for Ductile Iron shall be pressure rated to 350 psi in sizes up to and including 12", and 250 psi in sizes 16"–24". The restraining system for PVC shall be rated at a 2:1 safety factor for the pipe on which it is installed. The restraining system shall be rated in accordance with the performance requirements of *ANSI/AWWA C222/A21.22 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.*

# Assembly of Clow Water Systems Co. (McWane) SUPER-LOCK Restrained Joint Pipe

## SUPER-LOCK® RESTRAINED JOINT PIPE



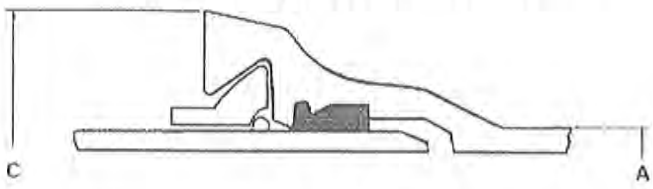

Type A 6"-30"

| Nominal Pipe Size Inches | Pressure Rating* psi | Joint deflection in Degrees | Inches in 18 feet | A Pipe O.D. Inches | B Retainer O.D. Inches |
|---|---|---|---|---|---|
| 6 | 350 | 4 | 15 | 6.90 | 11.75 |
| 8 | 350 | 4 | 15 | 9.05 | 14.38 |
| 10 | 350 | 4 | 15 | 11.10 | 16.75 |
| 12 | 350 | 4 | 15 | 13.20 | 19.13 |
| 14 | 350 | 3 | 11 | 15.30 | 21.75 |
| 16 | 350 | 3 | 11 | 17.40 | 24.00 |
| 18 | 350 | 3 | 11 | 19.50 | 26.38 |
| 20 | 350 | 3 | 11 | 21.60 | 28.63 |
| 24 | 350 | 3 | 11 | 25.80 | 33.75 |
| 30 | 250 | 2 | 7 | 32.00 | 40.13 |
| 36 | 250 | 2 | 7 | 38.30 | 43.875 |

*In the 14" and larger sizes, pressure rating is limited to the rating of the pipe barrel thickness selected.
Dimensions subject to manufacturing tolerances.

## PUSH-ON RESTRAINED JOINT PIPE

An All Ductile Iron, Restrained Push-On Joint




Type B
Size 36" Fastite Joint

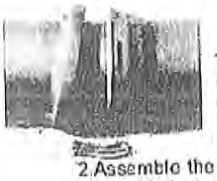
Push-on Restrained Joint pipe is a positive means of restraining Push-On Joint pipe and fittings. The joint is completely boltless and is recommended for both exposed and underground installations with working pressures well in excess of normal service requirements.
The joint can be deflected after assembly to facilitate installation and accommodate earth settlement or movement. The design assures uniform load distribution between the restraining components when the joint is deflected. The unique design provides for quick and easy disassembly should the need arise.
The joint complies with all the push-on requirements of ANSI/AWWA-C111/A21.11. Ductile pipe furnished with this joint is made in accordance with ANSI/AWWA-C151/A21.51. For ANSI/AWWA-C151/A21.51 thickness selection tables see pages 2 and 5.

## REFERENCE MATERIAL

# Assembly of Clow Water Systems Co. (McWane) SUPER-LOCK Restrained Joint Pipe

## CLOW SUPER LOCK®

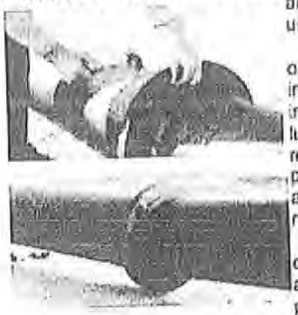
### ASSEMBLY INSTRUCTIONS



1.Remove hook bolts securing retainer to plain end. Clean plain end of pipe. Clean out any dirt behind retainer lugs. Lubricant may be applied to the beveled nose.

2.Assemble the joint in accordance with Clow Assembly Instructions. Make certain that the bell is clean prior to gasket insertion. Be sure that the correct gasket is used.

3.Guide plain end into Super-Lock bell and provide reasonably straight alignment. "Make" joint by pushing the plain end into the bell. A jack or come-a-long may also be used to pull the plain end into the bell. Position retainer so that the recesses line up with the lugs on the bell. Slide retainer over bell and rotate until the lugs on the bell and the retainer line up.



4.At drilled hole on retainer O.D., insert retainer lock in recess formed by lugs on bell and retainer. Insert roll pin in drilled hole and drive flush with retainer O.D.

5.Take any necessary deflection after joint is completely assembled.

### WELD-ON LOCK RING FOR FIELD-CUT PIPE

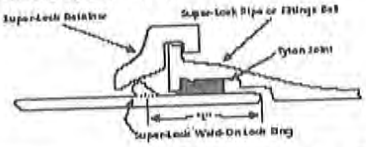
① Cut the pipe to the required laying length. The cut must be smooth and lie in the plane that is square with the axis of the pipe. Use a welder's wrap or other device, if necessary, to mark the pipe prior to cutting.

② Make certain the cut plain end is beveled for a distance of 3/8" to 1/2" along the barrel and smooth any sharp corners that could damage the gasket during joint assembly. (Proper beveling is very important and the use of a portable grinder is suggested).

③ Remove the asphaltic coating on the pipe in the area the retainer ring is to be welded - using a solvent wash or by burning with a torch. After the coating has been removed, grind the ring location to bright metal.

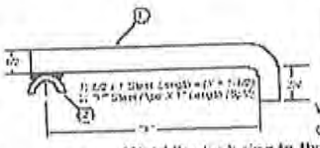
④ Slide the retainer casting on the pipe with the lugged side toward the plain end.

⑤ Slide the lock ring on the pipe and clamp the ring securely to the pipe in the location indicated at right:




| Description | Size | Description | Size |
|---|---|---|---|
| 6" Pipe | L-3 3/4" | 18" Pipe | L-5 1/8" |
| 8"-12" Pipe | L-4" | 20" Pipe | L-5 3/8 |
| 14" Pipe | L-4 3/4" | 24" Pipe | L-6 1/2" |
| 16" Pipe | L-5" | 30" Pipe | L-7 1/8" |

⑥ Use three (3) locating bars shown to secure field ring. Place the first bar at one end of the ring and the other two bars further around the pipe so that all bars are 6 to 10 inches apart. Clamp the bars securely by means of C-clamps or vise grips.




| Pipe size | 6 | 8-12" | 14" | 16" | 18" | 20" | 24" | 30" |
|---|---|---|---|---|---|---|---|---|
| "X" | 4 | 4 1/4 | 5 1/16 | 5 5/16 | 5 7/16 | 5 11/16 | 5 13/16 | 7 1/2 |
| "D" | 1/2 EX-HVY. | | 1/2 STD. WT. | | | | | 3/4 EX. HVY. |

As welding progresses around the pipe, the bar is removed from the welded area and reclamped further around the pipe, maintaining two clamps ahead of the area being welded. (See illustration photo)

Weld the lock ring to the pipe barrel on the side next to the spigot end as illustrated above. The weld electrode must be 55% nickel-Huntington Alloys Ni-Rod 55 or equal. Apply a 5/16" fillet weld using 1/8" diameter electrode.

Start at the end of the ring and skip weld every 2 inches-progressing around the pipe to the other end of the ring. Make sure that both ends of the ring are welded.

The recommended amperage range for 1/8" diameter rod is 75 to 95 amps-using a D.C. arc welder employing reverse polarity.

⑦ Thoroughly clean the weld and ring to remove all welt flux and splatter. Clean any weld splatter off the pipe spigot to assure proper joint assembly and gasket seating.

⑧ Paint the ring, weld and ground pipe surface with a smooth, uniform coat of brushable mastic, asphaltic base paint or machinery enamel.

⑨ Inspect the pipe lining for possible damage. Cement-mortar lining are normally not adversely affected by such welding procedures; however, if cement lining damage occurs, it should be patched in accordance with the procedures recommended in the ANSI/AWWA C104/A21.4 standard on cement-mortar linings.

⑩ Assemble the Super-Lock joint per Clow assembly instructions.

REFERENCE MATERIAL

# Griffin Pipe Products Co.'s SNAP-LOK Restrained Push-On Joint

## Griffin SNAP-LOK™ Restrained Push-On Joint

When joint restraint is specified, Griffin's ***SNAP-LOK*** is the system that has been designed to meet a variety of requirements for 6" through 48" pipe sizes. The ***SNAP-LOK*** restrained joint assembles with a simple, positive locking system that prevents joint separation. The design of the ***SNAP-LOK*** joint allows joint deflection after assembly while maintaining uniform load distribution. The ***SNAP-LOK*** joint may be easily disassembled should the need arise.

The completely boltless ***SNAP-LOK*** joint features a fast, easily installed push-on configuration. ***SNAP-LOK*** restrained joint pipe utilizes the ***TYTON® JOINT*** for 6" through 24" pipe sizes and the ***FASTITE®*** joint for the larger 30" through 48" pipe sizes. The restraining assembly consists of an integrally cast restrained joint bell, a spigot end with a factory-welded alloy steel ring, and a ductile iron "***SNAP-LOK***" restraining ring.

Griffin ductile restrained joint pipe is available in pressure class 350 for 6" through 24" sizes. The 30" - 36" sizes are available in pressure class 250 and 42" - 48" sizes are available in pressure class 200 or 250. All sizes of ***SNAP-LOK*** pipe are available in any of the special thickness classes.

**6" - 24" SNAP-LOK" with TYTON® JOINT**

**30" - 48" SNAP-LOK" with FASTITE® Joint**

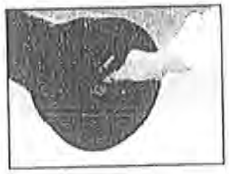
| Pipe Size (in.) | Maximum Bell Diameter (in.) | Laying Length | Deflection Angle (degrees) |
|---|---|---|---|
| 6 | 11.44 | 19'11" | 4 |
| 8 | 13.97 | 19'10" | 4 |
| 10 | 16.44 | 19'10" | 4 |
| 12 | 18.75 | 19'10" | 4 |
| 14 | 20.96 | 19'9" | 3 |
| 16 | 23.22 | 19'8" | 3 |
| 18 | 25.72 | 19'8" | 3 |
| 20 | 27.85 | 19'7" | 3 |
| 24 | 32.54 | 19'6" | 3 |
| 30 | 38.15 | 19'7" | 2 |
| 36 | 44.50 | 19'7" | 2 |
| 42 | 50.82 | 19'7" | 1/2 |
| 48 | 57.22 | 19'7" | 1/2 |

# Assembly of Griffin Pipe Products Co.'s SNAP-LOK Restrained Push-On Joint

1. Visually inspect the socket area for cleanliness. Remove any foreign matter such as mud, gravel, sand, ice, etc. The gasket seating area should be thoroughly inspected to ensure nothing will interfere with the proper seating of the gasket. Do not lubricate the inside of the bell!

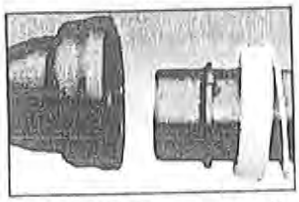
2. The gasket must be wiped clean with a clean cloth. Place the gasket into the socket with the rounded bulb-end entering first. Looping the gasket before the initial insertion will facilitate seating the gasket evenly around the retainer seat. Smaller sizes will require one loop while a larger gasket may require 2 loops. In cold weather (below 40°), the gaskets should be warmed for easier insertion.

3. Apply a thin film of pipe joint lubricant to the surface of the gasket that will contact the spigot end (plain end) of the pipe.



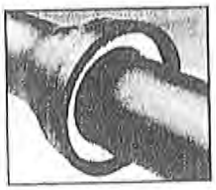
4. Remove any packing material from the pipe spigot. Clean dirt or debris from the outside of the large restraining ring. Clean the spigot end of the pipe and grind or file any sharp edges that may damage the gasket. Apply lubricant to the outside of the spigot end.

5. Place the spigot end into the companion bell socket. Maintain reasonably straight alignment. Push the pipe straight home with the aid of a pushbar or backhoe as necessary. If assembly is not achieved using reasonable force, dismantle the pipe and check for proper positioning of the gasket, adequate lubrication or debris in the joint.

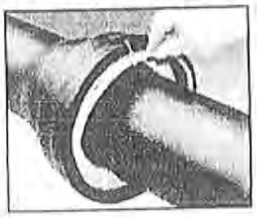


6. Slide the large ***SNAP-LOK*** restraining ring(s) fully into the bell socket. With proper insertion, the full depth of the locking ring groove should be visible. This is the groove closest to the face of the bell end.

   6" - 24" pipe sizes have one-piece ***SNAP-LOK*** rings which are pre-installed on the pipe. 30" - 48" pipes have segmented rings that are supplied separately with each shipment.
   30" - 36" pipe have 4 segments per joint.
   42" - 48" pipe have 5 segments per joint.

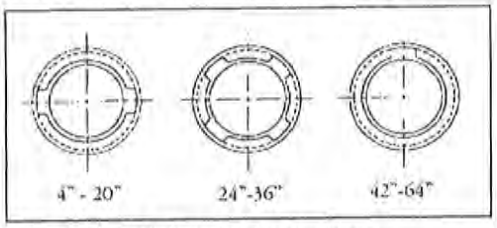


7. Insert the alloy steel locking ring into the groove. The ring may be forced into the groove if necessary. Once the ring is completely within the groove, the small wire-tie should be cut and removed. This will allow the locking ring to expand into place within the groove. This completes the ***SNAP-LOK*** assembly.



## Assembly of US Pipe & Foundry Co. TR-FLEX Pipe (page TR-2)

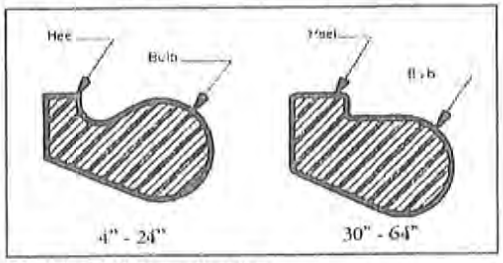
**CAUTION: The inside of the socket, the gasket, and the plain end to be inserted, must be kept clean throughout the assembly. Joints are only as watertight as they are clean. If the joint is somewhat difficult to assemble, inspect for proper gasket positioning, adequate lubrication, and removal of foreign matter in the joint.**




### Insertion Slot Orientation

The above 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 (see welded outlets 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.



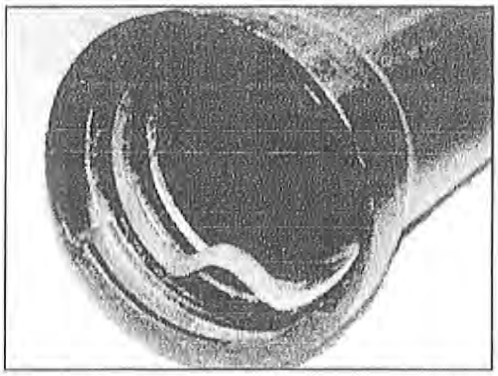

### Gasket Installation

Conventional TYTON® Gaskets are used for TR FLEX Pipe and Fitting sockets in the 4" - 42" size range. For the 48"-64" size range, a special TR FLEX Gasket is required. This TR FLEX Gasket has a smaller cross-section than the TYTON Gasket in this size range.

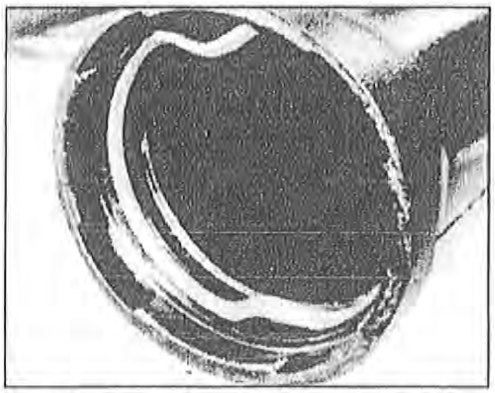
NOTE: For the 4"-10" sizes where TR FLEX GRIPPER® Rings are not used, it may be preferable to locate the bell slots vertically with only the slot in the 12 o'clock position being used for inserting locking segments.

## Assembly of US Pipe & Foundry Co. TR-FLEX Pipe (page TR-3)

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 heel retaining groove of the socket.



Smaller size gaskets *(4-inch through 20-inch)* require only one loop.

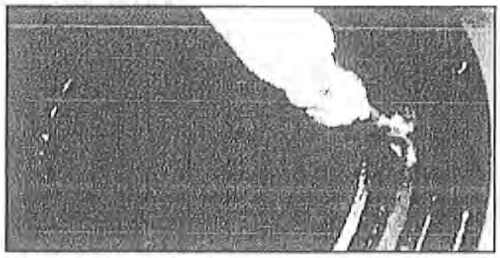


With larger sizes, additional loops may be required: 42" through 54", four to six loops; 60" and 64", six or more loops. Do not apply lubricant to the gasket seat.

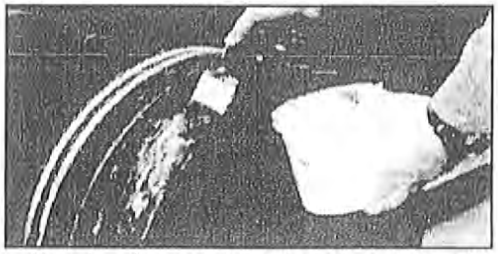
Make sure the gasket is uniformly seated around the inside of the socket.

In colder weather, the gaskets should be kept at temperatures above 40°F 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.

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

### Table 1
### Maximum Deflection of TR FLEX Pipe and Fittings*

| Size | Max. Deflection |
|---|---|
| 4 | 5° |
| 6 | 5° |
| 8 | 5° |
| 10 | 5° |
| 12 | 5° |
| 14 | 3 ½° |
| 16 | 3 ½° |
| 18 | 3° |

| Size | Max. Deflection |
|---|---|
| 20 | 2 ½° |
| 24 | 2 ½° |
| 30 | 1 ½° |
| 36 | 1 ½° |
| 42 | ½° |
| 48 | ½° |
| 54 | ½° |
| 60 | ½° |
| 64 | ½° |

*These deflections are based on joints with nominal dimensions; slightly higher deflections may be obtained in the field.

## Assembly of US Pipe & Foundry Co. TR-FLEX Pipe (page TR-4)

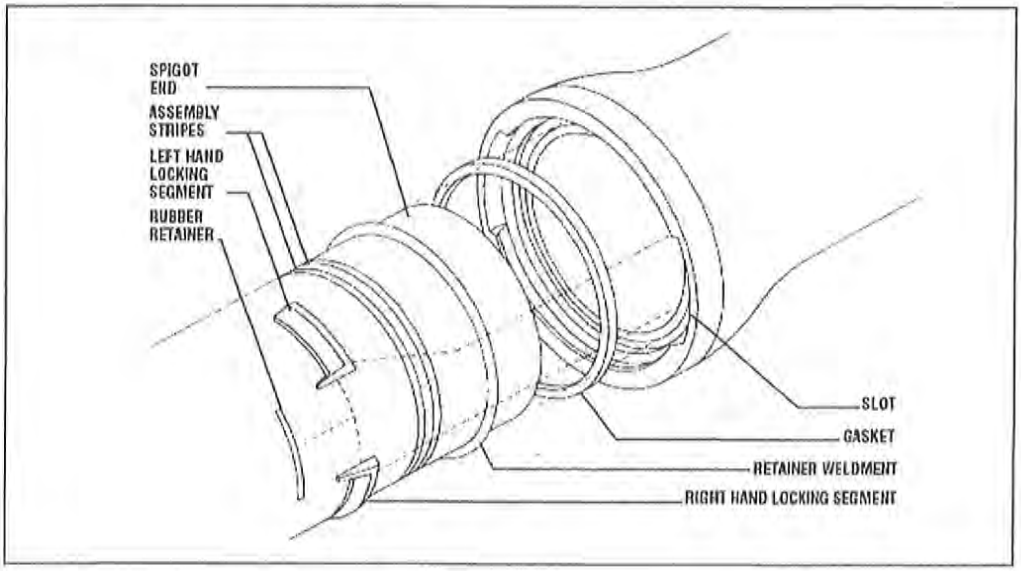
Instructions for 4" - 10" TR FLEX Pipe and Fittings - Two Bell Slots

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

INSTRUCTIONS:

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 counterclockwise 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 section entitled *TR FLEX Pipe and Fitting Socket Pullout, Page TR-8.*)
10. Set the joint deflection as required. (See Table 1)



## Assembly of US Pipe & Foundry Co. TR-FLEX Pipe (page TR-5)

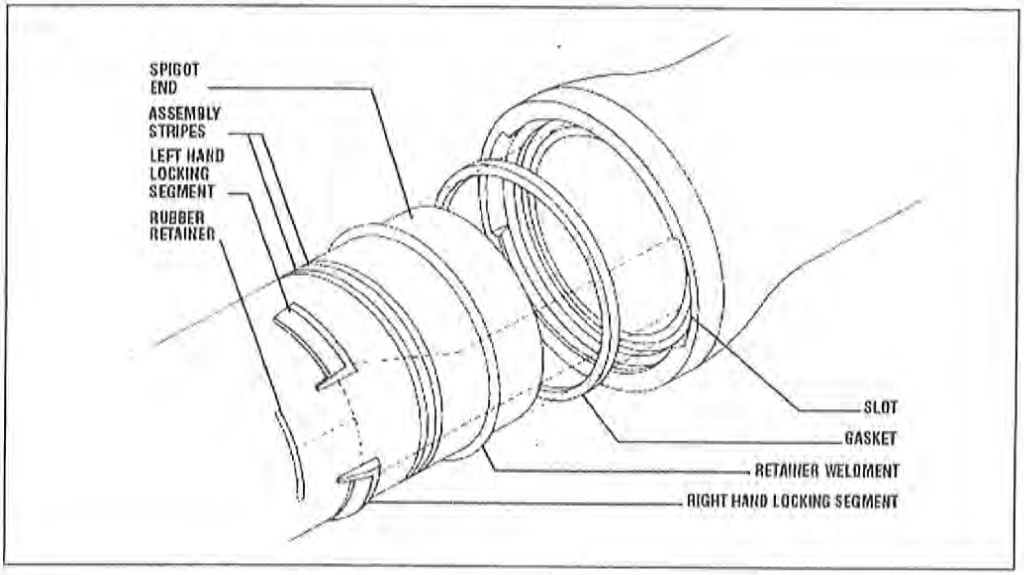
Instructions for 12" - 20" TR FLEX Pipe and Fittings - Two Bell Slots

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

INSTRUCTIONS:

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 section entitled *TR FLEX Pipe and Fitting Socket Pullout, Page TR-8.*)
11. Set the joint deflection as required. (See Table 1)



## Assembly of US Pipe & Foundry Co. TR-FLEX Pipe (page TR-6)

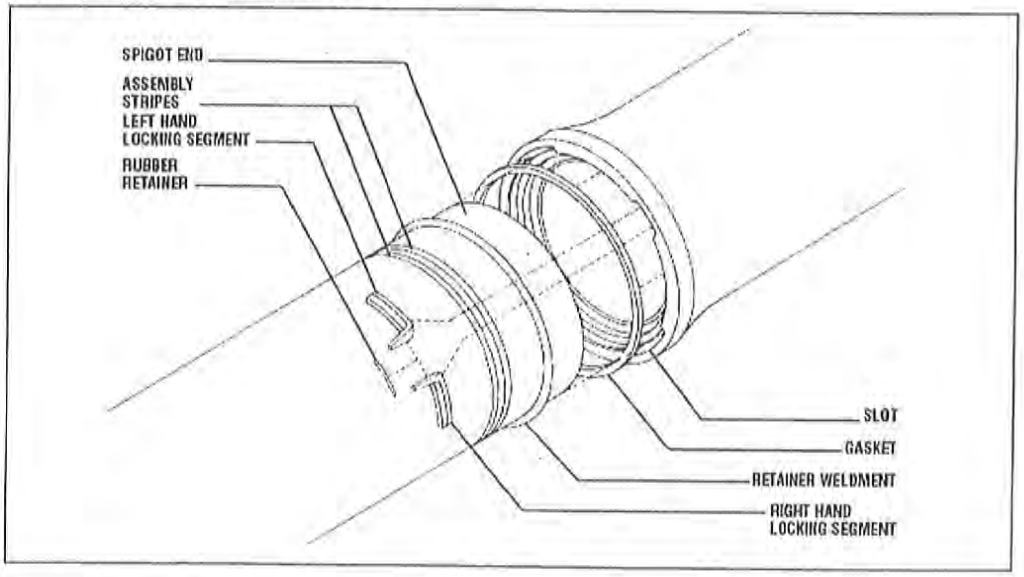
Instructions for 24" - 36" TR FLEX Pipe and Fittings - Four Bell Slots

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

### INSTRUCTIONS:

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 section entitled *TR FLEX Pipe and Fitting Socket Pullout, Page TR-8.*)
11. Set the joint deflection as required. (See Table 1)

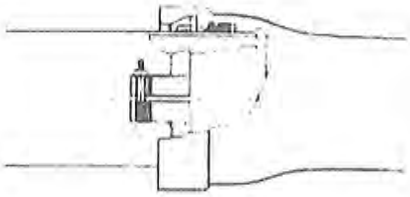


# Assembly of US Pipe Co. TR-FLEX Pipe using TR-FLEX Gripper Rings (page TR-9)

## TR FLEX GRIPPER® Ring

TR FLEX GRIPPER® Rings are used to restrain 4-inch through 36-inch field cut pipe (pipe without weldment) inside TR FLEX® Pipe and Fittings. 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.

For 42-inch through 64-inch TR FLEX Pipe, field welded bars must be used. Field weldments can also be used for smaller diameter Ductile Iron Pipe. Field weldment bars, lugs and instructions are available from U.S. Pipe. *(See U.S. Pipe brochure, "Field Cutting and Welding Procedure for TR FLEX® Pipe.")*

### NOTES ON THE USE OF TR FLEX GRIPPER RINGS:

1. There must be no more than 6 mils coating on the end of the pipe to be restrained with the TR FLEX GRIPPER Ring.
2. *The TR FLEX GRIPPER Ring should not be used on gray iron pipe.*

## 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 3. If the measurement is not within the prescribed range, another pipe should be selected and checked before cutting.

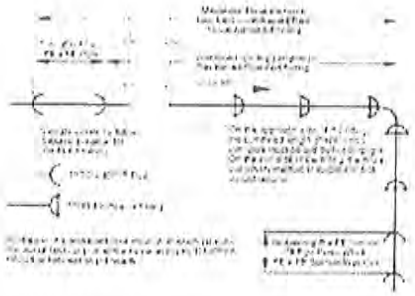
The pipe must be cut as square as is practical. A field cut end that is not square may leak, especially if the joint is fully deflected. Measure from the factory manufactured spigot end to the desired cut location. Mark the measured distance around the circumference of the pipe at sufficient intervals 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.

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

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.

## Alternate Method For Field Cut Pipe

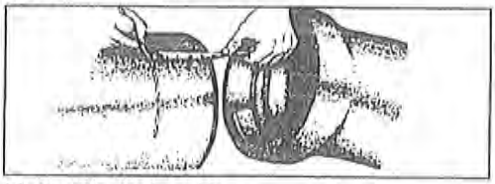
The following schematic illustrates the use of a field cut pipe in the unrestrained portions of the line, thus eliminating the requirements for GRIPPER Rings or field weldments.



# Assembly of US Pipe Co. TR-FLEX Pipe using TR-FLEX Gripper Rings (page TR-10)

## The Assembly Mark

Make an assembly mark on the pipe barrel at the location as shown in Table 4. Use this assembly mark to ensure that the pipe is inserted the proper depth into the socket. If the pipe is "bottomed out" in the socket, the amount of joint flexibility will be reduced. If the pipe is not inserted far enough into the socket, the gasket may not seal *(particularly if the joint is deflected.)*



Marking Pipe for Assembly

## Table 4 Assembly Mark Location

| NOM. PIPE SIZE | LOCATION OF ASSEMBLY MARK |
|---|---|
| 4 | 4 3/8 |
| 6 | 4 7/8 |
| 8 | 5 3/8 |
| 10 | 5 5/8 |
| 12 | 5 7/8 |
| 14 | 7 3/8 |

| NOM. PIPE SIZE | LOCATION OF ASSEMBLY MARK |
|---|---|
| 16 | 7 1/2 |
| 18 | 7 3/4 |
| 20 | 8 |
| 24 | 8 1/2 |
| 30 | 10 |
| 36 | 10 1/2 |

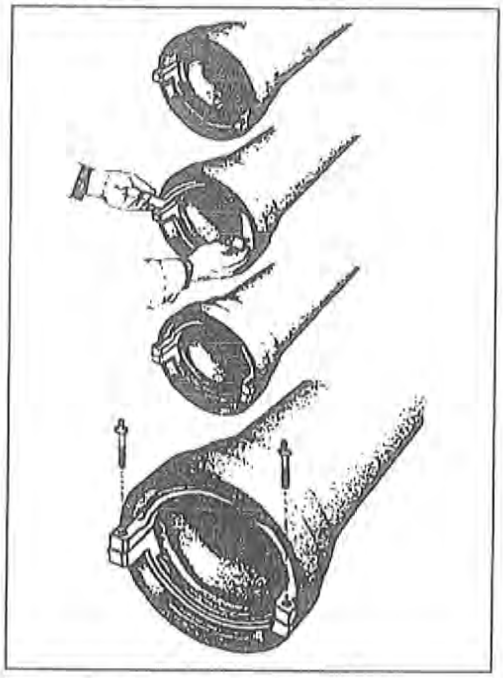
## Instructions for Assembling TR FLEX GRIPPER® Ring

Follow the instructions as previously set forth for cleaning the pipe or fitting bell and gasket.

## 4-inch Through 24-inch TR FLEX GRIPPER Ring Initial Assembly Instructions

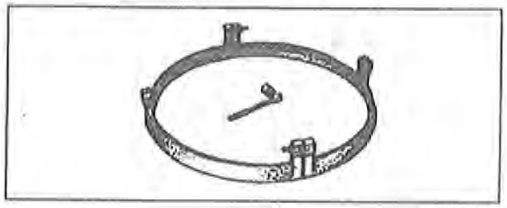
The 4-inch through 20-inch TR FLEX GRIPPER Rings are made in two segments. The 24-inch and larger rings are made in four segments. Remove the bolts from the TR FLEX GRIPPER Ring. Position the TR FLEX GRIPPER Ring segments into the bell locking segment cavity so that segment handles protrude beyond the bell face. Insert the bolts into the segment handles so that the segments form a loose ring.

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.

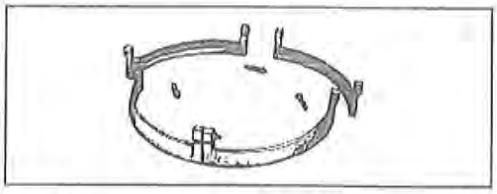


## 30-inch and 36-inch TR FLEX GRIPPER Ring Initial Assembly Instructions

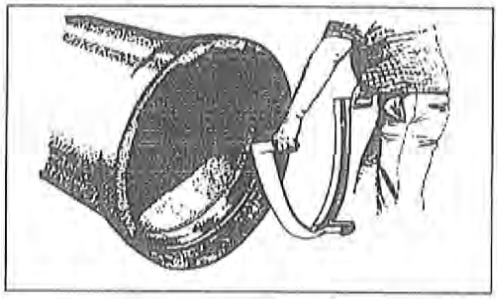
The four segment 30-inch and 36-inch TR FLEX GRIPPER Rings differ from the 24-inch ring in that two of the segments are joined with a jack screw. With the jack screw, it is possible to fully expand the ring segments to provide the maximum assembly clearance for the entering pipe.



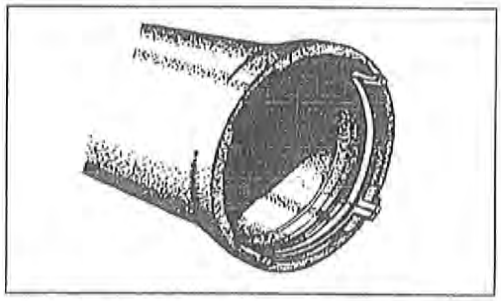
## Assembly of US Pipe Co. TR-FLEX Pipe using TR-FLEX Gripper Rings (page TR-11)



To install, remove the three short bolts. Do not remove the long jack screw. Position the two segment section into the lower half of the TR FLEX® pipe or fitting bell locking segment cavity.

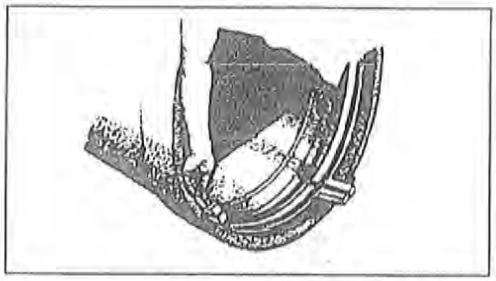


Correctly positioned, the locking segment handles protrude slightly beyond the bell face and the jack screw is easily assembled.

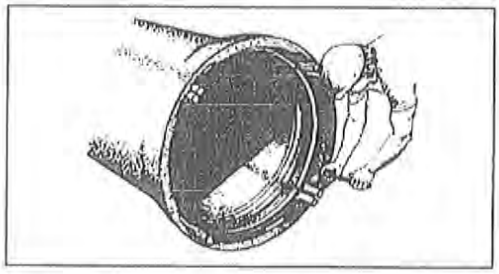


Reinsert the bolts into the locking segment handles. The segments should form a loose ring.

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.



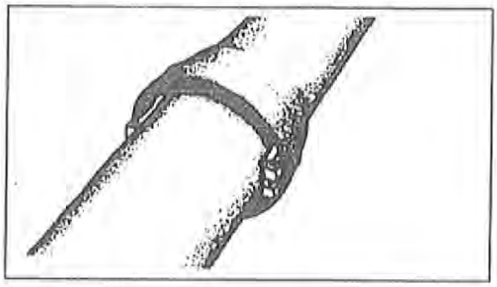
Back off the jack screw so that the locking segments are forced to become fully seated into the bell locking segment cavity.



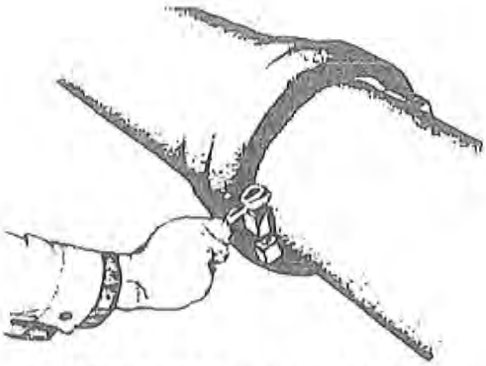
### 4-inch Through 36-inch Final Assembly Instructions

Clean the cut pipe spigot end to the assembly mark. Lubricate the exposed gasket surfaces and the pipe spigot end as previously instructed.

Assemble the cut pipe into the previously laid pipe or fitting bell. The assembly mark should be flush with the bell face. Keep the pipe in alignment during this stage of assembly.

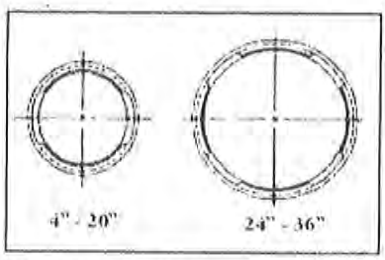


# Assembly of US Pipe Co. TR-FLEX Pipe using TR-FLEX Gripper Rings (page TR-12)



TR FLEX GRIPPER Rings in sizes 4" through 20" are equipped with 1/2" *Torque Limiting* bolts and sizes 24" through 36" with 5/8" *Torque Limiting* bolts.

While keeping the assembled joint in straight alignment, tighten the (2) - 1/2" bolts on the 4" - 20" sizes with a 3/8" 12-point socket wrench until the caps of the bolts shear off. Use the same procedure for the (4) - 5/8" bolts on the 24" size using a 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.




## 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 provide access to properly tighten bolts.

## Deflection

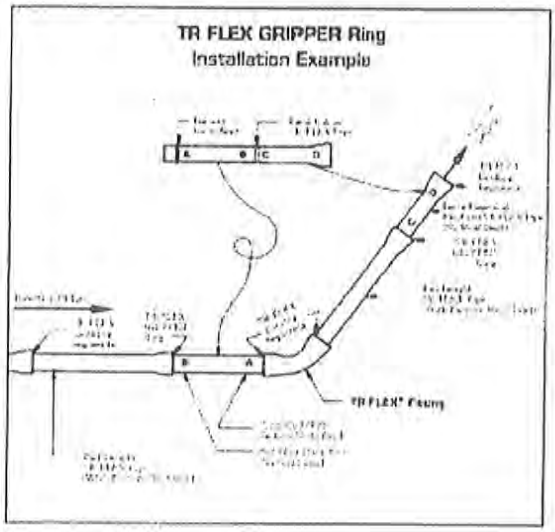
*If the TR FLEX GRIPPER Ring is not square with the pipe during installation, any subsequent movement of the joint as pressure is applied could result in loosening the ring and possible joint separation.*

The joint deflection should be set (as shown in Table 1, page TR-3) only after the installation is complete.

The precautions noted earlier under TR FLEX Pipe and Fittings Socket Pullout (page TR-8) also apply to TR FLEX GRIPPER Ring restrained joints.

## Installation Tip

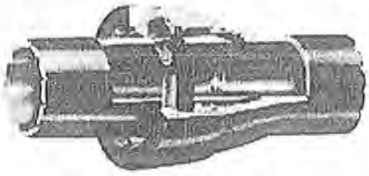
Many contractors have found that it is simpler to properly install the TR FLEX GRIPPER Ring in TR FLEX® pipe sockets than in TR FLEX fitting sockets since it is easier to keep the pipe-to-pipe joint in alignment during assembly and installation. The following illustration depicts an example of such an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



# American Cast Iron Pipe Co.'s (ACIPCO) Flex-Ring Restrained Push-On Joint Pipe

**4" - 12" Flex-Ring® Joint**

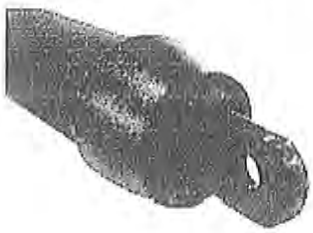
**14" - 36" Flex-Ring® Joint**



AMERICAN Flex-Ring® Restrained Joint Ductile Iron pipe, utilizing the sealing features of the time-proven Fastite® Joint and a bolt-less restrained connection, provides flexible, easily assembled, positive restraint against endwise separation due to thrust.

The patented[1] Flex-Ring Joint is designed for a working pressure[2] equal to that of the pipe or up to 350 psi in sizes 4"-24" and up to 250 psi in sizes 30" and 36". The joint has been thoroughly factory tested to withstand dead-end thrust resulting from more than twice those working pressures.

Flex-Ring® joint pipe with its positive, flexible joint restraint may also be used in trenchless applications such as **horizontal directional drilling** and pipe bursting. With spigot ahead, the low-profile Flex-Ring® bell assembles quickly and offers a smooth transition during pipe pull-back. AMERICAN offers a Flex-Ring® pulling bell assembly specifically designed for this installation method.



**Pulling Bell Assembly**

For 4"-12" sizes, a beveled ductile iron, welded-on retainer ring and a ductile iron split flex-ring, assembled behind the retainer ring, provide the means of restraint. After the plain end of the pipe is assembled into the Flex-Ring bell, the split flex-ring is inserted and springs into the socket locking groove. The flex-ring is securely positioned behind the welded-on retainer ring and in the socket locking groove on the inside of the pipe bell. This provides the flexible restraint.

For 14"-36" sizes, a shop-applied weld bead and a rubber-backed ring, containing yellow painted ductile iron segments, provide the means of restraint. As the plain end of the pipe is fully assembled into the bell, the ductile iron segments automatically close on the pipe behind the weld bead. The enclosure of the segments between the weld bead, spigot, and the sloped inner lip of the bell provides the flexible restraint.

The Flex-Ring Joint can be safely deflected after assembly to the limits shown in Table Nos. 9-1 and 9-2. This liberal deflection facilitates installation, decreases the number of necessary fittings, and accommodates settlement.

The Flex-Ring Joint is Underwriters Laboratories listed and Factory Mutual approved in sizes 4"-12". This UL listing and FM approval applies to all pressure classes and special thickness classes of ductile iron pipe.

The only joint components needed to assemble the Flex-Ring Joint are a gasket and a single ring.

# American Cast Iron Pipe Co.'s Flex-Ring Restrained Push-On Joint Pipe

## Standard Dimensions and Pressure Ratings

**4"-12"**

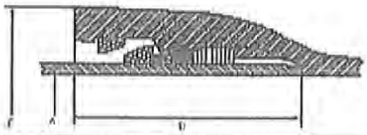


Table No. 9-1

| Size in. | Working Pressure* psi | Nominal Laying Length** ft. | A O.D. in. | B Socket Depth in. | F Bell O.D.† in. | Allowable Pulling Load lb.†† | Allowable Deflection degree | Offset per 20' Length in. | Radius of Curve^ ft. | Empty Pipe Buoyancy In Water (lb/ft)^^ |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 350 | 20 | 4.80 | 5.62 | 7.06 | 10,000 | 5 | 21 | 230 | -5 |
| 6 | 350 | 20 | 6.90 | 5.62 | 9.19 | 20,000 | 5 | 21 | 230 | -2 |
| 8 | 350 | 20 | 9.05 | 5.74 | 11.33 | 30,000 | 5 | 21 | 230 | 3 |
| 10 | 350 | 20 | 11.10 | 6.72 | 13.46 | 45,000 | 5 | 21 | 230 | 11 |
| 12 | 350 | 20 | 13.20 | 6.72 | 15.74 | 60,000 | 5 | 21 | 230 | 19 |

* Working pressure is the maximum pressure rating of the joint and is based on its capability to resist thrust due to internal pressure. If higher working pressure is required, check AMERICAN.

** Laying length is nominal 20'. Where exact lengths are required, contact AMERICAN. Minimum laying lengths for Flex-Ring & Flex-Ring End pipe is 1'-0" and for Flex-Ring End & Flex-Ring End pipe is 2'-0".

† Dimensions subject to change at our option. Check AMERICAN if smaller or exact dimensions are required.

†† Intended for Horizontal Directional Drilling (HDD) applications. Flex-Ring pipe may be available for greater pulling loads than indicated in the tabulated values. Contact AMERICAN when higher pulling loads are required.

^ Approximate radius of curve produced by a succession of 20' lengths of pipe fully deflected.

^^ Based on weight of empty (full of air) Pressure Class 350 Flex-Ring pipe with standard cement lining immersed in water. Positive numbers indicate such pipe will sink.

**14"-36"**

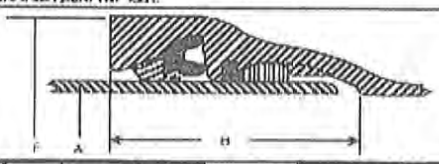


Table No. 9-2

| Size in. | Working Pressure* psi | Nominal Laying Length** ft. | A O.D. in. | B Socket Depth in. | F Bell O.D.† in. | Allowable Pulling Load lb.†† | Allowable Deflection degree | Offset per 20' Length in. | Radius of Curve^ ft. | Empty Pipe Buoyancy In Water (lb/ft)^^ |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 350 | 20 | 15.30 | 7.38 | 19.31 | 75,000 | 4 | 17 | 285 | 27 |
| 16 | 350 | 20 | 17.40 | 7.38 | 21.43 | 95,000 | 3 3/4 | 16 | 305 | 38 |
| 18 | 350 | 20 | 19.50 | 8.20 | 23.70 | 120,000 | 3 3/4 | 16 | 305 | 52 |
| 20 | 350 | 20 | 21.60 | 8.20 | 25.82 | 150,000 | 3 1/2 | 15 | 327 | 69 |
| 24 | 350 | 20 | 25.80 | 8.95 | 29.88 | 210,000 | 3 | 12 | 380 | 101 |
| 30 | 250 | 20 | 32.00 | 9.63 | 36.34 | 220,000 | 2 1/2 | 10 | 456 | 175 |
| 36 | 250 | 20 | 38.30 | 9.63 | 42.86 | 310,000 | 2 | 8 | 570 | 266 |

* Working pressure is the maximum pressure rating of the joint and is based on its capability to resist thrust due to internal pressure. If higher working pressure is required, check AMERICAN. Pressure rating of the joint is limited by the pressure rating of the thickest pipe.

** Laying length is nominal 20'. Where exact lengths are required, contact AMERICAN. See below for minimum laying lengths for 14"-36" Flex-Ring.

† Dimensions subject to change at our option. Check AMERICAN if smaller or exact dimensions are required.

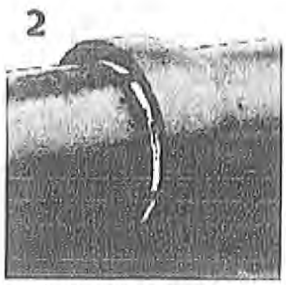
†† Intended for Horizontal Directional Drilling (HDD) applications. The tabulated values are based on Pressure Class pipe thickness of the "Working Pressure" shown. Contact AMERICAN when it may be desirable to use lower pressure class pipe or when higher pulling loads are required. Flex-Ring pipe may be available for greater pulling loads than indicated in the tabulated values.

^ Approximate radius of curve produced by a succession of 20' lengths of pipe fully deflected.

^^ Based on weight of empty (full of air) Pressure Class 350 Flex-Ring pipe with standard cement lining immersed in water. Positive numbers indicate such pipe will sink.

## Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

**Assembly Instructions**
**4"-12"**


Prior to joint assembly, remove the packing material holding the split flex-ring onto the pipe. (See "Field Assembly of Flex-Ring" if split flex-ring is shipped separately.) Thoroughly clean the socket locking groove as well as the Fastite gasket recess and pipe plain end. In accordance with standard Fastite joint assembly instructions, insert the gasket and lubricate the pipe plain end, bevel, and inside surface of the gasket. With the pipe in essentially straight alignment, assemble the plain end into the Flex-Ring socket until the spigot stripe disappears into the bell. The orientation of the spigot stripe relative to the bell face is an indication of pipe alignment.

**1.** Tap the flex-ring into the socket beginning with one end of the flex-ring and progressing around the joint as shown in Photo 1. This operation is made easier by holding one end of the flex-ring inside the bell as the remainder of the ring is caulked into the socket. Correct seating is generally ensured by a snapping noise as the flex-ring springs into position. (Note: When a visual inspection to determine the flex-ring position is not practical, such as in an underwater installation, a feeler gauge can be used to ensure the correct positioning of the flex-ring in the socket locking groove. It may be necessary to move the entering pipe slightly to improve alignment if the ring does not readily spring into the socket locking groove.)

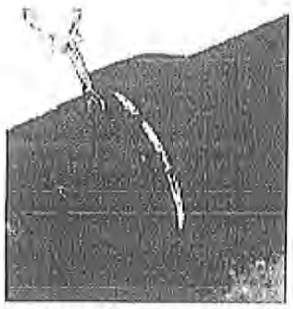
**2.** The completed joint.

## Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

**Assembly Instructions**
**4"-12"**

**FIELD ASSEMBLY OF FLEX-RING**

If the split flex-ring is shipped separately, assemble it onto the pipe spigot by spreading the Flex-Ring ends as shown above. Be sure that the flex-ring is oriented so that the small end is toward the pipe plain end.



**DISASSEMBLY OF 4"-12" FLEX-RING**

If disassembly of the joint is required, it may be accomplished by inserting pins or nails into the drilled holes furnished in the flex-ring ends and compressing the flex-ring firmly onto the pipe as shown above. If desired, steel pins can be field-welded onto the ends of common adjustable pliers, if such a disassembly tool is more desirable to the user. If axial movement or joint extension has occurred in the joint prior to disassembly, it may be necessary to move the spigot completely to the rear of the socket in straight alignment to allow the Flex-Ring to be compressed for removal.

**THE FOLLOWING INFORMATION PERTAINS TO 4"-36" JOINTS:**

**NOTE:** The AMERICAN Flex-Ring Joint allows for joint take-up and flexibility after installation. In most underground installations, including most restrained bend locations, this feature is advantageous in that increased thrust resisting soil forces are generated. Also, expansion and contraction due to temperature variations may be accommodated without excessive stress in the pipe members.

**In any application where axial or lateral movement may be undesirable, such as certain bridge crossings, certain other exposed piping testing or applications, or certain connections of restrained pipe sections at angles to rigid piping, special design or installation provisions, including effective joint extension, may be necessary to control any unacceptable pipeline movement. (See also Section 7, Pipe-On-Supports, etc.)** Depending on job conditions and restrained pipe length, cumulative joint take-up can be substantial, particularly in exposed or unburied piping applications. In this regard, joints may be extended after assembly to minimize further joint take-up in test or service. This will not prevent proper joint deflection.

The amount of joint take-up or line movement in buried restrained pipelines is substantially limited by the surrounding soil. Therefore, system security and safety is maximized by filling and testing restrained sections of pipelines after backfilling as recommended by ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances and AWWA Manual M41.

# Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

## Assembly Instructions
## 14"-36"

**1) Cleaning and Fastite gasket insertion**

Thoroughly clean the socket restraining groove (nearest the bell end), the Fastite gasket recess, and the pipe plain end, removing dirt, sand, ice, mud, or any other material which could prevent the proper placement of the Fastite gasket and flex-ring. As in normal Fastite joint assembly, insert the gasket into the gasket socket groove (Photo 1). **Important: A Fastite gasket must also be used, because the rubber-backed flex-ring does not perform any sealing function.**


**2) Placement of the flex-ring in socket and joint lubrication**


Remove the flex-ring from its container and place it in the socket restraining groove in gasket-like fashion (Photo 2). The **yellow** restraining segments of the flex-ring must be oriented toward the entering spigot. This may be done by first placing the flex-ring in the socket groove by forming one or more inward or lateral loops in the rubber-backed ring (Photo 3). Work all inward or lateral loops fully outward and planar such that each metal segment fits reasonably flush against the wedging surface of the socket, and no rubber bulges or twists remain (Photo 4).



Lubricate the inside surface of the gasket and the first four inches of the spigot including the beveled nose end of the pipe. Do not allow the lubricated spigot end of the pipe to contact the ground prior to insertion.

**3) Initial placement of Flex-Ring spigot end into socket**

With the spigot in reasonably straight alignment and centered within the flex-ring (Photo 5), insert the spigot until it contacts the back of the socket per normal Fastite joint assembly procedure. (See Section 2 for additional detail on Fastite assembly procedures.) When the weld bead is in proper assembled position fully beyond the yellow Flex-Ring segments, every segment will be trapped firmly between the weld bead, the spigot, and the wedging surface of the socket.


**Verify the correct positioning of the yellow Flex-Ring segments by visual inspection (or by "feeler" gauge if installed in conditions of poor visibility).** The segments will normally snap directly into the correct assembled position. However, if any segment should not come down firmly onto the pipe at any location, deflect the pipe slightly in that direction, thereby allowing the segment to seat itself correctly.

After joint assembly, the joint may be extended and then deflected within the range of allowable joint deflection for the size of pipe being assembled.

**4) Assembly of fittings**

Flex-Ring pipe and fitting joints can generally be assembled with the same tools and methods used for many years with Fastite joints. When using a field-cut pipe to locate a fitting, it may be advantageous to use an uncut flex-ring spigot end (with factory weld bead) and a standard flex-ring in the fitting socket rather than using a field-cut plain end and Field

## Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

### Assembly Instructions
### 14"-36"

Flex-Ring with black-toothed gripping segments. A Field Flex-Ring and cut pipe plain end may then be used in the nearest pipe socket on either side of the fitting. When possible, the use of standard flex-ring with yellow segments and factory spigots with weld beads in the sockets of a fitting may allow easier orientation or rotation of the fitting relative to the pipe after assembly, if this is needed. (See Section 4 for additional detail on the assembly of Fastite fittings.)

**5) Joint extension after installation**

The 14"-36" Flex-Ring locking mechanism allows approximately one inch of free axial movement and also provides substantial flexibility after installation. However, the joints may be extended after assembly to minimize this joint take-up in test or service conditions.

In most underground installations (including most restrained bend locations), joint take-up is advantageous in that increased thrust resisting forces are generated. Also, expansion and contraction due to temperature variations may be accommodated without excessive stress in pipe members. The amount of joint take-up or line movement in buried restrained pipelines is substantially limited by the surrounding soil. Therefore, system security and safety is maximized by filling and testing restrained sections of pipelines **after** backfilling as recommended by ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances and AWWA Manual M41.

**In any application where axial or lateral movement may be undesirable, such as certain bridge crossings, certain exposed or unburied piping applications, or certain connections of restrained pipe sections to rigid piping, special provisions, including effective joint extension, may be necessary to control unacceptable pipeline movement.**

Depending on job conditions and restrained pipe length, cumulative joint take-up can obviously be substantial, particularly in exposed piping applications.

Where joint pre-extension is necessary in a piping system, it may be accomplished by pulling or jacking the spigot away from the socket until firm resistance is encountered. This will not limit joint flexibility. See "Restrained Joint Pipe Assembly Extension Procedure" in this section of the Pipe Manual for more information concerning joint extension.

# Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

## Disassembly Instructions for 14"-36" Flex-Ring Joints

Flex-Ring joints may be disassembled if required using sharp wedges and 3/16"-1/4" thick disassembly shims. Flex-Ring disassembly sets are available from AMERICAN and are suggested for disassembly. These disassembly sets include two sharp steel starter wedges and 15 "L"-shaped shims. The wedges are used to start the separation of the yellow Flex-Ring joint locking segments outward from the spigot while it is in the bell of an already assembled joint. The "L"-shaped shims are then hammered between the spigot and each locking segment. The thicker shims lift the locking segments entirely away from the spigot when fully inserted, and allow the spigot weld bead to pass under the locking segments generally located as shown in Figs. 1 and 2. Step-by-step instructions follow:

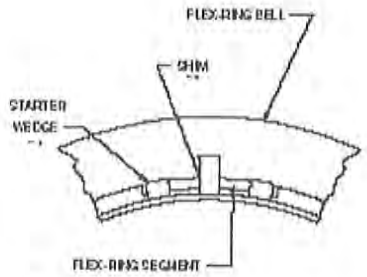



**Figure 1**
**Starter shim and wedge arrangement for 14", 18", and 20" sizes.**

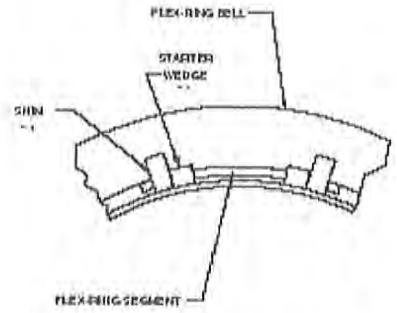



**Figure 2**
**Shim and wedge arrangement for 16", 24", 30", and 36" sizes.**

**1. First straighten the joint as much as possible and push or pull the spigot back into the bell until it "bottoms out" in the rear of the socket.** (Fig. 3)

**2. Hammer a starter wedge under a yellow locking segment until an approximately 1/8" gap is seen between the segment and the spigot.** (Fig. 4)

**3. Hammer a second wedge (if necessary to start the shims) under the other end of the locking segment as in step 2.**

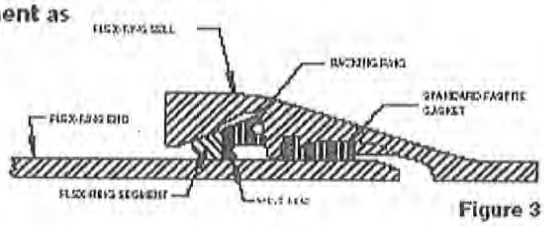



**Figure 3**

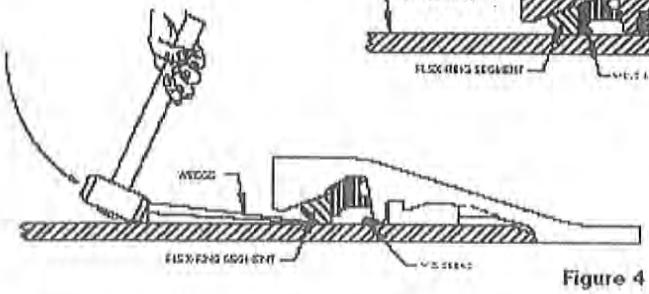



**Figure 4**

## Assembly of ACIPCO's Flex-Ring Restrained Push-On Joint Pipe

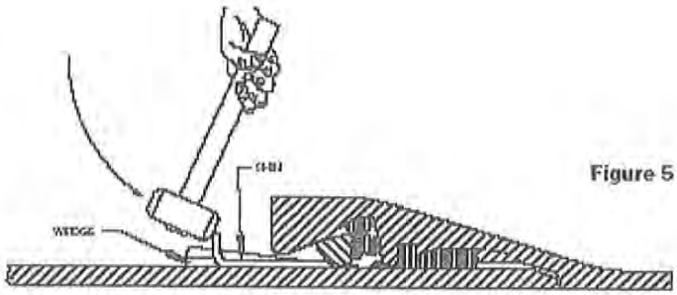



Figure 5

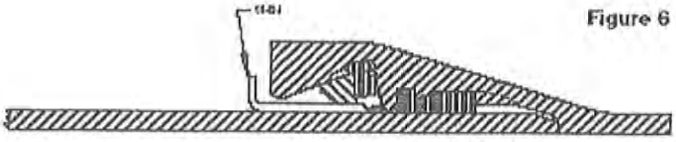


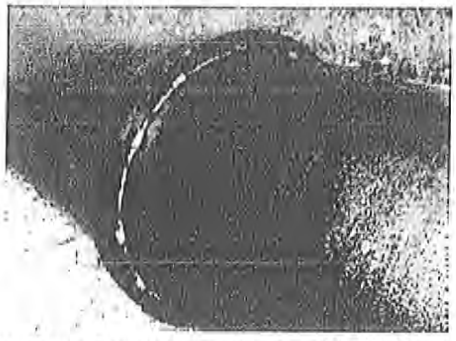
Figure 6

**4. With a large hammer (such as a six pounder) vigorously drive one or two "L"-shaped shims under the locking segment until the ends of the shims firmly contact the spigot weld bead.** (Fig. 5) Shims and wedges can be safely and firmly held against the pipe as they are hammered using a block of wood or a board. Safety precautions such as the wearing of safety glasses and keeping clear of the hammer during striking should always be taken to avoid injury.

**5. Remove the starter wedges from between the locking segment and spigot, leaving the shim(s) in place.** (Fig. 6) Note that the wedges are reused for each locking segment.

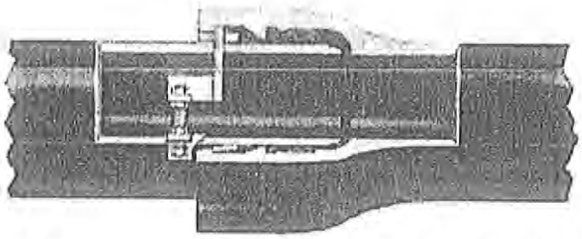
**6. Drive wedges and shims under all locking segments as shown in steps 2-5.** (See photo.) Check to be sure that the inner surface of all segments will not interfere with the spigot weld bead during joint separation after inserting shims.

**7. Separate the joint.** During joint separation, it is generally best to pull the spigot straight out of the socket. Extreme back and forth deflecting motions of the spigot during joint separation can cause shims to fall out of the joint and/or relocking to occur. If the joint does not readily come apart, check to see if one or more of the segments is in locking contact with the spigot weld bead. If so, push or deflect the spigot back in that location and add or replace shims as required.



**Disassembly kits accompanied by instructions for use can be furnished by AMERICAN upon request.**

## American Cast Iron Pipe Co.'s Lok-Ring Restrained Push-On Joint Pipe



The AMERICAN Lok-Ring® Joint is another restrained joint that utilizes the sealing features of the time-proven AMERICAN Fastite Joint. It is an essentially boltless, flexible restrained connection that provides an easily assembled positive restraint against endwise separation due to thrust resulting from internal pressure or external forces. Only a minimal amount of time is required to complete the Lok-Ring assembly, or disassembly if necessary.

The patented* AMERICAN Lok-Ring® Joint is designed for working pressures up to 250 psi for sizes 42" through 64". It can be used with any lesser pressure class of ductile iron pipe with the maximum operating pressure rating of the joint limited in such cases to that of the pipe. An alloy steel welded-on retainer ring and a split lok-ring, assembled behind the retainer ring, provide the means of restraint. The split lok-ring is held "snug" against the pipe O.D. for assembly of the AMERICAN Fastite portion of the joint. After the plain end of the pipe is assembled into the Lok-Ring bell, the Lok-Ring is released, permitting it to expand. The lok-ring is thus securely positioned behind the welded-on retainer ring and in the socket locking groove on the I.D. of the Lok-Ring bell. This locks the joint.

The joint can be easily disassembled if the need arises, using the closure-spreader mechanism provided for this purpose.

The lok-ring, welded retainer ring and all parts of the closure-spreader mechanism are all constructed of corrosion-resistant, high-strength, low-alloy (HSLA) steel. This is the same type steel specified for bolting material per ANSI/AWWA C111/A21.11. The alloy steel of the lok-ring and the welded retainer ring is also the same material that has been used successfully in several AMERICAN restrained joint constructions for approximately 40 years. The weld is aluminum bronze (also as was used in the Lok-Fast Joint), and both the weld and ring are cathodic to, and thus protected by, the greater area of the ductile iron pipe. Welding is performed using welders qualified to produce high-quality, dependable welds.

Standard Fastite gaskets and lubricant are used with the AMERICAN Lok-Ring® Joint. (See Section 2 for gasket compounds.) AMERICAN recommends underwater lubricant where the joint is to be assembled in very wet conditions or under water.

The AMERICAN Lok-Ring® Joint is designed to permit deflection in order to facilitate installation and accommodate settlement. It may be safely deflected after assembly to the limits shown in Table No. 9-7. These deflection values have proven adequate for thousands of Lok-Ring joints furnished over the past several years and exceed the deflection capabilities of many types of restrained joints that have performed successfully for many years in buried service. It is noted that rotation of the lok-ring under great loads helps to distribute the forces substantially around and between the bell and spigot members.

## American Cast Iron Pipe Co.'s Lok-Ring Restrained Push-On Joint Pipe

AMERICAN Lok-Ring® Pipe is ductile iron, grade 60-42-10, manufactured and tested in accordance with AWWA C151. It is normally furnished standard asphaltic coated outside and cement lined in accordance with AWWA C104. When specified, other special coatings or linings can be furnished as described in Section 11.

A full complement of AMERICAN Lok-Ring ductile iron fittings is available. These fittings are available in both bell-bell and bell-plain end configurations for installation versatility and economy. Lok-Ring fittings meet applicable requirements of ANSI/AWWA C110/A21.10 or ANSI /AWWA C153/A21.53 and are pressure rated for at least 250 psi in most configurations. Check AMERICAN if higher pressure is required. See Section 4.

### Standard Dimensions

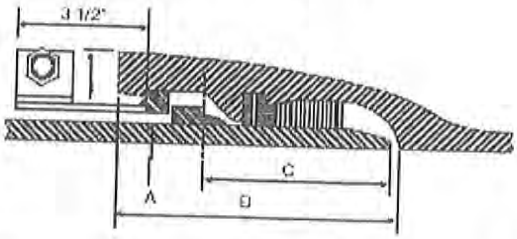



Table No. 9-5

| Size In. | Working Pressure* psi | Nominal Laying Length† ft. | A Outside Diameter In. | B Socket Depth In. | C Plain End to Retaining Ring In. | F Bell O.D.†† In. | Retainer Ring | Lok-Ring |
|---|---|---|---|---|---|---|---|---|
| 42 | 250 | 20 | 44.50 | 10.07 | 6.38 | 48.64 | ¾" x 1⅛" | ¾" sq. |
| 48 | 250 | 20 | 50.80 | 10.07 | 6.38 | 55.14 | ¾" x 1⅛" | ¾" sq. |
| 54 | 250 | 20 | 57.56 | 10.07 | 6.38 | 62.14 | ¾" x 1⅛" | ¾" sq. |
| 60 | 250 | 20 | 61.61 | 10.57 | 6.38 | 66.27 | ¾" x 1⅛" | ¾" x 1⅛" |
| 64 | 250 | 20 | 65.67 | 10.57 | 6.38 | 70.45 | ¾" x 1⅛" | ¾" x 1⅛" |

*Working pressure is the maximum pressure rating of the joint and is based on its capability to resist thrust due to internal pressure. †Higher working pressure is required, check AMERICAN.

†Laying length is nominal 20 feet. Where exact lengths are required, contact AMERICAN. (See minimum laying lengths in Table No. 9-6.)

††Dimensions subject to change at our option. Check AMERICAN if smaller or exact dimensions are required. Note that the studs may protrude slightly above the bell in one plane; contact AMERICAN if this may be critical to the application.

# Assembly of ACIPCO's Lok-Ring Restrained Push-On Joint Pipe

Thoroughly clean the socket locking groove as well as the Fastite gasket recess and pipe plain end, being sure to remove any mud, gravel, or any other foreign matter. Insert standard Fastite gasket and lubricate the joint components in accordance with standard Fastite assembly instructions and, with pipe in essentially straight alignment, assemble the plain end into the Lok-Ring bell. **(Photos 1 & 2.** Assembly tools shown in **Photo 2** are available from AMERICAN on a rental basis for installers not electing assembly with a backhoe or other like equipment.)

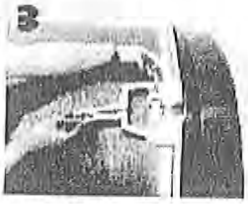
Once the spigot is completely inserted as evidenced by the spigot stripe disappearing into the bell (the orientation of the spigot stripe in relationship to the bell face is an indication of pipe alignment), loosen the outside stud closure nuts fully to the end of the stud to allow the lok-ring to spring outward and into the socket locking groove.* In lieu of the outside stud closure nut provided for this purpose, some installers prefer to install a "quick release" locking clamp or grip device beforehand (e.g., "outside the trench") and back the outside closure nut out of the way for very rapid assembly. **(Photo 3)** The correct seating** of the lok-ring in the socket locking groove should be accompanied by an obvious spreading of the lok-ring struts. If inspection around the joint reveals that the lok-ring is not completely seated in the annular socket locking groove at any location, the lok-ring may be completely seated by tapping the loose lok-ring into the socket locking groove with a flat caulking tool and/or by moving the entering pipe slightly. When a visual inspection to determine the Lok-Ring position is not practical, such as in an underwater installation, **a feeler gauge can be used to ensure that the Lok-Ring is correctly seated in the socket locking groove all around the joint. (Photo 4)**

Once the lok-ring is correctly seated in the socket locking groove, turn the inside stud spreader nuts out firmly against the struts **(Photo 5)** as shown to ensure firm contact of the lok-ring in the socket locking groove. **During the lok-ring spreading operation, the outside stud closure nuts should be positioned so as not to restrict the outward movement of the drilled struts on the stud.** (The outside stud closure nuts perform no function in the finished joint; however, these closure nuts can be used to effect simple disassembly of the joint, if required, by reversing the assembly procedure outlined above.) Once the inside spreader nuts are properly positioned, the lok-ring is positively secured in the socket locking groove.

1

2

3



4

5

*Note: The lok-ring is normally shipped in position on the pipe plain end behind the welded-on retainer ring. See page 9-25 if field assembly of Lok-Ring is required.

**Note: It is imperative that the installer verify that the lok-ring is seated outward in the socket locking groove completely around each joint. Lok-rings are painted yellow to visually aid in this verification.

## Useful Internet Links

| Organizations | Website Address |
|---|---|
| American Water Works Association (AWWA) | http://awwa.org |
| Ductile Pipe Research Association (DIPRA) | http://dipra.org |

| Manufacturers | Website Address |
|---|---|
| American Cast Iron Pipe Co. | http://acipco.com |
| Atlantic States Cast Iron Pipe Co. | http://atlanticstates.com |
| A.Y. McDonald | http://aymcdonaldmfg.com |
| Clow Water Systems Co. | http://clowwatersystems.com |
| Ebaa Iron Sales Inc. | http://www.ebaa.com |
| Ford Meter Box Co., Inc. | http://fordmeterbox.com |
| Golden Andersen Industries Inc. | http://gaindustries.com |
| Griffin Pipe Products Co. | http://griffinpipe.com |
| M & H Valve Co. | http://mh-valve.com |
| Mueller Co. | http://muellercompany.com |
| Powerseal Pipeline Products Corp. | http://powerseal.com |
| Romac Industries, Inc. | http://romacindustries.com |
| Ross Valve Mfg. Company | http://rossvalve.com |
| Sigma Corporation | http://sigmaco.com |
| Singer Valve Inc. | http://singervalve.com |
| Tyler Pipe | http://tylerpipe.com |
| US Pipe and Foundry Co. | http://uspipe.com |