General Guidelines for Connecting HDPE Potable Water Pressure Pipes to DI and PVC Piping Systems

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Foreword

This technical note (TN) was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute (PPI). The members have shown their interest in quality products by assisting independent standard making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

The TN has been prepared to provide those responsible for specifying, installing and connecting High Density Polyethylene (HDPE) solid wall piping systems to other Potable Water piping systems. These guidelines constitute a set of basic operations that has been demonstrated by test and experience to produce satisfactory connections with commercially available materials. Each specific procedure must be acceptable to, and qualified by, the operator having legal responsibility for the performance of the piping system.

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PPI intends to revise this report from time to time in response to comments and suggestions from users of this note. Please send suggestions for improvements to PPI. Information on other publications can be obtained by contacting PPI directly for visiting the web site.

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1.0 Introduction

High Density Polyethylene (HDPE) pipe is normally connected by heat fusion which creates a leak-free bond as strong, if not stronger, than the pipe itself in tensile and pressure applications. These heat fused joints are also self restrained and require no external restraining method to prevent the joint from pulling apart.

In this document, we will cover the various ways to connect HDPE pipe to existing Ductile Iron (DI) and PVC piping systems. In most cases, HDPE pipe can be easily connected to standard Ductile Iron fittings. Because Ductile Iron and PVC pipe are normally joined with bell and spigot joints, the connection to these systems generally requires some sort of restraint to prevent the expansion/contraction of HDPE pipe from pulling the existing systems joints apart. Several different restraining methods will be discussed. Before using any mechanical fitting, contact the manufacturer to verify the fitting is designed for HDPE pipe.

2.0 Connections to Ductile Iron Pipe / Fittings and PVC Pipe / Fittings

2.1 MJ Adapter Connections to DI Fittings

MJ (mechanical joint) Adapters are manufactured in standard IPS and DIPS sizes for connecting IPS sized or DIPS sized polyethylene pipe to mechanical joint fittings and appurtenances that meet AWWA C111/ANSI A21.11. When connected, they seal against leakage and restrain against pullout. No additional external clamps or tie rod devices are required unless connected to an existing piping system. In that case, refer to Section 4 on restraint recommendations.

In water systems that use ductile iron pipe (DIP), many valves are connected to pipe using MJ Adapters. A typical MJ Adapter Kit is shown below in Figure 1. Refer to the fitting manufacturer's installation instructions for joining a MJ Adapter to a DI Fitting. In general, the procedure is to first attach the HDPE MJ Adapter to the HDPE pipe line. Slip the Gland Ring over the pipe end and then butt fuse the HDPE MJ Adapter to the end of the pipe using the *PPI Generic Butt Fusion Joining Procedure TR-33*. Install the Gasket over the MJ Adapter and align the fitting with

the socket hub of the ductile iron fitting. Lubricate the gasket, the end of the MJ adapter, and the inside of the socket hub with an approved pipe lubricant meeting AWWA C111. Do not use soapy water.

Insert the MJ Adapter into the socket hub. Make sure it is evenly and completely seated in the socket hub. The MJ Adapter and the socket hub must be aligned straight into each other. Insert the gland bolts, and run the nuts up finger-tight. Tighten the gland bolts evenly to the fitting manufacturer's recommended procedures. This connection is used with a large number of DI fittings, some of which are shown in Figure 4.

When connecting to a valve with an MJ connection, longer T-Bolts may be required. If the T-Bolts that come with the kit are not long enough for the assembly, use a coupling nut and Grade 5 all thread to make up the length required (Figure 5).

Figure 1 HDPE MJ Adapter Kit

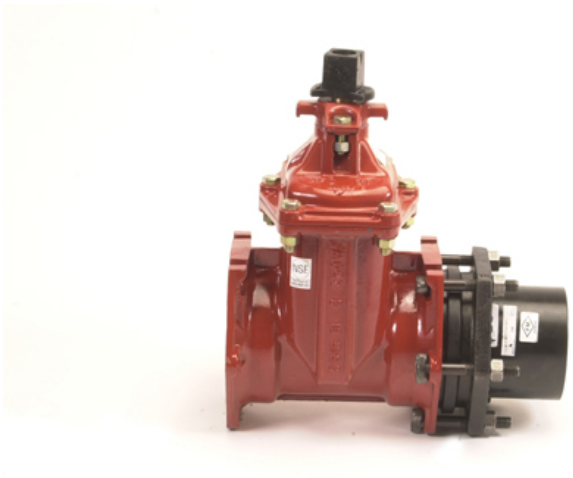

Figure 2 MJ connection to typical gate valve with MJ ends

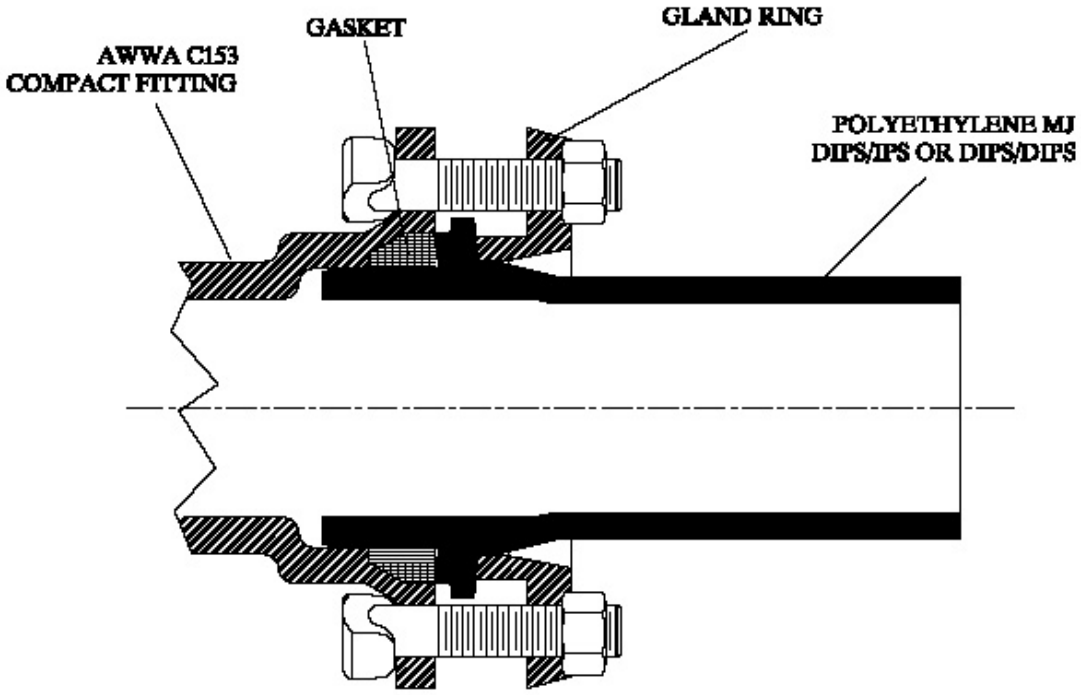

Figure 3 MJ Connection to DI fitting

Figure 4 Ductile Iron Fittings **MJ Connection**

Figure 5 T-Bolt Extension

2.2 Flanged Connection to DI Fittings

It is common to use a flanged connection to join HDPE pipe to HDPE pipe in a close quarter tie-in or when a piping section will require removal in the future. Flanged joints are also used to attach HDPE pipe to valves or DI fittings. The parts for a flange connection are the HDPE Flange Adapter, Back-Up Ring, Gaskets and Bolts, Nuts and Washers.

This connection is made by first sliding the Back-Up Ring over the pipe end and then butt fusing the HDPE Flange Adapter to the end of the pipe using the *PPI Generic Butt Fusion Joining Procedure TR-33*. Then align the flanges and back-up rings and follow the fitting manufacturer's recommended procedures for bolting the flanges together. The service pressure rating for the back-up ring should meet or exceed the service pressure in the pipe.

Gaskets may not be required, depending on the pressure in the pipeline. Gaskets are usually used for higher pressure application (over 100 psi) and must be used for connections between polyethylene and non-polyethylene flanges. If gaskets are used, the gasket manufacturer should recommend the gasket to use with polyethylene pipe.

This is considered a "fully restrained joint" and should not need external restraint devices.

Figure 6 Flange Adapter Assembly

Figure 7 Fused Manifold Assembly with Flange Adapters And Back Up Rings

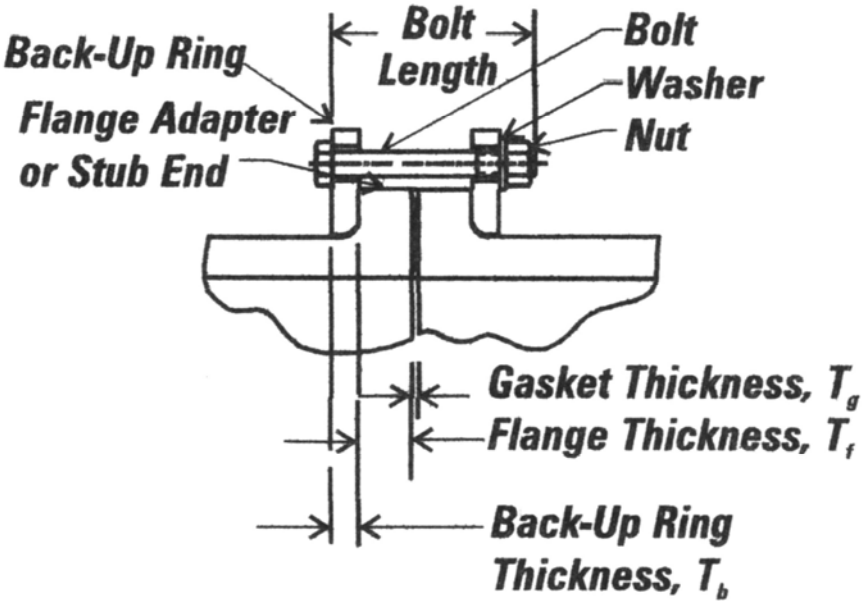

Figure 8 Flange Adapter Bolted Assembly Cross Section

Figure 9 Ductile Iron Tee with Flanged Outlet

2.3 Solid DI Sleeve Connections to HDPE pipe

Solid Sleeves are ductile iron fittings designed to connect DI / PVC pipe to other piping materials including HDPE pipe. They come in a variety of configurations depending on the application. Most solid sleeves have a flange or MJ hub to attach to the HDPE pipe. On the ductile iron pipe side, a Megalug flange is attached to the pipe and a gasket is installed over the pipe and into the sleeve before bolting the Megalug to the Sleeve flange. A standard HDPE MJ Adapter kit is used on the HDPE pipe side to complete the assembly. Be sure to use the manufacturer's recommended bolting procedures for this assembly. (see Figure 10)

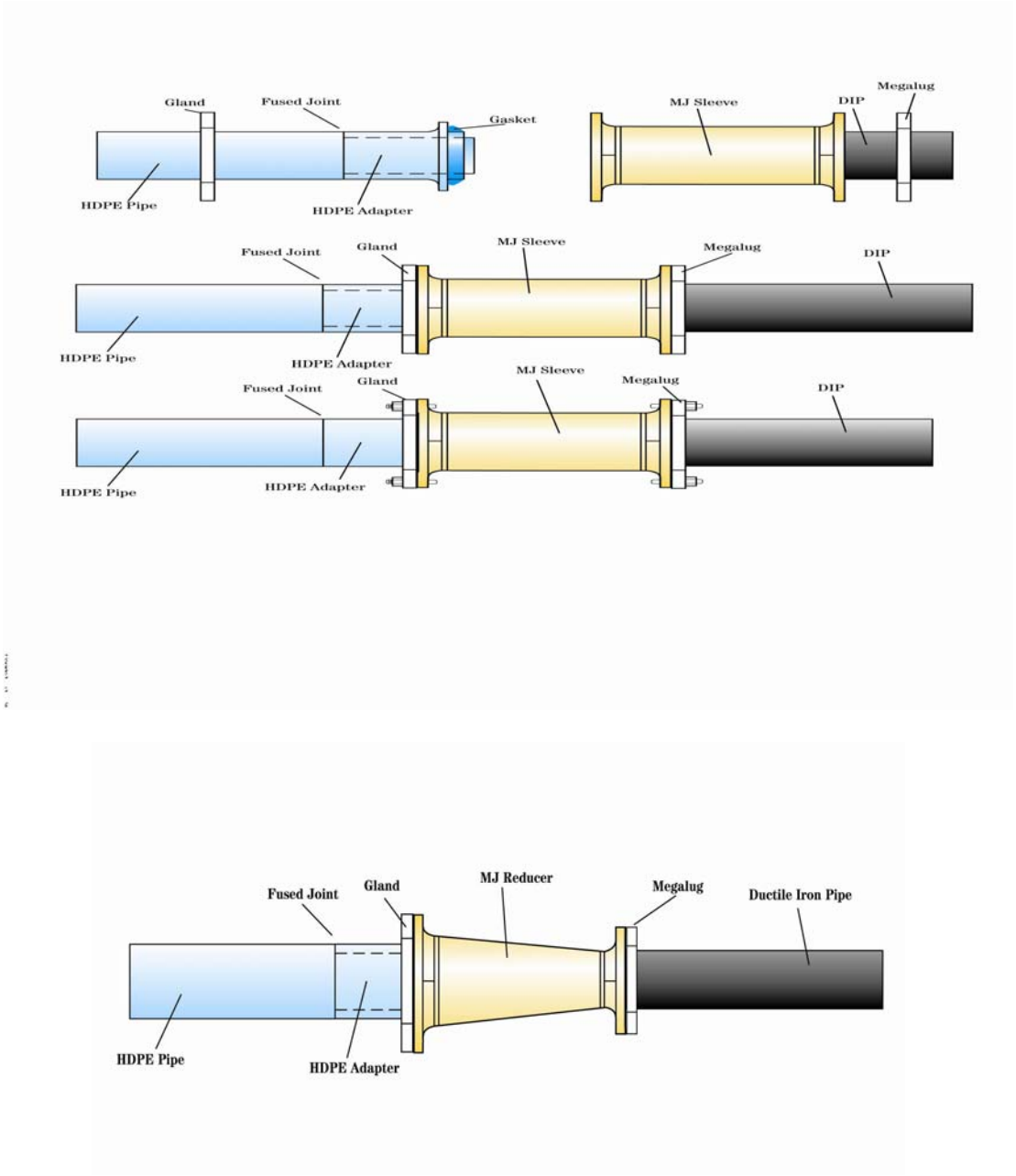

Figure 10 Solid DI Sleeve Connections to HDPE pipe

Another solid sleeve design is called a "One Bolt" Solid Sleeve and can be used to connect HDPE pipe to PVC or DI pipe. This is similar to a standard HDPE mechanical connector but has a special locking ring that grips the HDPE pipe to prevent pullout. It is recommended to use a stiffener inside the HDPE pipe, especially if the DR is more than 11. This connection can be installed very quickly in the field and may also be used for repair. Consult with the sleeve manufacturer for application and restraint advice.

Figure 11 One Bolt Solid Sleeve Connection

2.4 HDPE Pipe Connection to DI or PVC Bell End

Another method of restraining the above mentioned connection would be the use of a restraint harness and the attachment of flex restraint sections to the HDPE pipe. These flex restraint pieces are electro-fused to the HDPE pipe to achieve the proper stab depth in the PVC or DI bell and the restraint harness plate is attached behind them. The opposite end of the restraint harness is attached behind the DI /PVC hub. Install the HDPE pipe in the PVC/DI bell until it bottoms out on the flex restraints

and tighten the tie rods to prevent the assembly from pulling apart. As discussed above: to maintain proper contact with the seal in the DI /PVC fitting, it is recommended that a stiffener be installed in the HDPE pipe end.

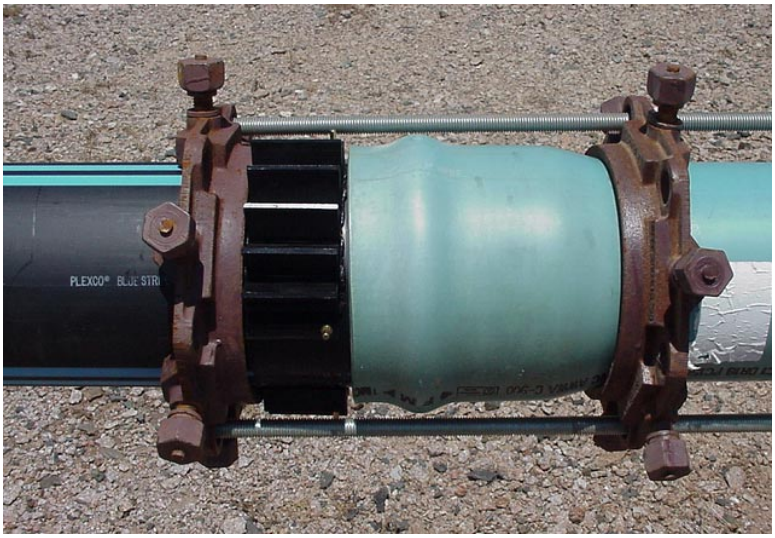

Figure 12 HDPE pipe connection to DI / PVC bell end using Flex Restraints on the HDPE pipe

2.5 HDPE Bell Adapters to DI or PVC Pipe End

There are HDPE Bell Adapters available, up to 24" IPS, that are machined to the standard MJ Adapter internal configurations and have an external stainless steel backup ring installed to ensure positive seal contact. This connection incorporates a back-up flange behind the HDPE Adapter and a Mega-Lug flange on the PVC or DI pipe. Standard MJ seals and bolts are used to connect the assembly.

Figure 13 HDPE Bell Adapter to DI or PVC Pipe End

2.6 DI Valve with HDPE Ends

In most potable water systems, a valve is installed between the main and the hydrant. This can be fused in line using this special valve assembly with HDPE pipe installed on each side and available up to 12" pipe size. It has an HDPE ends installed on each side of the valve.

Figure 14 Ductile Iron Gate Valve with HDPE Ends

2.7 Dismantling Joint

Dismantling joints simplify installations and replacement of flanged fittings in retrofitting applications. Dismantling Joints provide the solution for adding, repairing or replacing flanged fittings within a flanged pipe system. In all applications, a restrained dismantling joint is required unless otherwise specified. (see Section 4).

Adjustable, slip joint design accommodates either wide gaps or close quarter installations and eliminates the need for precise measurements between flange connections. Available in sizes 2" and larger, for ductile iron or flanged HDPE piping systems. Standard flanges AWWA C207 Class D Flange. Other flanges are available upon request.

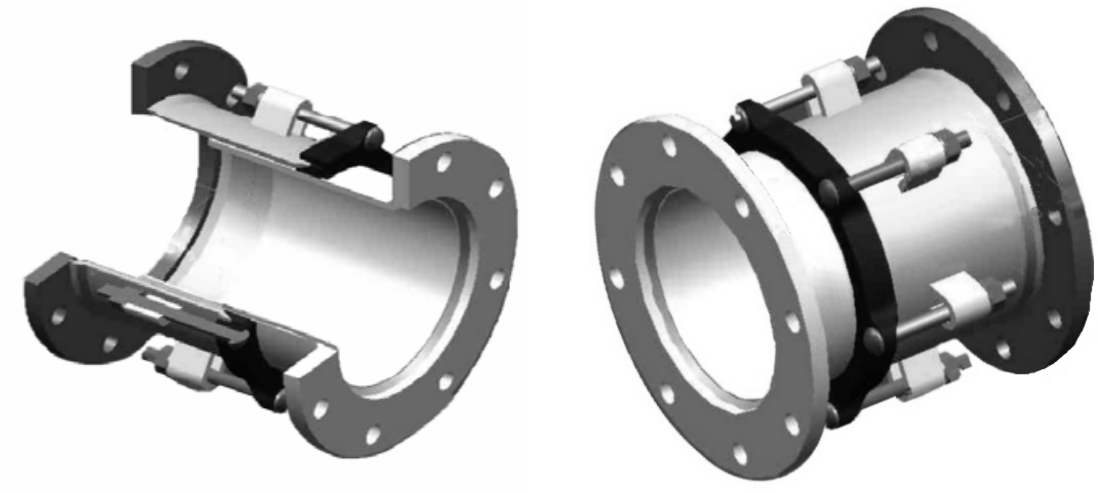

Figure 15 Dismantling Joint

2.8 Transition Fitting – HDPE pipe to DI / PVC pipe

A transition fitting is a mechanical assembly of HDPE and PVC or DI pipe. The resulting product will allow a butt fusion joint on the HDPE end and standard PVC

or DI mechanical connection on the other end. (See Figures 17, 18 & 19 for different configurations.)

Figure 16 Transition Fitting – HDPE to PVC

Figure 17 Transition Fitting – HDPE to DI with MJ Adapter

Figure 18 Hydrant Swivel Transition Fitting – HDPE to DI

2.9 Mechanical Connection – HPDE to PVC

This coupling provides the convenience of bolted mechanical assembly of plain-end PVC pipe to plain-end high density polyethylene (HDPE) pipe without special adapters. Integral rows of teeth on the HDPE side grip the pipe and diamond-shaped teeth safely grip the PVC pipe as you tighten the bolts to achieve metal-to-metal contact at the pads. This coupling is available in IPS pipe sizes up to 8" IPS. When connecting HDPE pipe to a mechanical coupling, restrain the fitting unless otherwise stated by the coupling manufacturer.

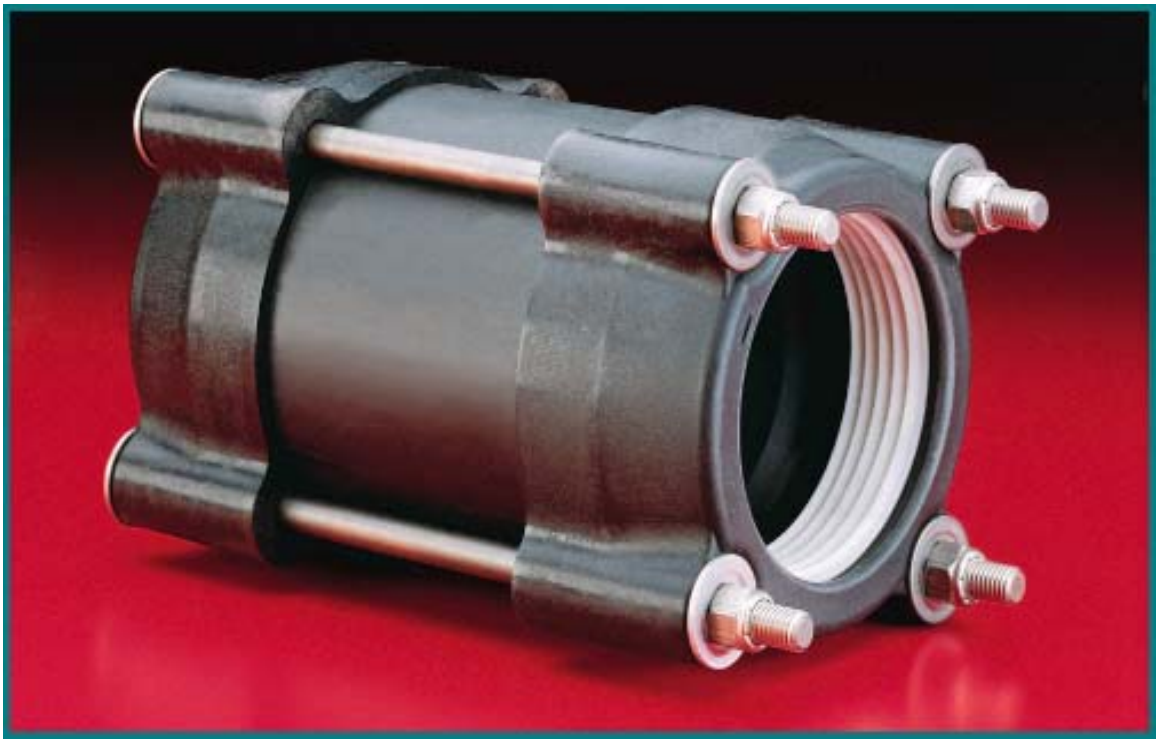

Figure 19 Mechanical Connection – HPDE to PVC

Figure 20 Mechanical Connection – HPDE to PVC

3.0 Stiffener Installation Guidelines

When connecting HDPE pipe to the bell end of a ductile iron or PVC pipe, it is recommended that a stiffener be added to the ID of the pipe to insure a good connection between the seal in the bell and the pipe. Check the pipe for toe in. If it is severe, cut the pipe back to remove it. If possible, have some means to press the stiffener into place. Lubricant will minimize the insertion effort required. A detergent or silicone grease is recommended.

There are two types of stiffeners available on the market. One type is a fixed diameter stiffener that matches the ID of the pipe being repaired (see Figure 21). Caution should be used when using fixed diameter stiffeners to be sure they are sized properly to obtain the proper press fit in the HDPE pipe. These are mainly used with smaller diameter service lines.

Figure 21 Fixed Diameter Stiffener for HDPE pipe

The other type of stiffener is a split ring stiffener (see Figure 22a). These are normally made of stainless steel and provide a thin yet strong pipe wall reinforcement without disturbing the flow characteristic of the pipe. The easy installation instructions are shown in Figure 22b.

Figure 22a Split Ring Stiffener for HDPE pipe

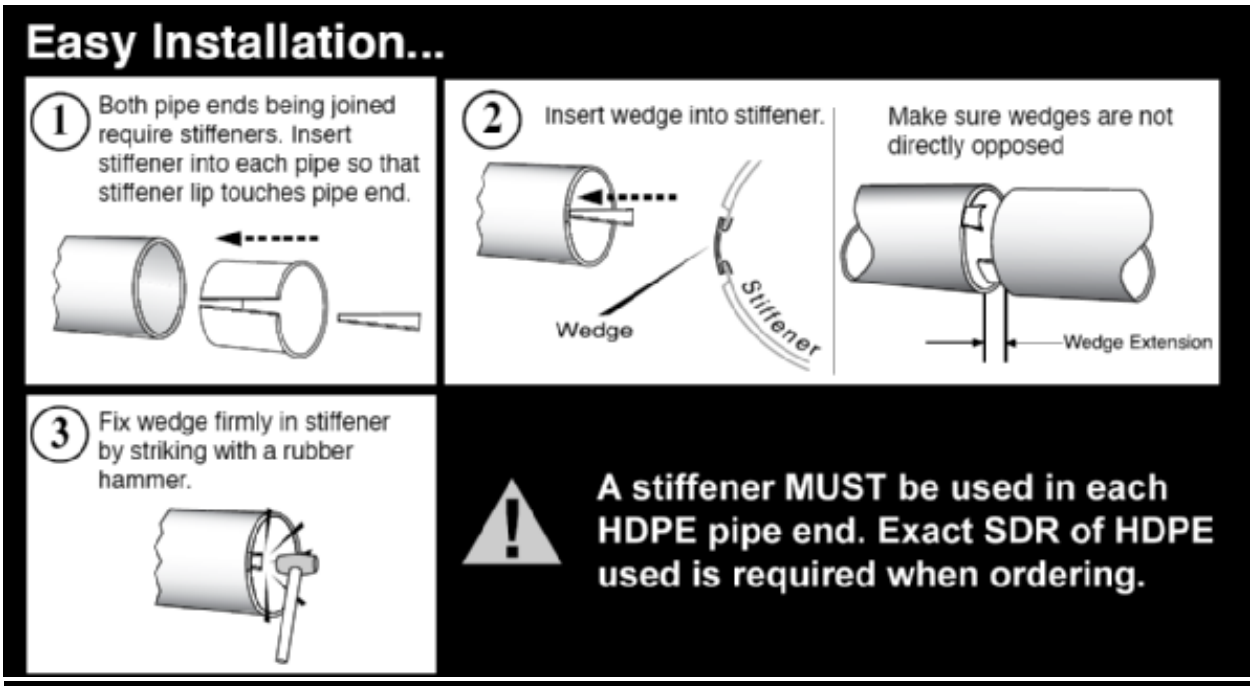

Figure 22b Easy installation instructions

Figure 23 Install Split Ring Stiffener in HDPE pipe

4.0 Restraint Methods

A pipe section with fully restrained joints such as a long string of butt fused HDPE pipe will transmit Poisson effect pipe shortening from length to length through the restrained joints along the pipe string. Restrained joints include butt fusions, electro-fusions, socket fusions, bolted flange connections, MJ Adapter connections or other restrained mechanical connections. If an unrestrained bell and spigot or mechanical sleeve joint is in-line with the restrained section, the cumulative Poisson effect shortening and possible thermal expansion / contraction effect may cause in-line unrestrained joints or connections to be pulled apart. Therefore, unrestrained joints or mechanical connections that are in-line with fully restrained HDPE pipe must be either restrained or otherwise protected against pullout disjoining.

4.1 Wall Anchor

A typical pullout prevention technique is to restrain the transition connection by butt fusing a Wall Anchor in the HDPE pipeline close to the connection and pouring a concrete anchor around it as shown in Figure 24. Refer to the pipe manufacturer's recommendations on anchor size and pull out loads.

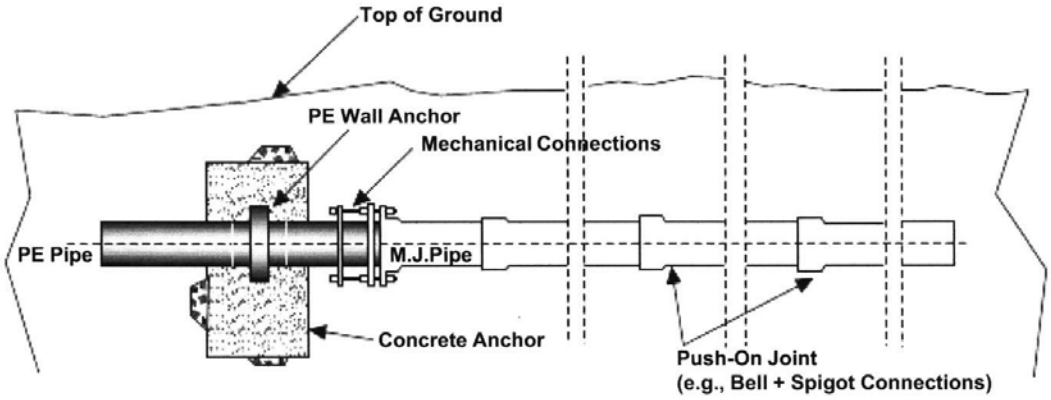

Figure 24 Wall Anchor Diagram

Another method of anchoring this connection is to electro-fuse several Flex Restraints to the HDPE pipe instead of butt fusing a wall anchor to the line as shown in Figure 25.

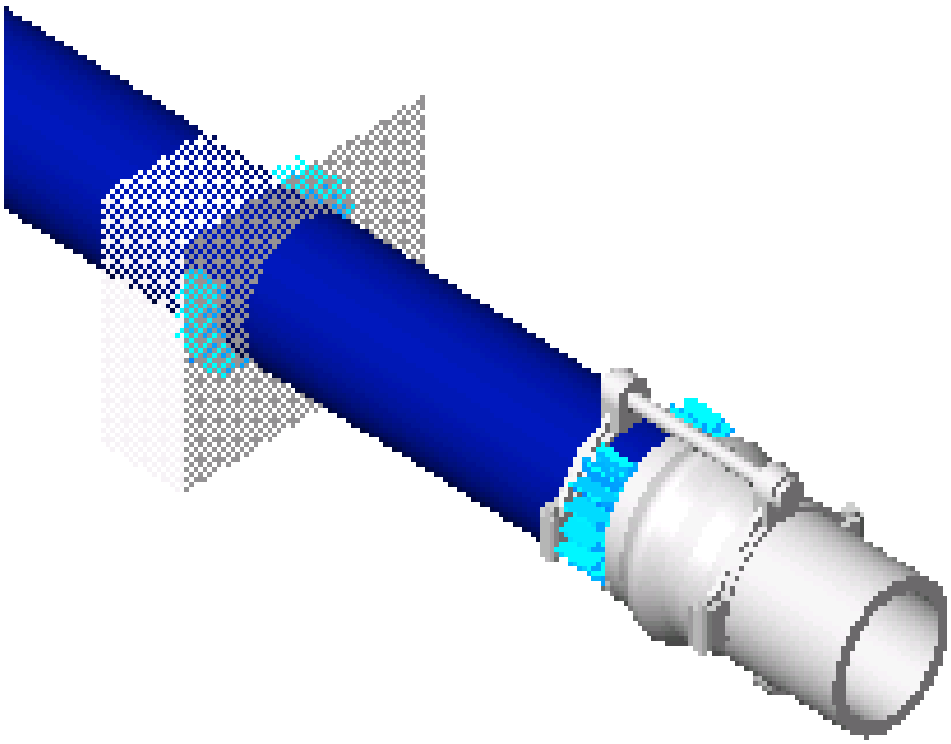

Figure 25 Flex Restraint Anchor

4.2 Mechanical Restraint Anchor

A typical pullout prevention technique is to restrain the transition connection and several non-PE bell and spigot joints down line from the transition connection as shown in Figure 26.

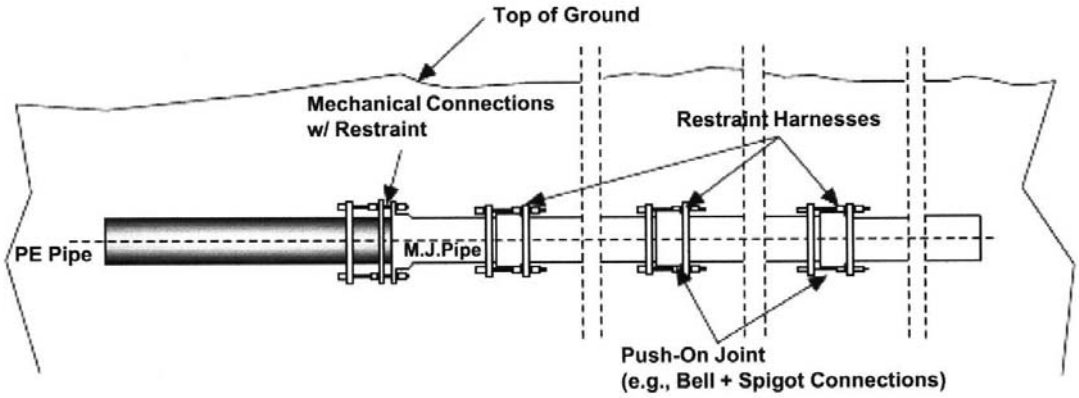

Figure 26 Mechanical Restraint of existing pipeline when attaching to HDPE pipe

4.3 Buried Poly Anchor

This product is designed to be buried in the soil and resist any linear movement that might occur with polyethylene pipe without pouring a concrete anchor around it. In order to mobilize its buried anchoring restraint action, the Poly-Anchor simply requires at least 85% standard Proctor Density soil compaction in-situ to the top of the plate. Consult with the fitting manufacturer to ensure that the anchor size is adequate for the bearing capacity of the soil.

Figure 27 Buried Poly Anchor

4.4 Above Ground Pipeline Anchor

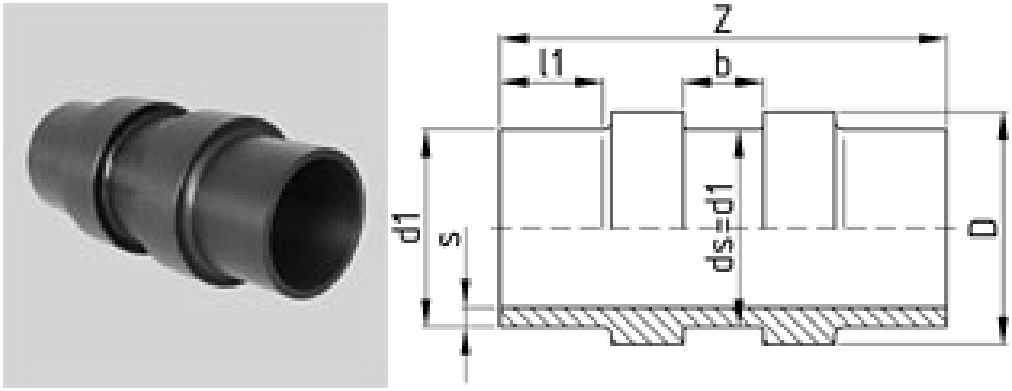

Figure 28 Above Ground Pipeline Anchor

The above ground anchor fitting is commonly used to manage HDPE pipe from thermal expansion and contraction. The fitting is fused into the pipe-line, and a metal band (C-Clamp) is secured over the anchor fitting in the middle, and securely bolted to an I-beam, support bracket, or embedded into a concrete block up-to the spring-line with C-clamp over the pipe crown and bolted to the block . The metal band attaches the pipeline to the anchoring point; the OD rings prevent the pipeline from moving in expansion or contraction in either direction. The width of the center groove can be made as wide as required so as to get sufficient grip on the HDPE pipe for the thermal excursions expected.

4.5 HDPE to PVC Slip-Joint Anchor Fitting

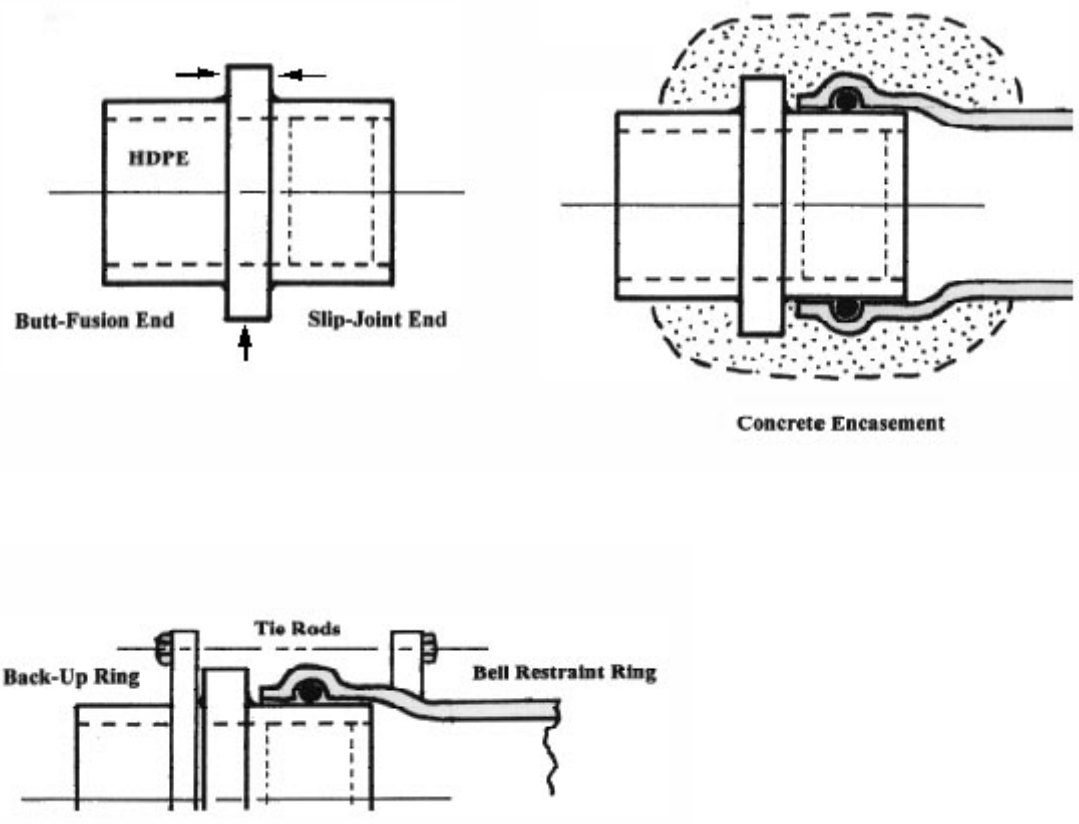

Figure 29 HDPE to PVC Slip-Joint Anchor Configurations

A gasketed PVC pipe bell to plain end HDPE pipe should be restrained against HDPE thermal contraction and pressure thrust, to avoid possible long-term joint separation. The PVC-Bell slip-Joint Anchor Fitting (PVC-SJA Fitting) with internal stiffener to support gasket load, provides the restrained connection from HDPE pipe to bell-end PVC pipe. (For plain-end PVC, refer to Section 2.5: the HDPE Bell-Adapter Fitting). When the restraint rings with tie-rod option is specified, the rods and rings are supplied separately from the SJA fitting.

5.0 References:

Plastics Pipe Institute -- www.plasticpipe.org
PPI Polyethylene Pipe Handbook
Technical Report TR-33 “Generic Butt Fusion Procedure”
Technical Report TR-41 “Generic Saddle Fusion Procedure”
Technical Note TN-34 “Installation Guidelines for Electrofusion Couplings 14" and Larger (2004)”
Technical Note TN-35 “General Guidelines Repairing Buried HDPE potable Water Pressure Pipes”

AWWA -- PE Pipe- Design and installation, M55, www.awwa.org

ASTM -- F1025 “Selection and Use of Full-Encirclement-Type Band Clamps for Reinforcement or Repair of Punctures or Holes in Polyethylene Gas Pressure Pipe”

Fusion Equipment Manufacturers

Connectra Fusion	www.connectrafusion.com
Fast Fusion	www.fastfusion.com
McElroy Manufacturing, Inc.	www.mcelroy.com
Ritmo America	www.ritmoamerica.com

Electro-Fusion Fitting and Equipment Manufacturers

Central Plastics Co.	www.centralplastics.com
Friatec	www.friatecusa.com
Kerotest-Innogaz	www.kerotest.com

Polyethylene Fitting Manufacturers

Central Plastics	www.centralplastics.com
Independent Pipe Products, Inc.	www.indpipe.net
ISCO Industries	www.isco-pipe.com
Industrial Pipe Fittings	www.hdpefittings.com
KWH Pipe	www.kwhpipe.ca
Performance Pipe	http://www.cpchem.com/enu/performance_pipe.asp
Poly-Cam	www.polycam.com

Pipe Manufacturers

ARNCO	www.arncocorp.com
Charter Plastics	www.charterplastics.com
Endot Industries	www.endot.com
Independent Pipe Products, Inc.	www.indpipe.net
J-M Manufacturing	www.jmpipe.com
KWH Pipe	www.kwhpipe.ca
Lamson and Sessions	www.vylonpipe.com
Performance Pipe	http://www.cpchem.com/enu/performance_pipe.asp
PolyPipe, Inc.	www.rinker.com/polypipe
Silverline	www.slpipe.com
US Poly	www.uspolycompany.com
WL Plastics	www.wlplastics.com

For more accurate and up-to-date information, please go to www.plasticpipe.org

Mechanical Fitting Manufacturers (Partial Listing)

Dresser	www.dressercouplings.com
Ebba Iron	www.ebba.com
Ford	www.fordmeterbox.com
JCM	www.jcmindustries.com
Mueller	www.muellercompany.com
One Bolt	www.onebolt.com
Romac	www.romacindustries.com
Smith-Blair	www.smith-blair.com
Tyler Union	www.tylerpipe.com
Union Foundry	www.ufco.com
Victaulic	www.victaulic.com