Polyethylene Joining Procedures

Introduction

An integral part of any pipe system is the method used to join the system components. Proper engineering design of a system will take into consideration the type and effectiveness of the techniques used to join the piping components and appurtenances, as well as the durability of the resulting joints. The integrity and versatility of the joining techniques used for polyethylene pipe allow the designer to take advantage of the performance benefits of polyethylene in a wide variety of applications.

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General Provisions

Polyethylene pipe or fittings are joined to each other by heat fusion or with mechanical fittings. Polyethylene may be joined to other materials by means of compression fittings, flanges, or other quilted types of manufactured transition fittings. There are many types and styles of fittings available from which the user may choose. Each offers its particular advantages and limitations for each joining situation the user may encounter. Contact with the various manufacturers is advisable for guidance in proper applications and styles available for joining as described in this document. There will be joining methods discussed in this document covering both large and small diameter pipe. Large diameter pipe is considered to be sizes 3" IPS (3.500" OD) and larger. Those persons who are involved in joining gas piping systems must note certain qualification requirements of the U.S. Department of Transportation Pipeline Safety Regulations.

Thermal Heat Fusion Methods

There are three types of heat fusion joints currently used in the industry; Butt, Saddle, and Socket Fusion. Additionally, there are two methods for producing the socket and saddle heat fusion joints.

The principle of heat fusion is to heat two surfaces to a designated temperature, and then fuse them together by application of a sufficient force. This force causes the melted materials to flow and mix, thereby resulting in fusion. When fused according to the pipe and/or fitting manufacturers procedures, the joint area becomes as strong as, or strongAer than, the pipe itself in both tensile and pressure properties. As soon as the joint cools to near ambient temperature, it is ready for handling. The following sections of this chapter provide a general procedural guideline for each of these heat fusion methods.

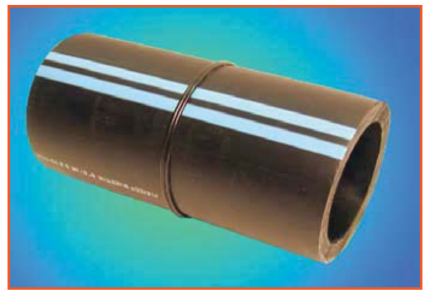
Butt Fusion

The most widely used method for joining individual lengths of polyethylene pipe and pipe to polyethylene fittings is by heat fusion of the pipe butt ends as illustrated in Figure 1. This technique produces a permanent, economical and flow-efficient connection. Quality butt fusion joints are produced by using trained operators and quality butt fusion machines in good condition.

The butt fusion machine should be capable of:

- Aligning the pipe ends
- Clamping the pipes
- Facing the pipe ends parallel with each other
- Heating the pipe ends
- Applying the proper fusion force that results in fusion

Figure 1 A Standard Butt Fusion Joint



The six steps involved in making a butt fusion joint are:

1. Clamp and align the pipes to be joined
2. Face the pipe ends to establish clean, parallel surfaces
3. Align the pipe profile
4. Melt the pipe interfaces
5. Join the two profiles together by applying the proper fusion force
6. Hold under pressure until the joint is cool

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Figure 2

Typical Butt Fusion Machine for Smaller Diameter Pipe
(Butt Fusion machines are available to fuse pipe up to 65 inches in diameter)

Optional Bead Removal

In some pipe systems, engineers may elect to remove the inner or outer bead of the joint. External beads are removed with run-around planning tools, which are forced into the bead, then drawn around the pipe. Power planers may also be used, but care must be taken not to cut into the pipes outside surface.

It is uncommon to remove internal beads, as they have little or no effect on flow, and removal is time-consuming. Internal beads may be removed from pipes after each fusion with a cutter fitted to a long pole. Since the fusion must be completely cooled before bead removal, assembly time is increased slightly.

Saddle/Conventional Fusion

The conventional technique to join a saddle to the side of a pipe, illustrated in Figure 3, consists of simultaneously heating both the external surface of the pipe and the matching surface of the "saddle" type fitting with concave and convex shaped heating tools until both surfaces reach proper fusion temperature. This may be accomplished by using a saddle fusion machine that has been designed for this purpose

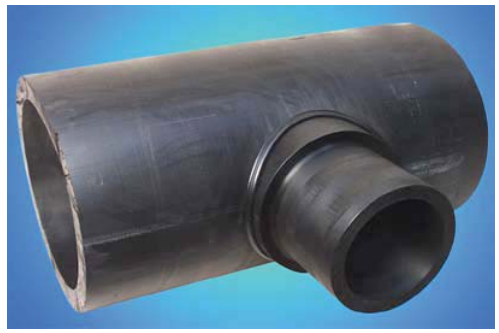

Figure 3 Standard Saddle Fusion Joint

Saddle fusion, using a properly designed machine, provides the operator better alignment and force control, which is very important to fusion joint quality. The Plastics Pipe Institute recommends that saddle fusion joints be made only with a mechanical assist tool unless hand fusion is expressly allowed by the pipe and/or Fitting manufacturer.

There are eight basic sequential steps that are normally used to create a saddle fusion joint:

1. Clean the pipe
2. Install heater saddle adapters
3. Install the saddle fusion machine on the pipe

4. Prepare the surfaces of the pipe and fitting
5. Align the parts
6. Heat both the pipe and the saddle Fitting
7. Press and hold the parts together
8. Cool the joint and remove the fusion machine

Socket Fusion

This technique consists of simultaneously heating both the external surface of the pipe and the internal surface of the socket Fitting until the material reaches fusion temperature, inspecting the melt pattern, inserting the pipe end into the socket, and holding it in place until the joint cools. Figure 4 illustrates a typical socket fusion joint. Mechanical equipment is available to hold the Fitting and should be used for sizes larger than 2" CTS to attain the increased force required and to assist in alignment.

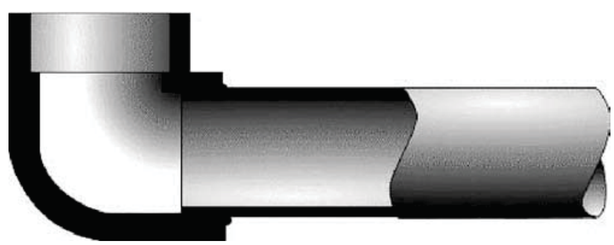

Figure 4

Standard Socket Fusion Joint

Follow these general steps when performing socket fusion:

1. Select the equipment
2. Square and prepare the pipe ends
3. Heat the parts

4. Join the parts

5. Allow to cool

Equipment Selection

Select the proper size tool faces and heat the tools to the fusion temperature recommended for the material to be joined. For many years, socket fusion tools were manufactured without benefit of any industry standardization. As a result, variances of heater and socket depths and diameters, as well as depth gauges, do exist. More recently, ASTM F1056[7] was written, establishing standard dimensions for these tools. Therefore, mixing various manufacturers heating tools or depth gauges is not recommended unless the tools are marked "F1056," indicating compliance with the ASTM specification and, thereby, consistency of tooling sizes.

Square and Prepare Pipe

Cut the end of the pipe square. Chamfer the pipe end for sizes 1¼"-inch diameter and larger. (Chamfering of smaller pipe sizes is acceptable and sometimes specified in the instructions.) Remove any scraps, burrs, shavings, oil, or dirt from the surfaces to be joined. Clamp the cold ring on the pipe at the proper position, using the integral depth gauge pins or a separate (thimble type) depth gauge. The cold ring will assist in re- rounding the pipe and provide a stopping point for proper insertion of the pipe into the heating tool and coupling during the fusion process.

Heating

Check the heater temperature. Periodically verify the proper surface temperature using a pyrometer or other surface temperature measuring device. If temperature indicating markers are used, do not use them on a surface that will come in contact with the pipe or fitting. Bring the hot clean tool faces Into contact with the outside surface of the end of the pipe and with the inside surface of the socket fitting, in accordance with pipe and Fitting manufacturer's instructions. Procedures will vary with different materials. Follow the instructions carefully.

Joining

Simultaneously remove the pipe and fitting from the tool using a quick Snap action. Inspect the melt pattern for uniformity and immediately insert the pipe squarely and fully into the socket of the fitting until the Fitting contacts the cold ring. Do not twist the pipe or Fitting during or after the insertion, as is a practice with some joining methods for other pipe materials.

Cooling

Hold or block the pipe in place so that the pipe cannot come out of the joint while the mating surfaces are cooling. These cooling times are listed in the pipe or Fitting manufacturer's instructions.

Electro fusion

This technique of heat fusion joining is somewhat different from the conventional fusion joining thus far described. The main difference between conventional heat fusion and electro fusion is the method by which the heat is applied. In conventional heat fusion joining, a heating tool is used to heat the pipe and Fitting surfaces. The electro fusion joint is heated internally, either by a conductor at the interface of the joint or, as in one design, by a conductive polymer. Heat is created as an electric current is applied to the conductive material in the Fitting.

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Figure 5 illustrates a typical electro fusion joint, and Figure 6 illustrates an electro fusion control box and fitting.

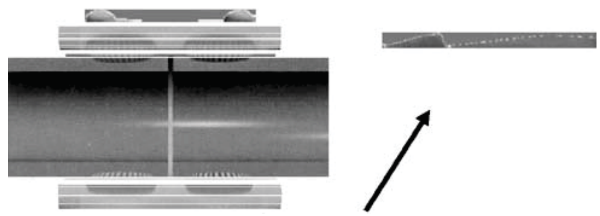

Figure 5 Typical Electro fusion Joint

General steps to be followed when performing electro fusion joining are:

1. Prepare the pipe (scrape, clean)
2. Mark the pipe
3. Align and restrain pipe and Fitting per manufacturer's recommendations
4. Apply the electric current
5. Cool and remove the clamps
6. Document the fusion procedures

Prepare the Pipe (Clean and Scrape)

Assure the pipe ends are cut square when joining couplings. The fusion area must be clean from dirt's or contaminants. This may require the use of water or 90% isopropyl alcohol (NO ADDITIVES OR NOT DENATURED). Scraping: The pipe surface in the fusion area must be removed to expose clean virgin material. This may be achieved by a various manufactured tools.

Mark the Pipe

Mark the pipe for stab depth of couplings and proper fusion location of saddles. (Caution should be taken to assure that a non-petroleum marker is used.)

Align and Restrain Pipe or Fitting Per the Manufacturer’s Recommendations
Align and restrain Fitting to pipe per manufacturer's recommendations. Place the pipe(s) and Fitting in the clamping Fixture to prevent movement of the pipe(s) or Fitting. Give special attention to proper positioning of the Fitting on the prepared pipe surfaces. Rerounding of pipe may be required with larger diameters.

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Apply Electric Current

Connect the electro fusion control box to the Fitting and to the power source. Apply electric current to the Fitting as specified in the manufacturer's instructions. Read the barcode which is supplied with the electro fusion Fitting. If the control does not do so automatically, turn off the current when the proper time has elapsed to heat the joint properly.

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Figure6

Typical Electro fusion Control Box and Leads with Clamps and Fittings

Cool Joint and Remove Clamps

Allow the joint to cool for the recommended time. If using clamps, premature removal from the clamps and any strain on a joint that has not fully cooled can be detrimental to joint performance.
Consult the fitting manufacturer for detailed parameters and procedures.

Documenting Fusion

The Electro fusion control box that applies current to the Fitting also controls and monitors the critical parameters of fusion, (time, temperature, & pressure). The control box is a micro- processor capable of storing the specific fusion data for each joint. This information can be downloaded to a computer for documentation and inspection of the day's work.

Heat Fusion Joining of Unlike Polyethylene Pipe and Fittings

Research has indicated that polyethylene pipe and fittings made from unlike resins can be heat-fused together to make satisfactory joints. Some gas companies have been heat-fusion joining unlike polyethylene's for many years with success.

Mechanical Connections

As in the heat fusion methods, many types of mechanical connection styles and methods are available. This section is a general description of these types of Fittings.
Fitting selection is important to the performance of a piping system. Product performance and application information should be available from the Fitting

manufacturer to assist in the selection process as well as instructions for use and performance limits, if any. Additional information for these types of products is also contained in a variety of specifications such as ASTM F1924, F1973, AWWA C219, and UNI-B-13.

Polyethylene pipe, conduit and Fittings are available in outside diameter controlled Iron Pipe Sizes (IPS), Ductile Iron Pipe Sizes (DIPS), Copper Tubing Sizes (CTS) and Metric Sizes. There are also some inside diameter controlled pipe sizes (SIDR-PR). Before selecting mechanical Fittings, establish which of the available piping system sizes and types are being installed to ensure proper Fit and function. The pipe manufacturer can provide dimensional information, and the Fitting manufacturer can advise on the correct Fitting selection for the application.

Mechanical Compression Couplings for Small Diameter Pipes

This style of fitting comes in many forms and materials. The components, as depicted in Figure 7, are generally a body; a threaded compression nut; an elastomeric seal ring or O-ring; a stiffener; and, with some, a grip ring. The seal and grip rings, when compressed, grip the outside of the pipe, affecting a pressure-tight seal and, in most designs, providing pullout resistance which exceeds the yield strength of the polyethylene pipe. It is important that the inside of the pipe wall be supported by the stiffener under the seal ring and under the gripping ring (if incorporated in the design), to avoid deflection of the pipe. A lack of this support could result in a loss of the seal or the gripping of the pipe for pullout resistance. This Fitting style is normally used in service lines for gas or water pipe 2" IPS and smaller. It is also important to consider that three categories of this type of joining device are available. One type is recommended to provide a seal only, a second provides a seal and some restraint from pullout and a third provides a seal plus full pipe restraint against pullout.

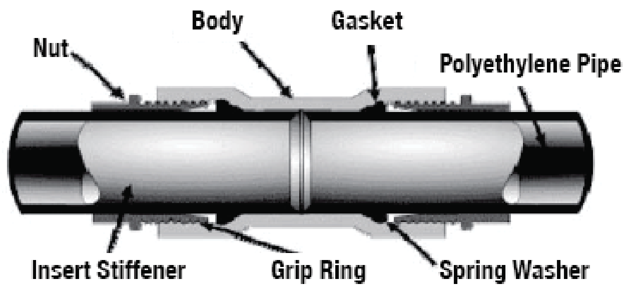

Figure 7 Typical Compression Nut Type Mechanical Coupling for Joining Polyethylene to Polyethylene

Stab Type Mechanical Fittings

Here again many styles are available. The design concept, as illustrated in Figure 8, is similar in most styles. Internally there are specially designed components including an elastomeric seal, such as an ÒOÓ ring, and a gripping device to effect pressure sealing and pullout resistance capabilities. Self-contained stiffeners are included in this design. With this style Fitting the operator prepares the pipe ends, marks the stab depth on the pipe, and Stabs' the pipe in to the depth prescribed for the Fitting being used. These Fittings are available in sizes from ½"CTS through 2" IPS and are all of ASTM D2513 [(2)] Category I design, indicating seal and full restraint against pullout.

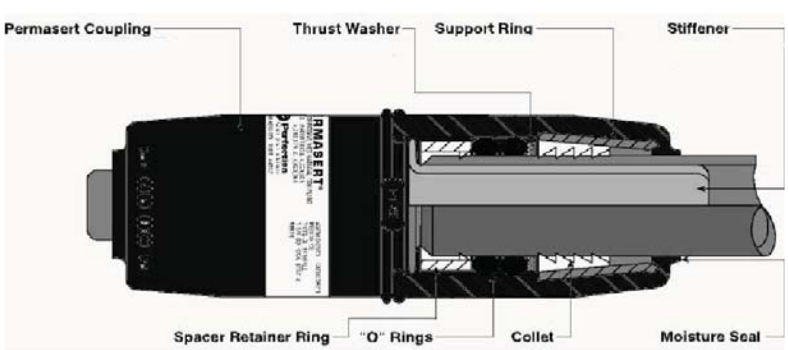

Figure 8 Stab Type Fitting

Mechanical Bolt Type Couplings for Large Diameter Pipes

There are many styles and varieties of "Bolt Type" couplings available to join polyethylene to polyethylene or other types of pipe such as PVC, steel and cast iron in sizes from 1¼" IPS and larger. Components for this style of Fitting are shown in Figure 9. As with the mechanical compression Fittings, these couplings work on the general principle of compressing an elastomeric gasket around each pipe end to be joined, to form a seal. The gasket, when compressed against the outside of the pipe by tightening the bolts, produces a pressure seal. These couplings may or may not incorporate a grip ring, as illustrated, that provides pullout resistance sufficient to exceed the yield strength of the polyethylene pipe. When PE pipe is pressurized, it expands slightly and shortens slightly. In a run of PE pipe, the cumulative shortening may be enough to disjoin unrestrained mechanical joints that are in-line with the PE pipe. This can be a particular concern where transitioning from PE pipe to Ductile Iron pipe. Disjoining can be prevented by installing external joint restraints (gripping devices or flex restraints; see Figure 16) at mechanical connections, or by installing in-line anchors or a combination of both. Additional restraint mechanisms are available to supplement the pull resistance of these types of Fittings' if needed. The Fitting manufacturer can help guide the user with that information. Use of a stiffener is needed in this Fitting style to support the pipe under the area of the seal ring and any gripping devices incorporated for pullout resistance.

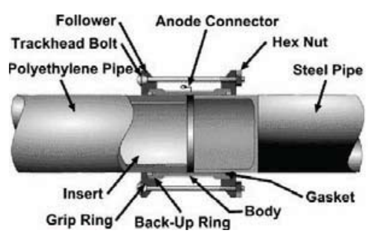

Figure 9

Mechanical Bolt Type Coupling for Joining Steel Pipe to Polyethylene or for Joining Two Polyethylene Pipes

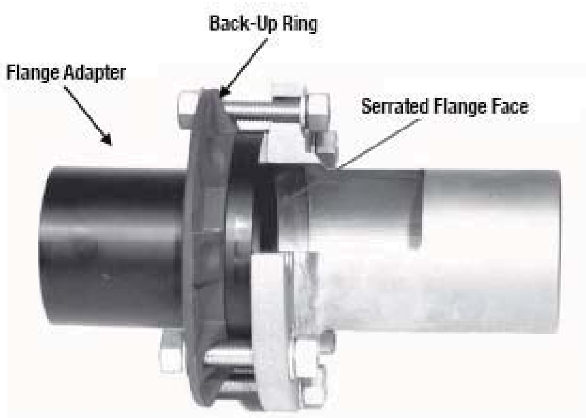

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Figure 10 Typical Application of Polyethylene Flange Adapter or Stub End

Polyethylene Flange Adapters and Stub Ends

When joining to metal or to certain other piping materials, or if a pipe section capable of disassembly is required, polyethylene flange adapters, as depicted in Figure 10, are available. The "Flange Adapter" and its shorter version, the "Stub End," are designed so that one end is sized the same as the plastic pipe for butt fusion to the plastic pipe. The other end has been especially made with a flange-type end that, provides structural support, which nullifies the need for a stiffener and, with a metal back-up ring, permits bolting to the non-plastic segment of a pipe line normally a 150-pound ANSI flange.(1)

The procedures for joining would be:

1. Slip the metal ring onto the plastic pipe section, far enough away from the end to not interfere with operation of the butt fusion equipment.
2. If a stub end is used, First butt-fuse a short length of plastic pipe to the pipe end of the stub end. If a "flange adapter" is used, the plastic pipe-sized end is usually long enough that this step is unnecessary.
3. Butts fuse the flange adapter to the plastic pipe segment.
4. Position the flanged face of the adapter at the position required so that the back-up ring previously placed on the plastic pipe segment can be attached to the metal flange.
5. Install and tighten the flange bolts in an alternating pattern normally used with flange type connections, drawing the metal and plastic flange face evenly and flat. Do not use the flanges to draw the two sections of pipe together.

At lower pressure, typically 80 psi or less, a gasket is usually not required. At greater pressure, the serrated surface of the flange adapter helps hold the gasket in place. The flange faces serration's should be individual closed concentric serration's as opposed to a continuous spiral groove which could act as a leak path. Standard Back-Up Rings are AWWA C207 Class D for 160 psi and lower pressure ratings, or Class 150 for higher pressure. Back-up ring materials are steel, primer coated steel, epoxy coated steel, or stainless steel. Ductile iron and Fiberglass are also available. In below ground service, coatings and cathodic protection may be appropriate to protect metal back-up rings from corrosion. One edge of the back-up ring bore must be radiuses or chamfered. This edge Fits' against the back of the sealing surface flange.

An all-polyethylene flange without a back-up ring is not recommended because polyethylene flanges require uniform pressure over the entire sealing surface. Absent a back-up ring, a polyethylene flange will leak between the bolts.

Flange adapters differ from stub-ends by their overall length. A flange adapter is longer allowing it to be clamped in a fusion machine like a pipe end. The back-up ring is Fitted to the flange adapter before fusion, so external fusion bead removal is not required.

A stub end is short and requires a special stub-end holder for butt fusion. Once butt fused to the pipe, the external bead must be removed so the back-up ring can be Fitted behind the sealing surface flange. In the Field, flange adapters are usually preferred over stub-ends.

Flange Gasket

A flange gasket may not be required between polyethylene flanges. At lower pressures (typically 80 psi or less) the serrated flange sealing surface may be adequate. Gaskets may be needed for higher pressures and for connections between polyethylene and non-polyethylene flanges. If used, gasket materials should be chemically and thermally compatible with the internal fluid and the external environment, and should be of appropriate hardness, thickness and style. Elevated temperature applications may require higher temperature capability. Gasket thickness should be about 1/8"-3/16" (3-5mm) and about 55-75 udometer Shore D hardness. Too soft or too thick gaskets may bow out under pressure. Overly hard gaskets may not seal. Common gasket styles are full-face or drop-in. Full-face style gaskets are usually applied to larger sizes, because flange bolts hold a flexible gasket in place while Fitting the components together. Drop-in style gaskets are usually applied to smaller pipe sizes.

Flange Bolting

Mating flanges are usually joined together with hex bolts and hex nuts, or threaded studs and hex nuts. Bolting materials should have tensile strength equivalent to at least SAE Grade 3 for pressure pipe service, and to at least SAE Grade 2 for non-pressure service. Corrosion resistant materials should be considered for underground, underwater, or other corrosive environments. Flange bolts are sized 1/8" smaller than the blot hole diameter. Flat washers should be used between the nut and the back-up ring.

Flange bolts must span the entire width of the flange joint, and provide sufficient thread length to fully engage the nut.

Flange Assembly

Mating flanges must be aligned together before tightening. Tightening misaligned flanges can cause flange failure. Surface or above grade flanges must be properly supported to avoid bending stresses. Below grade flange connections to heavy appurtenances such as valves or hydrants, or to metal pipes, require a support foundation of compacted, stable granular soil (crushed stone), or compacted cement stabilized granular backfill, or reinforced concrete. Flange connections adjacent to pipes passing through structural walls must be structurally supported to avoid shear loads.

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Prior to Fit-up, lubricate flange bolt threads, washers, and nuts with a non-fluid lubricant. Gasket and fl anger sealing surfaces must be clean and free of significant cuts or gouges. Fit the flange components together loosely. Hand-tighten bolts and re-check alignment. Adjust alignment if necessary. Flange bolts should be tightened to the same torque value by turning the nut. Tighten each bolt according to the patterns and torques recommended by the flange manufacturer. Polyethylene and the gasket (if used) will undergo some compression set. Therefore, retightening is recommended about an hour or so after torquing to the final torque value the First time. In pattern sequence, retighten each bolt to the final torque value. For high pressure or environmentally sensitive or critical pipelines, a third tightening, about 4 hours after the second, is recommended.

Special Cases

When flanging to brittle materials such as cast iron, accurate alignment, and careful tightening are necessary. Tightening torque increments should not exceed 10 ft.-lbs. Polyethylene flange adapters and stub ends are not full-face, so tightening places a bending stress across the flange face. Over-tightening, misalignment, or uneven tightening can break brittle material flanges.

When joining a polyethylene flange adapter or stub end to a flanged butterfly valve, the inside diameter of the pipe flange should be checked for valve disk rotation clearance. The open valve disk may extend into the pipe flange. Valve operation may be restricted if the pipe flange interferes with the disk. If disk rotation clearance is a problem, a tubular spacer may be installed between the mating flanges, or the pipe fl ange bore may be chamfered slightly. At the sealing surface, chamfering must not increase the flange inside diameter by more than 10%, and not extend into the flange more than 20% of the flange thickness. Flange bolt length must be increased by the length of

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the spacer.

Mechanical Flange Adapters

Mechanical Flange Adapters are also available and are shown in Figure 11A. This Fitting combines the mechanical bolt type coupling shown in Figure 9 on one end with the flange connection shown in Figure 10 on the other. This Fitting can provide a connection from flange Fittings and valves to plain end pipes. The coupling end of this Fitting must use a stiffener when used to join polyethylene pipe. Mechanical flange adapters may or may not include a self-restraint to provide restraint against pipe pullout as part of the design. Alternative means of restraint should be used when joining polyethylene pipe if the mechanical flange adapter does not provide restraint. Contact the manufacturer of these Fittings for assistance in selecting the appropriate style for the application.

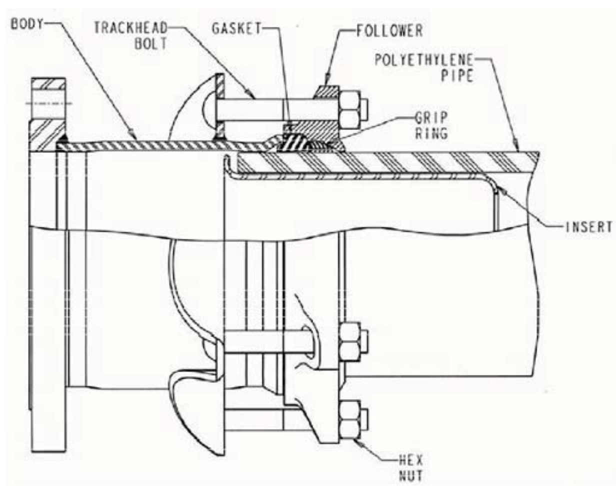

Figure 11A Bolt Type Mechanical Flange Adapter

Mechanical Joint (MJ) Adapters

PE pipe can be connected to traditional hydrants, valves and metal pipes using an MJ Adapter. A gland ring is placed behind the adapter before fusing, which can be connected to a standard ANSI/AWWA mechanical joint. When the gland ring is used, restraining devices are not required on the PE pipe.

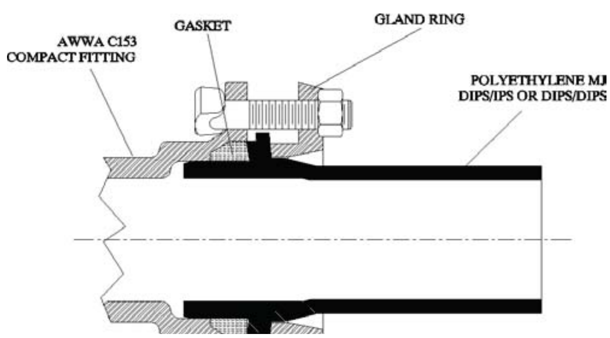

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Figure 11B Typical Application of Polyethylene MJ Adapter Transition Fittings

Other methods are available that allow joining of plastic to metal. Transition Fittings are available which are pre-assembled at the manufacturers facility. These transition Fittings are normally pull-out resistant, seal tight with pressure and have tensile values greater than that of the plastic pipe part of a system. However, the user should insist on information from the manufacturer to confirm design capabilities or limitations. Transition Fittings are available in all common pipe sizes

and polyethylene materials from CTS and larger with a short segment of plastic pipe for joining to the plastic pipe section. The metal end is available with a bevel for butt welding, with male or female pipe threads, or is grooved for a Victaulic(14) style, or flanged for connecting to an ANSI 150-pound flange.(1)

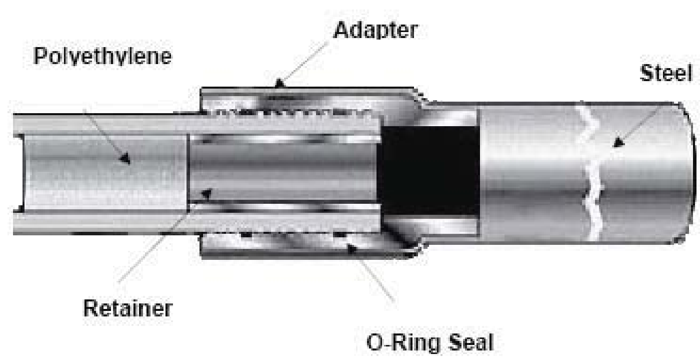

Figure 12

Standards Fitting for Plastic Pipe to Steel Pipe Transition

Mechanical Joint Saddle Fittings

Mechanical joint saddle Fittings have at least one mechanical joint which may connect the outlet to the service or branch pipe, or may connect the Fitting base to the main, or both connections may be mechanical joints. Mechanical joint saddle Fittings are made from plastics, metals, and other materials.

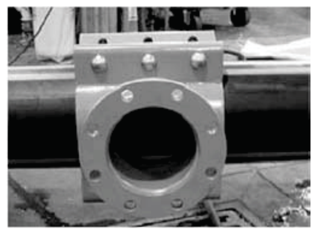

Figure 13 Mechanical saddle

For mechanical joint outlets, the service or branch pipe is either supported with a tubular stiffener in the pipe ID, or the pipe end is fitted over a spigot (insert) end of the Fitting. The outlet joint is completed using mechanical compression around the service or branch pipe OD. Depending upon design, gaskets may or may not be used. Observe the Fitting manufacturer's instructions in making the outlet connection.

Plastic outlet pipes must be protected against shear or bending loads by installing protective sleeves or bridging sleeves, or special care must be taken to ensure that embedment materials are properly placed and compacted around the outlet.

The connection between the saddle base and the main may be by hot plate saddle fusion, or by electro fusion, or by mechanical connection. Hot plate saddle fusion and electro fusion have been previously discussed.

Mechanical saddle base connections are clamped or strapped to the side or top of the main pipe. Typically, gaskets or o-rings are used to seal between the saddle base and the main pipe OD surface to prevent leakage when the main wall is pierced. Once secured to the main per the Fitting manufacturer's instructions, the main may be pierced to allow flow into the service or branch pipe.

Some mechanical joint saddle Fittings can have an internal cutter to pierce the main pipe wall (Fig. 13). "Tapping tees or tapping saddles" (Fig. 14) are generally suitable for installation on a "live" or pressurized main (hot tapping). Branch saddles or service saddles that do not have internal cutters may also be hot tapped using special tapping equipment. Contact equipment manufacturer for information.

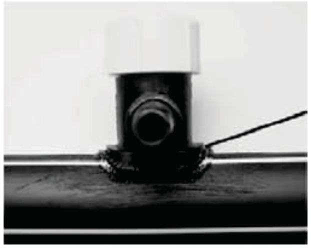

Figure 14 Tapping Tee with Cutter

Repair Clamps

Third party damage to polyethylene or any pipe material is always a possibility. Repairs can be made by cutting out the damaged section of pipe and replacing the section by use of heat fusion or mechanical FItting technology discussed earlier. Within limits, repairs can also be made with clamp-on repair saddles as depicted in Figure 15. Such devices do have limitations for use. They are intended only to repair

locally damaged pipe such as gouges or even punctures of the pipe wall. A clamp length of not less than 1½" times the nominal pipe diameter is recommended. The procedure is basically to clean the pipe area where the clamp will be placed, and bolt the clamp in place according to the Fitting manufacturer s instructions. As with all Fittings, limitations on use should be verified with the Fitting manufacturer.

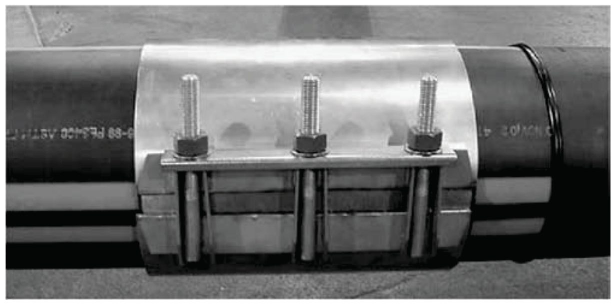

Figure 15 Clamp-on Repair Saddle

Other Applications

Restraining Polyethylene Pipe

Restraining of polyethylene is not required in a totally fused system. When concerns of thermal contraction or slippage due to terrain arise, PE may be restrained by use of Electro fusion Flex Restraints fused onto the pipe or a PE water stop fused inline. These Fittings serve as an anchor to allow concrete to be formed around the pipe encapsulating the anchor. Other methods of restraining polyethylene pipe include

A wall anchor fused in the line with the proper sized reinforced concrete anchor around it or adding restraint harnesses to several existing bell and spigot joints of the existing system to prevent pullout. Contact the pipe manufacturer for details.

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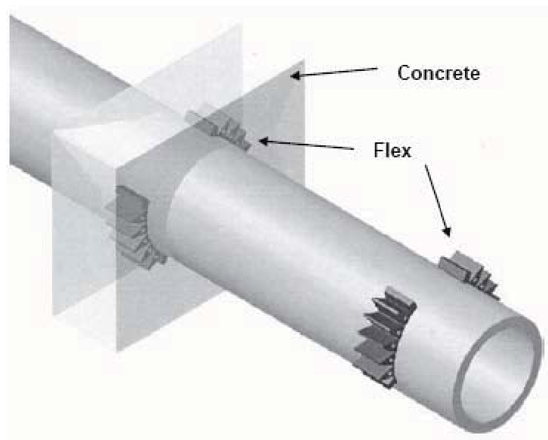

Fig. 16 Electrofusion Flex Pipe Restraint

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Fig. 17 Illustration of Method I-PE Wall Anchor

Squeeze-off

Regardless of the joining method applied in the installation of polyethylene pipe, it may become necessary to shut off the flow in the system. With PE pipe materials, squeeze-off of the pipe with specially-designed tools is a common practice. Use squeeze-off tools per ASTM F 1563 and follow the squeeze-off procedures in ASTM F 1041.

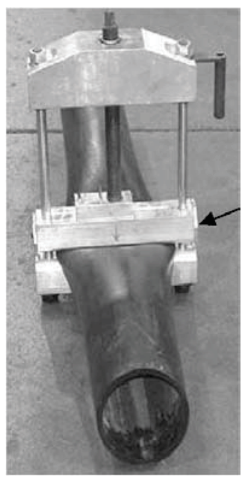

Fig. 18 Squeeze-Off Tool

Summary

The applications for polyethylene piping products continue to expand at an accelerating rate. Gas distribution lines, potable water systems, submerged marine installations, gravity and force main sewer systems, and various types of above-ground exposed piping systems are but a few of the installations for which polyethylene pipe and Fittings have been utilized.

As piping products applications expand, so does the use of new and existing joining methods expand?

A key element to this continued success is the diversity of methods available to join polyethylene pipe and Fittings. The integrity of the butt and socket fusion joining technique has been proven by the test of time in a variety of applications. The manufacturers of polyethylene pipe and Fittings have made every effort to make the systems as comprehensive as possible by producing a variety of Fittings and components to insure compatibility with alternate piping materials and system appurtenances.

The purpose of this chapter has been to provide the reader with an overview of the various methods by which polyethylene piping materials may be joined. As a result the reader has developed a further appreciation for the flexibility, integrity, and overall utility afforded in the design, installation, and performance of polyethylene piping systems and components.

It should be noted that this document does not purport to address the safety considerations associated with the use of these procedures. Information on safe operating procedures can be obtained from the manufacturers of the various types of joining equipment or polyethylene products.

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