

HIGH-DENSITY
POLYETHYLENE
BLACK GAS

ASTM D2513; OIL & GAS GATHERING PIPE API 15 LE

TECHNICAL & INSTALLATION GUIDE



*Building essentials
for a better tomorrow™*

HIGH-DENSITY POLYETHYLENE BLACK GAS

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J-M Manufacturing Company Inc. (JM Eagle™) warrants that its standard polyvinyl chloride (PVC), polyethylene (PE), conduit/plumbing/solvent weld and Acrylonitrile-Butadiene-Styrene (ABS) pipe products (“Products”) are manufactured in accordance with applicable industry specifications referenced on the Product and are free from defects in workmanship and materials. Every claim under this warranty shall be void unless in writing and received by JM Eagle™ within 30 days of the date the defect was discovered, and within one year of the date of shipment from the JM Eagle™ plant. Claims for Product appearance defects, such as sun-bleached pipe etc., however, must be made within 30 days of the date of the shipment from the JM Eagle™ plant. This warranty specifically excludes any Products allowed to become sun-bleached after shipment from the JM Eagle™ plant. Proof of purchase with the date thereof must be presented to the satisfaction of JM Eagle™, with any claim made pursuant to this warranty. JM Eagle™ must first be given an opportunity to inspect the alleged defective Products in order to determine if it meets applicable industry standards, if the handling and installation have been satisfactorily performed in accordance with JM Eagle™ recommended practices and if operating conditions are within standards. Written permission and/or a Return Goods Authorization (RGA) must be obtained along with instructions for return shipment to JM Eagle™ of any Products claimed to be defective.

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JM Eagle's liability shall not, at any time, exceed the actual wholesale purchase price of the Product. The warranties in this document are the only warranties applicable to the product and there are no other warranties, expressed or implied. This Limited Warranty specifically excludes any liability for general damages, consequential or incidental damages, including without limitation, costs incurred from removal, reinstallation, or other expenses resulting from any defect. IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED AND JM EAGLE™ SHALL NOT BE LIABLE IN THIS RESPECT NOTWITHSTANDING JM EAGLE'S ACTUAL KNOWLEDGE THE PRODUCT'S INTENDED USE.

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1.0 INTRODUCTION

These product lines are manufactured from a high-density material. The Gas Piping System can be joined by butt fusion, socket fusion, saddle fusion, mechanical fittings, or electrofusion. All methods are reliable means of joining the Gas Piping System. Generally, the choice of which system to use is at the discretion of the individual user.

Installer training for the proper use and installation of polyethylene pipe is a critical factor in its long-term performance. The Gas System has ample safety factors included in its design for providing reliable long-term performance in service, if the system is properly installed and operated at design pressures. The importance of proper training in the installation and operation of polyethylene plastic piping systems cannot be overemphasized.

Installation and operating recommendations are included in this bulletin to help the operator develop effective training programs.

Publications by the American Gas Association, the American Society for Testing and Materials, and the Plastics Pipe Institute can be helpful in assuring proper installation. Use of this information will minimize the potential for failure resulting from improper installation practices.

The Gas Piping System is manufactured to meet the requirements of ASTM D2513, which is necessary to meet the Pipeline Safety Regulations Part 192, Minimum Federal Safety Standards for the transport of natural gas.

2.0 PRODUCT & TECHNICAL INFORMATION

2.1 CODE COMPLIANCE

All Gas Pipe and Fittings meet the requirements specified in ASTM D2513. This Standard Specification is incorporated, by reference, in Appendices A and B of Part 192, Title 49 of the Code of Federal Regulations (CFR), "Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards." All Gas butt fusion and socket fusion fittings also meet the requirements of ASTM D3261 and ASTM D2683 respectively.

2.2 PHYSICAL PROPERTIES

Typical physical properties of Gas Pipe are available in polyethylene gas distribution catalogs.

2.3 LONG-TERM STRENGTH

The industry standard for establishing the design basis for polyethylene gas distribution systems is ASTM D2837, "Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials." This standard assigns the long-term strength of the pipe based on hydrostatically tested samples at a range of pressures that result in creep rupture failures (normally ductile) over a period of 10,000 hours or more. A regression analysis of these burst data is made to project the failure curve to 100,000 hours establishing the Long-Term Hydrostatic Strength (LTHS). Based on this, a Hydrostatic Design Basis (HDB) is assigned for each standard temperature tested.

The pressure rating and associated ASTM D2513 designation for two temperatures are listed in PPI's TR-4 report.

2.4 PIPE PRESSURE RATING

Design pressure ratings for Gas Pipe can be calculated by using the following formula given in the Department of Transportation (D.O.T.), minimum federal safety standards for gas lines, subpart C, Section 192.121:

$$P=2S/(SDR-1) \times 0.32$$

Where:

P= PRESSURE RATING IN PSI GAGE

S= HYDROSTATIC DESIGN BASIS CATEGORY, PSI

SDR= STANDARD DIMENSION RATIO

2.5 EFFECT OF ENVIRONMENTAL EXPOSURE ON PHYSICAL PROPERTIES

2.5.1 CHEMICAL RESISTANCE

Polyethylene Gas Pipe, for all practical purposes, is chemically inert. It has good resistance to most solvents and chemicals that it is likely to encounter in dry natural and manufactured gas distribution services. Examples are odorants (mercaptans), fogging oils, antifreezes (glycols and other alcohols) and the many constituents of natural and synthetic gas.

Gas pipe meets the chemical resistance specifications outlined in ASTM D2513. Chemical resistance data for polyethylene pipe can be found in the PPI Technical Report TR-19, "Thermoplastic Piping for the Transport of Chemicals" or through your JM Eagle™ sales representative.

2.5.2 WEATHER RESISTANCE

Gas Pipe is protected against degradation caused by ultraviolet rays from direct sunlight. The polyethylene resin contains 2 percent to 3 percent of finely divided carbon black. This provides the black color for black gas pipe. Carbon black is the most effective additive for enhancing the weathering characteristics of polyethylene pipe. JM Eagle™ gas pipe can be safely stored outside in most climates for periods of many years without danger of loss of physical properties due to ultraviolet exposure. In general, JM Eagle™ recommends the use of a first-in, first-out inventory management procedure.

2.5.3 INSTALLATION TEMPERATURES

Gas Pipe can be installed at any ambient temperature condition in which normal installation operations would continue. In cold weather, however, special procedural recommendations, as outlined in this bulletin, should be followed.

2.5.4 THERMAL EXPANSION AND CONTRACTION

The coefficient of thermal expansion for Gas Pipe is 9×10^{-5} inch/inch/degrees F. This translates to an easy rule of thumb: the pipe changes in length 1 inch per 10 degrees F change in temperature per 100 feet of pipe length.

The effect of expansion and contraction must be considered when using compression type fittings. The fitting must possess sufficient pullout resistance to counteract the thermal stress forces generated by the pipe.

2.5.5 PERMEATION

All types of plastics are permeable by gases to varying extents. The constituents of natural gas are somewhat permeable through polyethylene pipe, but not enough to have any detrimental effects on function in fuel gas service.

Because methane is the primary constituent of natural gas, it may be of interest to know its rate of permeation through Gas Pipe. The American Gas Association (AGA) "Plastic Pipe Manual for Gas Service" lists the permeability rate of methane through HDPE as:

$$2.4 \times 10^{-3} \frac{\text{Ft}^3 \text{ of gas-mils of wall thickness}}{\text{Ft}^2 \text{ pipe area} \times \text{day} \times \text{pressure in atmospheres}}$$

The rates of permeation for other constituents of natural gas, except hydrogen, are generally equivalent to, or less than, that for methane.

Even though the value for hydrogen is five times that of methane, considering its relatively low concentration in most natural and synthetic gas, it is apparent that the actual amount that could permeate is normally so low as to be insignificant.

2.5.6 EFFECT OF EXTERNAL LOADING STRESSES

Consideration must be given to the installation of all plastic piping systems, including the Gas Piping System, to avoid failures caused by excessive external stress. Field experience has shown that excessive externally induced stresses can act independently or together with internal pressure to exceed material strength and cause failure. Because polyethylene is subject to “crack propagation” under excessive stress conditions, such failures may not occur until after several years of use. Excessive installed bending in plastic piping systems, particularly at joints, can exceed stress limits and result in failure. Pipe where joined to fittings should be laid true to line and grade and backfilled carefully to prevent differential settlement, and thus excessive bending. See Permanent Minimum Bending Radius Limits.

Excessive stresses and failure of plastic pipe can also result from impact, indentations or deflection. Avoid excessive compaction forces and particularly avoid installation of the pipe against a source of point loading. The bed for the pipe and fill materials around the pipe must be free of rocks, blocking materials or other sources of point loading or deflection. Heavy machine compaction as by roller or hydrohammer should be used only for consolidation of final backfill with a minimum of 24 inches of previously layered and compacted backfill.

ASTM D2774, “Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping,” provides additional information for direct burial of Gas Pipe.

2.5.7 PLASTIC PIPE DAMAGE & REPAIR

Industry surveys indicate the primary causes for repair of plastic piping are from third party damage and poor workmanship in the initial installation. Repair can be minimized by using careful mapping and location methods and by proper training and inspection procedures. When repair is required, an advantage of Gas Polyethylene Pipe is its capability of being squeezed to control gas flow quickly and localize system shutdown.

Recommended procedures for repair are outlined in the Gas Piping Technology Committee (GPTC) of the AGA Guide as well as the AGA “Plastic Pipe Manual.”

Squeeze-off in sections of pipe, which are to be left in the system, should only be done using approved techniques and properly designed equipment to minimize pipe damage. Procedures for squeezing-off Gas Pipe are provided in the squeeze-off section of this bulletin.

An Electrofusion System and the MetFit Mechanical Fitting System (through 2") are useful in making repairs to polyethylene pipe.

2.5.8 PRODUCT DISPOSAL

At present, most polyethylene is disposed of by landfill. Gas Polyethylene Pipe is quite stable and poses no health hazards in properly operated landfill situations.

In some instances, polyethylene refuse is burned. Under conditions of good combustion, such as is found in forced draft incinerators, polyethylene is converted to carbon dioxide and water. Incomplete combustion results in the generation of volatiles that are the same as those produced during high-temperature processing operations. Carbon monoxide and acrolein are believed to be the most toxic fume components produced under poor combustion conditions.

The combustion of polyethylene is discouraged where large amounts of oxygen cannot be maintained. Such situations include open burning or dump fires and pit burning. When the oxygen supply during burning is limited, the smoke produced should be considered toxic and not inhaled. The same is true for smoke produced from wood and paper burned under poor combustion conditions. Applicable regulations should be considered in the disposal of solid waste.

3.0 INSTALLATION GUIDELINES

3.1 HANDLING

Gas Pipe is a tough flexible product that is able to withstand normal installation handling. However, unusually rough handling of Gas Pipe can result in damage to the pipe wall. Care should be taken to avoid pushing or pulling Gas Pipe over or around sharp projections. Gas Pipe is subject to impact

damage when dropped from excessive heights or when heavy objects are dropped upon it, particularly during cold weather. Kinking or buckling should be avoided and any section of pipe that has been damaged in this manner should be cut out. Based on pipe pressure tests, a good rule of thumb in determining if a scratched piece of pipe should be cut out of the piping system is: if the scratch depth is greater than 10 percent of the pipe wall thickness, then the section should be removed or repaired.

3.2 UNLOADING AND LOADING

When unloading or loading a shipment of Gas Pipe, forklift operators should be cautioned against damaging the pipe with the fork or tines of the lift truck. Coils of pipe are strapped or palletized for easy unloading or loading. When unloading or loading straight sticks of pipe, allow for some bending in the middle of the lift. Position forklift tines as far apart as possible to reduce the amount of bending. This will enable operators to lift the load without raising the forks to excessive heights which risks dropping the load.

Pipe unloaded by hand from a truck bed should be rolled down inclined planks to keep damage to a minimum. It should not be dropped to the ground. Never drop the pipe onto hard pavements or rocky terrain from truck beds. This is particularly important when unloading pipe at temperatures of 40 degrees F or below; under these conditions, the pipe is stiffer and more susceptible to damage from impact.

WARNING: When breaking down bulk packs, take care to stand clear of the pipe while strapping is being cut. Coiled High-Density Polyethylene (HDPE) pipe may contain energy as in a spring. Uncontrolled release, i.e., cutting of straps, can result in dangerous uncontrolled forces. All safety precautions and proper equipment is required.

3.3 STRINGING

Reel trailers can be helpful when stringing out coiled pipe for direct burial, plow-in, pull-in or insertion renewal. It is helpful when handling coiled pipe to string the pipe out on the ground upon arrival at the job site. This allows time for the coil set to relax, and will simplify handling and emplacement of the pipe.

When uncoiling pipe by hand, only cut those straps on the coils which are necessary to uncoil outer rolls; cut internal bands whenever necessary as the coil is unrolled.

Always inspect the pipe as it is being uncoiled and during installation to make sure no damage to the pipe has occurred during shipment and subsequent handling at the job site.

3.4 DRAGGING

Occasionally, when long strings of pipe are joined together, it is necessary to drag the pipe to where it will be installed. When the pipe must be dragged over rocky terrain or hard pavement, take precautions to protect the pipe from abrasion. Sandbags, used tires or short logs may be used to support the pipe and prevent hard contact with sharp rocks or hard pavement.

3.5 CUTTING

Gas Pipe should be cut with pipe cutters designed for plastic pipe. These tools easily provide the square cut ends that are necessary to provide satisfactory fusion joints. If carpenter or hacksaws are used to cut the pipe, special care must be taken to ensure square cut ends and to clean the resultant sawdust from inside the pipe.

WARNING: Before cutting coiled pipe, restrain both sides of cut. Pipe is under tension. Unrestrained pipe can spring back forcibly while being cut and could cause personal injury.

3.6 COLD-WEATHER HANDLING

Polyethylene is a tough piping material, yet colder temperatures can reduce resistance to damage from mechanical abuse, such as impact. Avoid dropping the pipe, especially in cold weather. Although the recommended method of unloading is to use a forklift or crane, an alternate method is to roll the sticks of pipe down inclined planks. In all cases the pipe should be inspected for damage.

When handling coiled pipe at temperatures below 40 degrees F, it is helpful to uncoil the pipe that is to be installed and let it straighten out prior to making the installation. This can be done by gradually uncoiling the pipe and covering it with dirt at intervals to keep it from coiling up again. Always be careful when cutting the straps on coils of pipe because the outside end of a coil may spring out when the strapping is removed.

In cold weather conditions, more effort will be required to uncoil the pipe and piping will spring back more forcibly if the ends are not anchored or restrained. Carefully follow equipment manufacturers' recommendations and guidelines for cold-weather conditions.

3.7 OTHER HANDLING PRECAUTIONS

During the transport of pipe, it should be continuously supported in a manner so as to minimize movement between the pipe and its support. Any practice of carrying supplies or equipment on top of plastic pipe should be avoided because of damage from sharp edges and other projections.

Care should be taken to protect the pipe from excessive heat. Be particularly careful of open flames. Do not lay an open flame or torch across pipe surfaces.

3.8 TRENCHING

For direct burial of Gas Pipe, trench bottoms should be relatively smooth, continuous and free of rocks and other debris. When ledge rock, hardpan or boulders are encountered, the bottom of the trench should be padded with sand or other fine grained fill materials. The trench should be wide enough to allow (a) fusion in the ditch if required, (b) snaking of the pipe along the bottom of the trench if needed, and (c) filling and compaction of side-fills. Minimum trench widths can be utilized in most instances by joining the pipe before lowering it into the trench.

Generally, sufficient cover must be maintained to provide reasonable protection against anticipated external stress loads. Gas Pipe should be installed at a minimum depth of 24 inches.

3.9 PIPE PLACEMENT IN TRENCHES

Gas Pipe can be joined either above ground or in the ditch as the situation dictates. Though most joining can be accomplished above ground, joining that must be done in the ditch should be well planned to ensure that enough space is available and that proper alignment is achieved. Care should be taken to avoid buckling, gouging, and other mechanical damage when lowering Gas Pipe into the ditch.

Align all pipe true to line and grade. As mentioned earlier, extremely cold weather makes Gas Pipe stiffer and increases the likelihood of impact damage.

Because plastic pipe contracts as it cools, it is desirable in warm weather to snake the pipe in the bottom of the trench. This provides for “slack” in the pipeline to be taken up as the pipe cools and contracts in the ditch prior to backfilling.

3.10 VALVE INSTALLATION

In the event valves are used in a Gas Pipe installation, it is recommended that the guidelines provided in the Federal Regulations be followed. The Code of Federal Regulations Title 49, Part 192.193 states: “Each valve installed in plastic pipe must be designed so as to protect the plastic material against excessive torsion or shearing loads when the valve or shut-off is operated and from any other secondary stresses that might be exerted through the valve or its enclosure.” Following these recommendations will help avoid damage to the piping system.

3.11 PIPE LOCATING

Polyethylene materials are generally not detectable by standard magnetic locating equipment. There are several methods available to aid in the detection of polyethylene pipelines. These include tracer wires, identification tape, detection tape, line markers, electronic marker systems and acoustic pipe tracing. When installing the Gas System, consideration should be given to a method or methods that will allow the pipeline to be located in the future. This alerts the locating personnel that the pipeline may not be identifiable by standard locating equipment. A standard method for locating plastic

pipe is to use an electrical conductor (such as metallic wire or metallic tape) installed with the pipe. This will permit location with electronic detectors. The AGA (American Gas Association) PLASTIC PIPE MANUAL FOR GAS SERVICE (2006 Edition) provides the following information on the use and placement of such electrical conductors: "Companies have reported that current surges (such as developed by lightning strikes) have followed the tracer causing physical damage to plastic pipe. Where practical, a separation of wire and pipe may be beneficial. However, separation may lead to difficulty in precise location of the plastic pipe. The engineer must consider the relative importance of locating the pipe versus the possibility of current surges."

3.12 BACKFILLING & COMPACTION

Backfilling and compaction of installed Gas Pipe must be accomplished so as to avoid induced bending stresses both as a result of the backfilling itself and from differential settling of fill materials subsequent to the backfilling operation. Additionally, care should be taken to avoid mechanical damage to the pipe from the fill material itself.

Attention to careful emplacement, filling and compaction procedures will prevent such induced stresses and mechanical damage.

Gas Pipe installations should be continuously supported beneath their entire lengths by clean and firm backfill materials (no rocks). Intermittent blocking should not be used to support pipe excavated sections.

Relatively compactible and clean fill materials should be used to bed newly installed pipe with particular attention to filling voids beneath transition connections. Side-fill compaction should be utilized to develop lateral passive soil forces when backfilling larger diameter thin wall pipes. The first layer of fill material around and about 12 inches over the pipe should be free from rocks or frozen chunks which could damage the pipe. This layer should be well compacted by hand. Successive layers should be spread uniformly to fill the trench completely. Large rocks, frozen earth and decomposable debris such as wood should not be included in the backfill.

Heavy rollers and large mechanical tampers such as hydrohammers should only be used to consolidate the final backfill and even then there should be a minimum of 24 inches of layered and previously compacted cover.

3.13 PERMANENT MINIMUM BENDING RADIUS LIMITS

The permanent minimum-bending radius at fusions (butt, saddle, socket and electrofusion) in the Gas System should be 90 times the pipe diameter. Gas Pipe without fusions can accommodate a permanent bending radius of 20 times the pipe diameter. Tighter bends down to 10 times the pipe diameter can be made if they are temporary, such as in the plowing or the insertion method of installation.

3.14 INSERTION RENEWAL

When inserting HDPE pipe, avoid damage to the pipe both during installation and from shear forces caused by earth loading after the system is installed. The CFR Title 49, Part 192.321 (f) states: "Plastic pipe that is being encased must be inserted into the casing pipe in a manner that will protect the plastic. The leading end of the plastic must be closed before insertion." The suggestions that follow should aid in meeting the requirements of this federal regulation.

To protect encased HDPE mains and services against damage from bending and shear stresses due to earth loads:

1. Any portion of exposed plastic piping which spans disturbed earth should be protected by adequate consolidation and compaction of backfill beneath and around the exposed section or by bridging between casing ends.
2. The inserted pipe must be padded where it emerges from the casing to prevent it from bearing on the end of the casing.
3. When holes in the casing must be cut for installation of services it is desirable to remove only the top part of the casing to insure continuous support for the inserted HDPE main.
4. The same care in backfilling and compaction around service connections that applies for direct burial applications also applies for insertion service connections.

To protect HDPE mains and services against damage during the insertion procedure:

1. A starter ditch of sufficient length must be opened to allow UAC 2000 to be inserted without buckling or excessive bending.
2. The casing pipe should be prepared to the extent necessary to prevent any sharp edges, projections or abrasive material from damaging the plastic pipe during or after insertion. This can often be accomplished with pigs or reamers. It is advisable to pull a test piece of the same size HDPE pipe through the casing for examination prior to the actual insertion.
3. The edge of the casing opening should be shielded to prevent shaving or gouging of the pipe being inserted.
4. If HDPE pipe is to be pulled through the casing pipe, the tensile loading should not exceed half the tensile strength of the inserted pipe. "Weak links" made from smaller sizes of HDPE pipe can be fabricated to protect the inserted pipe from damage due to excessive pulling stress.
5. The federal regulation requires that the leading end of the plastic be closed before insertion. Fabricated nose cones of wood, metal or HDPE end caps can be used for this purpose. A straight length on the lead end of a coiled pipe will often aid insertion, especially in cold weather.

A newly inserted main or service line must be allowed to contract while cooling to ground temperature prior to tie-in. Tie-in or coupling of inserted mains or services can be accomplished using standard heat fusion, electrofusion or compression type fittings. When compression fittings are used to join inserted mains, a precaution, such as anchoring, may be required to ensure against pull-out due to earth settlement and thermal contraction of the plastic. The plastic pipe should be anchored close to the tie-in point against movement relative to the joint.

3.15 PRESSURE TESTING AND LEAK DETECTION

JM Eagle™ recommends pressure testing and leak detection for newly installed Gas Pipe and Fittings. An excellent guide is the procedure outlined in the Federal Regulations, which must be followed for any system that should ever fall within the jurisdiction of the Federal Regulations.

The CFR Title 49, Part 192.513 lists the test requirements for plastic pipelines:

- a. Each segment of a plastic pipeline must be tested in accordance with this section.
- b. The test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested.
- c. The test pressure must be at least 150 percent of the maximum operating pressure, or 50 psig, whichever is greater.
- d. The temperature of thermoplastic material must not be more than 140 degrees F during the test.

State and local codes, as well as utility standards, often dictate pressure test duration. Generally, test duration should be determined by consideration of the volumetric content of the test section and the instrumentation used to ensure discovery of all leaks. Air or inert gases are standard test mediums.

Pressure testing of Gas Pipe should not be initiated until about 20 minutes after the final heat fused joint is made. It is generally desirable to pressure test new installations prior to backfilling so that soap bubble checks of joints can be used to locate leaks, if they occur. The test section should be tied down at intervals to prevent whipping of the pipeline should sudden pressure release occur. This is particularly important when pressure testing sections of pipe on top of the ground prior to insertion.

When using expandable caps or compression type couplings as test heads, adequate pullout resistance of the mechanical connector must be demonstrated. Additional methods including anchoring, sandbagging, staking or strapping should be used for safety. Many utilities use transition fittings with welded on closure caps as test heads.

When using air compressors to pressure test sections of Gas Pipe, care should be taken to minimize contamination of the pipe with excessive amounts of oil or other agents. Oil has the effect of plasticization of Gas Pipe that results in a small decrease in strength in regions where high concentrations of oil are absorbed by the plastic. For this reason, traps or filters should be used on the discharge side of the compressor to minimize the amount of contamination. Also, the temperature of the air from the compressor must be low enough so as not to allow the test temperature to exceed the maximum allowable 140 degrees F.

When time testing large volume sections of Gas Pipe, the operator should be aware of the creep characteristics of plastic pipe and the effects of temperature change. After initial pressurization, polyethylene pipe may continue to expand slightly, causing a noticeable drop in gauge reading that will stabilize after a few minutes. A long-term reading should be initiated when the stabilization point has been reached. Of course, any heating and cooling of the test medium as in an overnight test will affect pressure readings, which could conceivably mask or falsely indicate slow leaks. No specific guidelines can be given, as readings would vary greatly depending on volume and temperature characteristics.

It is occasionally necessary to use gaseous leak detection tracers to locate leaks in a buried system. Commercial odorants in liquid form should not be injected directly into the Gas System because they can temporarily affect the strength of polyethylene. Odorants should be vaporized prior to injection. When bar-holes are sunk to provide a path to the surface for the tracers, care should be taken to avoid puncturing the buried pipeline.

3.16 SAFETY AND FIELD PRECAUTIONS

1. **WARNING:** Treat electrical tools as potential sources of ignition and follow standard safety procedures for working in explosive atmospheres.
2. **WARNING:** Only properly trained and qualified personnel should make fusions.
3. **WARNING:** Wear suitable gloves and eye protection.
4. **WARNING:** Temperature of fusion tools should be checked to be sure that they conform to the recommended operating temperature range.
5. **WARNING:** When breaking down bulk packs, take care to stand clear of pipe while strapping is being cut. Coiled HDPE pipe may contain energy as in a spring. Both the straps and the pipe may spring outward when the strap is cut and could cause severe injury. All safety precautions and proper equipment is required.
6. **WARNING:** Before cutting coiled pipe, restrain both sides of cut. Pipe is under tension. Unrestrained pipe can spring back forcibly while being cut and could cause personal injury.
7. **WARNING:** Understand and follow all equipment manufacturer's recommendations and guidelines.

3.17 HEATING TOOL MAINTENANCE

Clean heater adaptors carefully before and after each fusion. Remove any residual polyethylene using a clean non-synthetic cloth. Never use metal objects to clean heater adaptors because they can damage the surface.

The heating tool temperature recommendations shown in this bulletin represent the temperature on the surface of the heater adaptors that actually contact the pipe or fitting. This temperature should be monitored daily to ensure compliance with recommendations.

The operator can usually expect the tool thermometer to indicate a higher temperature than specified in order to achieve the correct surface temperature. In addition, the operator will normally encounter variations in heater adaptor temperature due to different adaptor configurations. In these cases, the adaptor having the lower temperature should be set at the recommended temperature.

4.0 FUSION PROCEDURES

WARNING: Understand and follow all equipment manufacturers' recommendations and guidelines.

4.1 SOCKET FUSION

4.1.1 EQUIPMENT

1. Pipe or tubing cutter
2. Cold ring
3. Depth gauge
4. Chamfering tool
5. Heating tool
6. Female and male heater adaptors
7. Fitting puller
8. Clean non-synthetic cloth

4.1.2 PROCEDURES

1. Cut the pipe squarely with a pipe or tubing cutter.
2. Chamfer pipe using a chamfering tool.
3. Clean the end of the pipe with a clean non-synthetic cloth.
4. Install the depth gauge and cold ring. Remove depth gauge once cold ring is secured. Ensure pipe is sufficiently round once cold ring is installed.
5. Place a fitting puller on couplings, caps and reducers 2-inch IPS through 4-inch IPS.
6. Check the heater adaptor faces for proper joining temperature 500 degrees F (\pm 10 degrees F).
7. Place the fitting on the tool and then the tool on the pipe. Push the tool, pipe and fitting together with even pressure.
8. When the fitting is against the tool and the tool against the cold ring, begin the heating cycle shown in [Table 1](#).
9. When you have heated for the proper cycle time, remove the fitting from the tool with a quick snap action. Then remove the tool from the pipe in the same way.
10. Quickly inspect the melt pattern on the pipe and fitting. If an incomplete pattern is obtained, repeat Steps 1 to 9 using a longer heating cycle and new fitting.
11. Within 3 seconds, carefully line up and push the fitting onto the pipe until it bottoms against the cold ring on the pipe. Do not twist or rotate the fitting.
12. Hold the joint firmly together without movement for the recommended holding time shown in [Table 1](#). After an additional 3 minutes, release the cold ring and fitting puller.
13. Inspect the entire circumference of the fused joint to be sure there are no open gaps in the pipe to fitting juncture, and that the melt is pressed against the coupling all the way around. If a gap is found or the joint is not aligned properly, cut it out and repeat the procedure. See a properly made socket fusion joint appearance in [Figure A](#). Only accept joints that meet these requirements. Never allow a questionable joint to be installed.
14. Wait an additional 10 minutes prior to pressure testing or burial.

SOCKET FUSION TIME CYCLES <i>(Heater Face at 500° F)</i>		
PIPE SIZE	HEATING TIME (sec)	HOLDING TIME (sec)
½" CTS	9-10	30
¾" CTS	9-10	30
1" CTS	14-16	30
1¼" CTS	14-16	30
½" IPS	9-10	30
¾" IPS	12-14	30
1" IPS	15-17	40
1¼" IPS	18-21	40
1½" IPS	20-23	40
2" IPS	24-28	40
3" IPS	28-32	50
4" IPS	32-37	50

Table 1



Figure A

4.1.3 COLD-WEATHER CONSIDERATIONS (BELOW 55°F)

- Carefully remove (by light tapping or scraping) the ice and frost from the fusion areas and the areas to be clamped. Otherwise, ice will melt when exposed to the heating tool and spot chill the polyethylene. This could cause incomplete fusion.
- If possible, store fittings at room temperature (such as in truck cab) prior to use. This will reduce fitting contraction and make placing fitting on heater adaptor easier.
- Cold weather also causes pipe contraction that can result in a loose or slipping cold ring. For best results, clamp one cold ring in its normal position behind the depth gauge. Place shim material (i.e., a piece of paper or rag) around the inside diameter of a second cold ring and clamp this cold ring directly behind the first cold ring to prevent slippage.
- Shield the heating tool and fusion area from the wind, snow and freezing rain.
- Ensure heater adaptor faces maintain a temperature of 500 degrees F ± 10 degrees F.
- The length of cycle necessary to obtain a complete melt pattern will depend not only on the outdoor temperature, but also on wind conditions, pipe contraction and operator technique. The maximum heating cycle times shown in [Table 1](#) should be used as a starting point for determining the exact heating cycle time for the particular installation conditions. Determining the exact heating cycle time can be accomplished by making a test melt pattern on a piece of cold scrap pipe. If the initial melt pattern is incomplete, try a 5-second-longer cycle on another cold piece of scrap pipe. Continue this process until a complete melt pattern is obtained. Avoid cycles in excess of that required to achieve a good melt pattern.
Once the optimum heating cycle is established, begin fusion by placing the female adaptor on the pipe.
Start counting the heating cycle once the pipe is completely seated. The socket fitting should then be pushed on the male adaptor. There should be no problem with melt development in the fitting since the fit will be snug.
- Work quickly once pipe and fitting have been removed from the heating tool so that melt heat loss is minimized. But, still take time (2-3 seconds) to inspect both melt patterns.

4.2 BUTT FUSION

In addition to the following procedure, JM Eagle™ also has tested and endorses TR-33, the generic butt fusion procedure that is available at www.plasticpipe.org.

4.2.1 HEATING TIME

The heating time for virtually all large diameter pipe is determined by visually observing the melt bead during heating. For sizes 8 inches and larger, a bead width of three sixteenths of an inch to one quarter of an inch is recommended.

4.2.2 INTERFACIAL PRESSURE

The interfacial pressure for butt joints has been expanded to 60 to 90 psi. For hydraulic machines, the fusion force is determined by multiplying the interfacial pressure times the calculated pipe end area. The gauge pressure is theoretical; the internal and external drag needs to be added to this figure to obtain the actual fusion pressure required by the machine. Contact the machine manufacturer for set-up details.

4.2.3 HOLDING & COOLING TIME

The molten joint must be held immobile under pressure until cooled adequately to develop its strength. Due to the heavy weight of large diameter, heavy (lower SDR number) wall pipe, the newly made joint must be able to withstand the added stress of pipe removal from the machine. The fusion force should be held in the machine until the surface of the bead is cool to the touch. Ambient field conditions may require a cooling time of 30 to 90 seconds per inch of pipe diameter to achieve the cool temperature for removal from the machine. Pulling, installation, or rough handling of the pipe should be avoided for an additional 30 minutes.

WARNING: Understand and follow all equipment manufacturer's recommendations and guidelines.

4.2.4 EQUIPMENT

1. Pipe cutter
2. Butt fusion machine
3. Clean non-synthetic cloth

4.2.5 PROCEDURES

1. Install appropriate shell clamp liners and any other equipment required to fuse the size pipe (fitting) to be joined.
2. Select and control heating tool temperature. Temperatures of 500 degrees F (± 10 degrees F) or 375 degrees to 400 degrees F and 440 degrees F (± 10 degrees F) may be used.
3. The pipe must be clean and dry. Wipe the inside and outside of pipe to be joined with a clean cloth. Make sure all foreign matter is removed. Cut off damaged or flattened pipe ends.
4. Swing facing unit into place and lock.
5. Retract movable shell back against the stops.
6. Position longer lengths of pipe in stationary shell clamp by placing pipe end lightly against the facing unit plate so that a sufficient amount of pipe end will be removed during facing. Close shell and tighten sufficiently to prevent slippage. Position shorter pipe or fitting in movable shell in similar manner. In the case of coiled pipe, print lines should be 180 degrees apart to form an "S" configuration in the pipe. If the pipe is out-of-round, wait 2 minutes for pipe relaxation and retighten the shells.
7. Turn on facer motor and advance the pipe (fitting) ends against the facer cutters using enough pressure to cut a continuous ribbon. Continue facing until stops are reached and both ends are completely parallel and smooth. Remove facing unit per butt fusion machine manufacturer's instructions.
8. Remove the shavings from pipe ends and facer base. Faced pipe ends should be kept clean and free of dust, water oil or anything that might contaminate the fusion area.
9. Check the ends of the faced pipe. If either pipe is not completely faced, go back to Step 3. Facing should be occasionally checked by carefully placing a straight edge across a faced pipe end to insure that the entire surface is level for complete contact of the pipe with the heating tool.

10. Bring the faced pipe ends together to ensure that the pipe will not slip in the shells. Check for high-low alignment between pipe ends. Tighten the inside clamp on the high side to align pipe ends as closely as possible.
Never loosen the low side clamp. If the pipe ends are not aligned or if gaps are present, adjust the pipe in the shells and go back to Step 3.
11. Retract the shells and position the heating tool between the pipe ends.
12. Move the pipe and/or the fitting ends against the heating tool firmly to assure complete contact; then relax to slight contact pressure only.
13. Heating guidelines shown in [Table 2](#) should develop an approximate bead width of the size shown in [Table 3](#). Heating cycle starts when a complete, uniform bead of molten material is visible around the entire circumference of both ends. It is optional to develop melt based on visual appearance provided that Bead Width guidelines shown in [Table 3](#) are attained.
14. At the end of the heating cycle, quickly retract the pipe shell clamps to snap the heater away from the pipe ends. Remove the heater without touching the pipe (if melted material is pulled off the pipe ends, allow the pipe to cool and then repeat the entire procedure). Bring the melted ends together rapidly (do not slam) to develop a double roll back of each bead onto the pipe. Use only enough pressure to form a double rollback bead. This operation should take no longer than three seconds.

NOTE: Hydraulic butt fusion machines should be set using an interfacial pressure of 60 to 90 psi. Refer to butt fusion machine manufacturer's recommendation for specific machine settings.

15. Maintain pressure for the "Holding Time Cycle" shown in [Table 2](#).
16. Release pressure and allow joint to cool in the machine for an additional 3 minutes. Open shells and remove the pipe from the machine handling it with care.
17. Inspect the entire circumference of the fused joint for uniformity in size and shape. Each bead width should be the approximate dimensions shown in [Table 3](#). See [Figure B](#) for a properly made butt fusion joint. Only accept joints meeting these requirements. Never allow a questionable joint to be installed.
18. Visually mitered joints (angled, offset) should be cut out and re-fused.
19. Allow further cooling of 20 minutes or until bead is not hot to the touch, before subjecting the pipe to rough handling.

4.2.6 COLD WEATHER CONSIDERATIONS (BELOW 55 DEGREES F)

- Carefully remove (by light tapping or scraping) the ice and frost from the fusion areas and the areas to be clamped. Otherwise, ice will melt when exposed to the heating tool and spot chill the polyethylene. This could cause incomplete fusion.
- Shield the heating tool and fusion area from the wind, snow and freezing rain.
- Ensure heating tool maintains temperature.
- Normally, the shell clamps are more than adequate to prevent pipe slipping in the liner. However, contraction in the pipe O.D. (because of low temperature) may, on occasion, result in pipe slippage in the shell. A shim layer (pressure sensitive tape or metal shim, etc.) can be placed on the liner I.D. to provide clamping restraint to the pipe.
- Follow the standard procedure with particular attention to the fusion steps. The timed cycles remain the same, but it may take longer to develop the initial melt bead completely around the pipe ends. Do not increase pressure. Quickly snapping the pipe from the heater and immediate closing of the shells to minimize melt cooling is important.

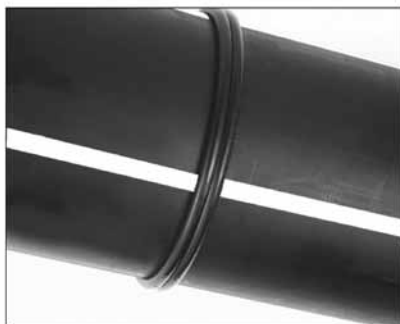


Figure B

BUTT FUSION TIME CYCLE GUIDELINES			
PIPE SIZE	440°F HEATING TIME (sec)	500°F HEATING TIME (sec)	HOLDING TIME (sec)
* ½" CTS	15-18	6-7	50
* ¾" CTS	16-19	8-10	50
* 1" CTS	18-22	14-17	50
* 1¼" CTS	20-24	16-19	50
* ½" IPS	16-19	8-10	50
* ¾" IPS	18-22	14-17	50
* 1" IPS	20-24	16-19	50
1¼" IPS	35-42	18-22	70
1½" IPS	50-60	26-31	90
2" IPS	55-66	28-34	90
3" IPS	65-78	30-36	120
4" IPS	75-90	35-42	120
6" IPS	105-126	55-66	180
8" IPS & larger	Visual	Visual	Cool To Touch

Table 2

* Socket Fusion recommended for these sizes.

APPROXIMATE BEAD WIDTH GUIDELINES (400°, 440°, OR 500°F)	
PIPE SIZE	PROPER MELT
1¼" - 3"	approximately ¼"
3" - 6"	⅛" - ⅜"
6" - 8"	⅛" - ⅜"
8" IPS & larger	⅜" - ¼"

Table 3

Each bead after fusion may be slightly wider than those in Table 3.

4.3 SADDLE OR SIDEWALL FUSION PROCEDURE

In addition to the following procedure, JM Eagle™ also has tested and endorses TR-41, the generic fusion procedure that is available from PPI at www.plasticpipe.org.

An application tool must be used when making saddle fusion joints. Follow the tool manufacturer's operating procedures for proper use of the tool.

WARNING: Understand and follow all equipment manufacturer's recommendations and guidelines.

4.3.1 EQUIPMENT

1. Application Tool
2. Heating Tool
3. Appropriate size saddle heater adapters
4. 50- to 60-grit utility cloth
5. Clean non-synthetic cloth or lint-free paper towel

4.3.2 PROCEDURE

Place the tool on the main. It must be able to straighten, round and support the main during the heating, joining, and holding steps. A bolster plate is recommended for 6-inch IPS and smaller mains. Heating times start when the fitting and pipe are firmly seated against the heater faces. During heating, the heating tool may be rocked slightly, about 2 degrees, to seek its own alignment and to assure full contact with the main.

Clean main and fitting. Ensure that heater adaptor surfaces are at 500 degrees F \pm 10 degrees F and the correct heating faces are installed. Roughen pipe main and fitting fusion surface with 50- to 60-grit utility cloth. Brush any residue away with a clean, dry non-synthetic cloth or paper towel.

Insert fitting into application unit, confirm proper alignment, then secure fitting tightly in unit. Center heater tool under the fitting, then apply and maintain firm, continuous pressure until a complete melt bead is seen on the

main. Heat for the period of time shown in [Table 6](#) or until melt bead size shown in [Table 4](#) is visible on the crown of the pipe. Remove the heater from the fitting and the main with a quick snapping action. Quickly check the melt patterns of the heated surfaces for complete, even melt patterns.

APPROXIMATE PIPE MELT BEAD SIZE	
PIPE SIZE	BEAD THICKNESS
1¼"	1/32"
2"	1/16"
3" & larger	1/8"

Table 4

If the melt patterns are satisfactory, press the fitting on the pipe within 3 seconds after removing the heater and apply joining/fusion pressure as indicated in [Table 6](#), until a melt bead of the following size appears around the entire base of the fitting:

APPROXIMATE FTG. BASE BEAD SIZE	
PIPE SIZE	BEAD THICKNESS
1¼"	1/16"
2"	1/8"
3" & larger	larger than 1/8"

Table 5

Maintain fusion-joining pressure for time specified in [Table 6](#). Remove the application tool after an additional 3 minutes of cooling. For Standard Tap Tees and Service Saddles, let fusion cool an additional 10 minutes before pressure testing or tapping the main. Allow an additional 30 minutes before pressure testing or tapping High Volume Tapping Tees or Branch Saddles.

If melt patterns are unsatisfactory, complete the fusion; allow time for cooling, and then cut off top of the fitting to prevent use. Never reapply the heater for additional time, as the additional heat may risk a blowout on pressurized mains. Determine corrective steps to take and begin a new fusion at a new location.

Carefully inspect the fusion for the required visual criteria. Confirm that fitting is located completely within the pipe melt pattern and ensure that the appropriate size bead width is visible around the entire base of the fitting. Never accept a questionable fusion. See [Figure C](#) for an example of a properly made saddle fusion joint.

NOTE: For saddle fusions, it should be emphasized that these heating/fusion recommendations are strictly guidelines. This is true of all saddle fusion procedures. Certain conditions will almost always exist which result in longer or shorter heating times. The most important guideline is to achieve a complete pipe and fitting melt pattern.

STANDARD TAP TEES AND SERVICE-SADDLES				
PIPE SIZE	HEATING PRESSURE (lb/)	FUSION PRESSURE (lb/)	HEATING TIME (sec.)	COOLING TIME (sec.)
1¼"	60-70	40-50	45-Saddle 30-Pipe*	70
2"	65-75	45-65	45	70
3"	70-80	50-70	45	70
4"	70-80	60-80	45	70
6"	75-80	70-80	45	70
8"	75-80	70-80	45	70
HIGH VOLUME TAPPING TEES & RECTANGULAR BASE BRANCH SADDLES				
2"	120-140	65-75	55-65	150
3"	125-140	80-100	75-90	180
4"	125-140	90-110	75-90	180
6"	130-140	90-120	85-100	180
8"	130-140	90-120	85-100	180

Table 6

* Use heat shield between main and heater for first 15 seconds of heating cycle.

NOTE: Times shown are guidelines ONLY. Actual times will depend on field site factors and the condition of the fusion equipment



Figure C

4.4 HEAT FUSION QUALIFICATION

Gas socket, saddle and butt fusion joints made according to procedures described in this bulletin have been tested by JM Eagle™ using ASTM test methods given in [Table 7](#) and meet the requirements of DOT Regulation Section 192.283.

The Material Transportation Board has stated that results of tests properly performed by a manufacturer of pipe and fittings may be adopted by a gas utility to qualify socket, saddle and butt fusion procedures pursuant to DOT Regulation Section 192.283. The regulations provide, however, that “it is still the operator who is responsible for compliance of his pipeline.”

ASTM TEST METHODS		
TEST	ASTM NO.	REQUIREMENT
Short term rupture strength (hoop stress)	D1599	Ductile failure
Test for tensile properties of plastics	D638 ⁽¹⁾	> 25%
Time to failure under constant internal pressure (1600) psi hoop stress	D1598	> 1000 hours
Knock-off resistance of saddle fusions	F905	No joint failure

Table 7

(1) As applied to machined specimens of polyethylene pipe joints (socket and butt fusion) at a strain rate of 0.5 inches/rnin.

4.4.1 DOT REGULATIONS FOR PROCEDURES AND PERSONNEL QUALIFICATION

The DOT has ruled that, effective July 1, 1980, Part 192 of Title 49 of the Code of Federal Regulations is amended as follows (for heat fusion joints):

Section 192.283 Plastic Pipe; Qualifying Joining Procedures-Heat Fusion

Before any written procedure established under Section 192.273(b) is used for making plastic pipe joints by a heat fusion method, the procedure must be qualified by subjecting specimen joints made according to the procedure to the following tests:

1. The burst test requirements of Paragraph 6.6 (Sustained Pressure Test) or Paragraph 6.7 (Minimum Hydrostatic Burst Pressure) of ASTM D2513⁽²⁾.
2. For procedures intended for lateral pipe connections subject a specimen joint made from pipe sections joined at right angles according to the procedure to a force on the lateral pipe until failure occurs in the specimen (ASTM F905). If failure initiates outside the joint area, the procedure qualifies for use; and
3. For procedures intended for nonlateral pipe connections, follow the tensile test requirements of ASTM D638, except that the test may be conducted at ambient temperature and humidity. If the specimen elongates no less than 25 percent or failure initiates outside the joint area, the procedure qualifies for use.

Section 192.285 Plastic Pipe; Qualifying Persons to Make Joints

1. No person may make a plastic pipe joint unless that person has been qualified under the applicable procedure by:
 - a. Appropriate training or experience in the use of the procedure, and
 - b. Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth below.
2. The specimen joint must be:
 - a. Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and
 - b. In the case of a heat fusion ... joint:
 - i. Tested under Section 192.283;
 - ii. Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or

- iii. Cut into at least 3 longitudinal straps, each of which is:
 - a. Visually examined and found not to contain voids or discontinuities on the cut surface area; and
 - b. Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

4.4.2 PROCEDURES FOR HEAT FUSION QUALIFICATION

1. Prepare fusion joint as described previously in the “Fusion Procedures” section of this manual. Allow joint to cool one hour.
2. Compare the outside appearance of joint with photograph illustrating the correct procedure.
3. Section the joint axially into at least three straps (1-inch wide) to expose the bond area. Leave approximately 8 inches of pipe on both sides of the joint.
4. Inspect the fusion to verify:

Socket Fusion

- Complete melt development
- No gaps or voids
- External melt pressed against coupling
- Bond length
- Proper alignment

Butt Fusion

- Complete and uniform melt beads
- Melt bead rolled back to pipe
- No gaps or voids
- Proper alignment
- Complete facing
- Visually mitered joints (angled, offset) should be cut out and re-fused.

Saddle Fusion

- Complete pipe melt pattern
- No gaps or voids
- Complete melt development around base of fitting
- Fitting placement in pipe melt pattern
- Properly prepared pipe surface

- Using the sectioned joint from Step #3, perform the bend test as shown in Figures D, E and F. Hold the ends of the strap in the bent position and inspect the fusion area. If there are any gaps or voids evident, the joint should be rejected. The sectioned joint must be free of gaps or voids.
- If the joint is not representative of the photographs shown in this bulletin, determine the incorrect procedure step taken and make another joint.



Figure D
Correctly Made Socket Fusion Joint

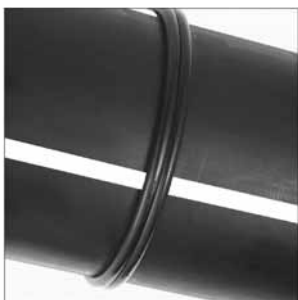


Figure E
Correctly Made Butt Fusion Joint

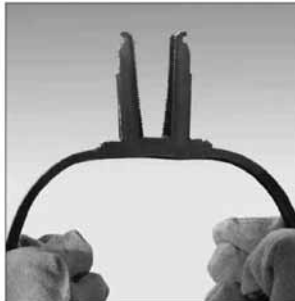


Figure F
Correctly Made Saddle Fusion Joint

5.0 SQUEEZE-OFF

WARNING: Understand and follow all equipment manufacturer’s recommendations and guidelines.

Effective flow control is a basic requirement in gas distribution systems. This is accomplished with the Gas Pipe in two ways. The primary method of flow control should be those installed system valves that are available. Secondly squeeze-off using suitable equipment can be used to control flow or isolate a section of pipe. Also, squeeze-off is frequently used to control flow for emergency repairs or during certain pipeline or branch extension operations.

This section describes equipment and explains proper procedures and precautions for effectively and safely squeezing off Gas Pipe for flow control. The pressure rating of the pipe is retained if the recommended procedures and equipment are used.

5.1 TOOLS

Squeeze units suitable for use on Gas Pipe consist of steel bars and a mechanical or hydraulic means of forcing the bars together. These units are designed to squeeze Gas Pipe until the inside surfaces meet. This adequately controls gas flow although a bubble tight seal is not always obtained. A positive locking mechanism should be available.

CAUTION: To assure flow control, yet prevent damage to the pipe, tools have mechanical stops to limit the minimum gap between the squeeze bars. Recommended minimum gaps between the squeeze bars for Gas Pipe are based on the formula:

$$\text{Min.gap} = (2) (\text{max wall thickness}) \times (0.7)$$

In addition to observing the minimum gap distances between bars, the bars themselves should be rounded to prevent pipe damage.

The user also may want to consult the “Standard Guide for Squeeze-Off of Polyolefin Gas Pressure Pipe and Tubing,” Designation F1041, issued by ASTM.

5.2 PRECAUTIONS FOR SQUEEZE-OFF

- Certain precautions should be taken to prevent damage to the squeeze tools or to Gas Pipe during squeeze-off in recognition of the large forces required for flow control, particularly in large main sizes. Damage to the pipe from improper squeeze-off procedures may cause eventual failure.
- Make certain the pipe is centered and squared in the squeeze tool. It is important that the pipe be free to spread as it flattens. Failure to do so may prevent flow control or result in damage to the pipe or the tool.
- Locate the squeeze point at least three pipe diameters away from the nearest fitting or butt-fused joint. Failure to do so may result in damage to the fittings or joints.
- Squeeze-off Gas Pipe only once in the same place. It is possible for scale or other metal particles contained within the gas flow to become trapped at the squeeze point. A second squeeze in the immediate area of the first could force these particles to penetrate into or through the pipe wall.
- Always use a squeeze tool with gap stops to limit the amount of squeeze and use the proper gap stops for the pipe size being squeezed. Using smaller gap stops or otherwise **over-squeezing** the pipe may result in damage to the pipe or tool.
- A bubble tight flow control will not always be obtained through squeeze-off. If more complete flow control is required, a valve should be used or additional squeeze tools used in series to supplement each other.
- Close the squeeze tools until flow is controlled or until the gap stops make contact. Do not use extension levers or “cheater bars”, or otherwise abuse the tools in trying to effect a squeeze-off. Such abuse may overstress the tool and result in failure of the tool and release of the gas flow. Any damaged tool should be repaired or replaced before use for squeeze-off of Gas Pipe.
- Squeeze Gas Pipe slowly or use momentary pauses in the operation to allow for pipe relaxation and reduction in resistance to closure. This is particularly helpful in larger diameters or when the pipe becomes stiffer in cold weather.
- A release rate of 0.5 inches/minute or less is recommended by ASTM F1041 based on a GRI/Battelle Study, “Effect of Squeeze-Off Practices and Parameters on PE Gas Pipe Damage.” *

* *Twelfth Plastic Fuel Gas Pipe Proceedings, pp. 228-242 (1991).*

5.3 STATIC ELECTRICITY

WARNING: Treat electrical tools as potential sources of ignition and follow standard safety procedures for working in explosive atmospheres.

Emergency flow control situations requiring squeeze-off may involve working in the vicinity of blowing gas. The possibility and potential hazard of static electricity should be considered and the company standards on **bell-hole** safety followed.

Because static electricity can build up on any non-conductor such as plastic pipe, there is a possibility of a spark discharge of sufficient energy to cause ignition if the proper air/gas mixture is present. It is also possible for repair crews to receive shocks even though ignition does not occur. Therefore, a study was made with a major gas utility to define the nature of static charge buildup on polyethylene pipe. The results of that study indicated that:

1. Potential for ignition is present if all three of the following conditions are present: (a) there is sufficient gas flow to cause extensive turbulence; (b) rust particles or other foreign particles are present in the gas; (c) the charge is present at a point where a combustible air/gas mixture is present.
2. During the study, voltages over 30,000 volts were generated, but no ignitions occurred. The location of the measured charge (on the inner wall of the pipe several inches from the opening) was such that there is some doubt that it is present at a point where the combustible air/gas mixture is also present.
3. Although ignition was not obtained, it is clear that under certain conditions high static charges can be developed and static discharge is a possible ignition source.

Some users have taken precautions to dissipate the charge and minimize the possibility of an ignition and maximize the personal safety of the crew. The objective is to provide a path to ground for any static charge.

These precautions have included:

- Before personnel are permitted in the bellhole, a fine water spray is applied over the entire area including all exposed pipe and dirt.
- The pipe is kept wet during the squeeze-off procedure until squeeze-off is complete.

- A wet rag is applied to the pipe surface to provide dissipation of static charge to ground.
- In freezing weather, a 50/50 solution of antifreeze and water is sometimes necessary.

Squeezing the pipe used for gas distribution causes an increase in the velocity of flowing gas and thus possible increase in static charge development. Therefore, it is suggested that squeeze-off be done in a separate **bell-hole** remote to the leak whenever possible.

Additional information on static electricity is summarized in the report, "Static Electricity Considerations in Repair of Polyethylene Pipe Systems," available from JM Eagle™ sales representatives, and in the AGA "Plastic Pipe Manual for Gas Service."

JM Eagle™ gas pipe conforms to the requirements outlined in ASTM D 2513 specifications for Thermoplastic Gas Pressure Pipe, Tubing and Fittings, which is necessary to meet the Pipeline Safety Regulations Part 192, Minimum Safety Standards for the transport of natural gas.

Gas pipe products (previously produced by US Poly) are currently manufactured by JM Eagle™.

This guide is meant as an explanatory supplement to the materials above on how to install JM Eagle™ Black Gas Pipe under normal or average conditions so as to comply with Standard Laying Specifications. Any discrepancies between the above standards and the written information contained herein should be brought to the attention of Product Assurance immediately for resolution, prior to any actions by either contractor, engineer or municipality.

This guide is not intended to supply design information nor to assume the responsibility of the engineer (or other customer representative) in establishing procedures best suited to individual job conditions so as to attain satisfactory performance.

Engineers, superintendents, contractors, foremen and laying crews will find out much to guide them. This booklet will also be of help in determining pipe needs when ordering.



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GLOBAL HEADQUARTERS:

Nine Peach Tree Hill Road
Livingston, NJ 07039
T: 973.535.1633
F: 973.533.4185

www.JMEagle.com

REGIONAL OFFICE:

5200 West Century Blvd
Los Angeles, CA 90045
T: 800.621.4404
F: 800.451.4170