

CHAPTER VI

REPAIRS AND NEW CONSTRUCTION

This chapter is designed to help the operators of small natural gas systems meet the construction and repair requirements set by the pipeline safety regulations. It outlines construction, pipe handling, and pressure testing requirements for installation of safe natural gas systems. It explains the procedures to qualify a person to make a pipe joint. It gives directions for locating "qualified persons" to do construction and repair work on a gas system. Remember, it is always the operator's responsibility to see that a contractor follows all requirements.

Manufacturers of pipe, valves, fittings, and other gas system components must design and test them to mandatory industry specifications. The specifications are incorporated by reference into 49 CFR Part 192, the gas pipeline safety regulations. Components meeting the requirements are qualified for gas service and marked with the "approved" markings. In addition, manufacturers usually develop procedures for joining their products and joining other materials to their products. Manufacturers produce manuals and provide procedures for installation and operation that must be incorporated in the operator's operations and maintenance plans.

PLANNING AHEAD

It is essential that a natural gas operator know the types of material and various elements of its gas piping system. A piping system consists of pipes, valves, fittings, regulators, relief devices, and meters. The operator must select components for the system that meet all applicable standards and that comply with the pipeline safety regulations. For example, to develop a cathodic protection program, it is necessary to know the type of metal piping in the system.

Records of the type and location of system components are critical for planning purposes. Operators who are uncertain of the type of material in their gas piping system must identify the materials. This may be done in one of the following ways:

- Contact previous owners of the system.
- Contact the contractor who installed and/or maintained the system.
- Check state, city or county permits.
- Carefully expose the pipe in certain locations to determine the type of materials and components.

Operators unfamiliar with the types of material must rely on a qualified person to identify the components. These investigations may require the operator to engage a consultant if in-house expertise is lacking.

EXCAVATION

Excavation must not be conducted in and near the location of an underground facility without first ascertaining the location of all underground facilities which could be affected by the excavation.

Prior to any excavation, each excavator must serve notice of intent to excavate to the One-Call Center serving the area in which the proposed excavation will occur. Notice must be given to the local One-Call Center in accordance with local state regulations in advance of excavation. This requirement may vary from 24-72 hours.

EMERGENCY EXCAVATION

An emergency excavation is an excavation which is performed to eliminate an imminent damage to life, health, or property. Oral notice of the emergency excavation must be given as soon as possible to the One-Call Center or to each operator having underground facilities in the area. If necessary, emergency assistance must be requested from each operator to locate and protect its underground facilities.

PRECAUTIONS TO AVOID DAMAGE

Each person responsible for an excavation or demolition operation must:

- Plan the excavation to avoid damage to underground facilities in and near the construction area.
- Maintain a safe clearance between the underground facilities and the cutting edge of any mechanized equipment, taking into account the known limit of control of the cutting edge to avoid damage to facilities.
- Provide support for underground facilities in and near the construction area during excavation and backfilling operations to protect the facility.
- Dig test pits to determine the actual location of gas facilities if these facilities or utilities are to be exposed or crossed.

EXCAVATION: REPAIR OF DAMAGE

Each person responsible for excavation operations which results in damage to an underground facility must, immediately upon discovery of that damage, notify the operator of the facility of the location and nature of the damage. The operator shall have reasonable time to accomplish necessary repairs before the excavation or backfilling in the immediate area of damage is continued.

Each person responsible for an excavation operation that damages an underground facility and permits the escape of any flammable or toxic gas shall, immediately upon discovery of that

damage, notify the operator, local police, and the local fire department. Then take any actions necessary must be taken to protect persons and property and to minimize the hazards until arrival of the operator's personnel or police and fire departments.

RECOMMENDATION

It is in the public interest to promote the protection of citizens, workers, and property in the vicinity of underground facilities. Also, it is in the public interest to promote the health and well being of the community by preventing the interruption of essential services that may result from damage to underground facilities. It is recommended that all underground (gas) utility operators become members of, participate in, and share in the cost of their area's One Call Center.

PIPE INSTALLATION, REPAIR, AND REPLACEMENT: GENERAL COMMENTS

Gas service lines must be installed with at least 12 inches of cover in private property and at least 18 inches of cover in streets and roads. Gas mains must have at least 24 inches of cover.

Qualified personnel must conduct installation of gas pipes. Local gas utilities and local gas associations may be able to recommend qualified persons/contractors who have the necessary background for gas pipe installation. However, contractor work must be supervised carefully. The following sections list the minimum requirements for pipe joining and construction activities.

METALLIC PIPE INSTALLATION

All the conditions listed below must be met when installing metallic pipe.

- Make each joint in accordance with written procedures that have been proven by test or experience to produce strong, gas-tight joints.
- Obtain and follow the manufacturer's recommendations for each specific fitting used. See FIGURE VI-1 for examples of manufacturer's instructions for a mechanical coupling. Include the manufacturer's procedures in the operations and maintenance plans.
- Handle pipe without damaging the outside coating. If the coating is damaged, accelerated corrosion can occur in that area.
- Coat or wrap steel pipe at all welded and mechanical joints before backfilling.
- Pressure test new pipe for leaks before backfilling. Mains and services to be operated at 60 psig or less must be tested to 100 psig. This test must be maintained for at least 1 hour. When performing maintenance, short sections of pipe may be pre-tested prior to installation.
- Support the pipe along its length with proper backfill. Make certain that backfill material does not contain any large or sharp rocks, broken glass, or other objects that could scrape the coating or dent the pipe.

- Cathodically protect steel pipes.
- Electrically insulate dissimilar metals (see CHAPTER III for illustrations).

If welding steel is necessary in a pipeline, review the pipeline safety regulations in Subpart E of 49 CFR Part 192. Remember: welding must be performed in accordance with established written welding procedures that have been qualified and tested to produce sound ductile welds, and must be performed by welders who are qualified for that welding procedure. Some states have special welding certification programs.

Welding of steel pipe is difficult. Both the procedures and the personnel must be qualified for the type of weld performed. If welding is done on a gas system, qualified welders can be referred by:

- the local gas utility;
- local gas associations;
- consultants.

PLASTIC PIPE INSTALLATION

Plastic pipe is commonly used for distribution mains and services by the gas industry. Polyethylene (PE) pipe is recommended as the most suitable plastic pipe for natural gas piping. Acceptable PE plastic pipe is manufactured according to standard ASTM D2513 and is marked with that number.

Plastic pipe is unsuitable for aboveground installation. Plastic pipe must be buried or inserted. The operator must include written joining procedures in its operations and maintenance plan. Each joint must be made in accordance with written procedures that have been proven by test or experience to produce strong gas-tight joints. Plastic pipe joining procedures can be obtained from qualified manufacturers. Do not purchase a product if the manufacturer or supplier does not certify it for qualified joining procedures.

If a contractor installs PE plastic pipe, the operator is responsible to ensure that only PE pipe manufactured according to ASTM D2513 is installed. In addition, the operator must verify that the contractor follows written joining procedures that meet the manufacturers' recommended joining procedures for each type of pipe and fitting used. No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by making a specimen joint that passes inspection and test.

The specimen joint must be visually examined during and after joining and found to have the same appearance as a joint or photograph of a joint that is acceptable under the procedure. In the case of heat fusion, the specimen must be cut into at least three longitudinal straps, each of which is:

- Visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area;

- Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

A person must be requalified under an applicable procedure, if during any 12-month period that person:

- Does not make any joints under the procedure;
- Has 3 joints or 3 percent of the joints made, whichever is greater, that are found unacceptable by testing.

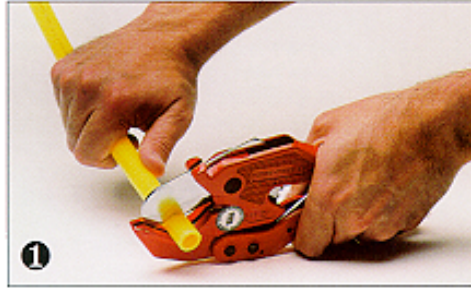
FIGURE VI-1

An example of a manufacturer's instruction for a mechanical coupling.

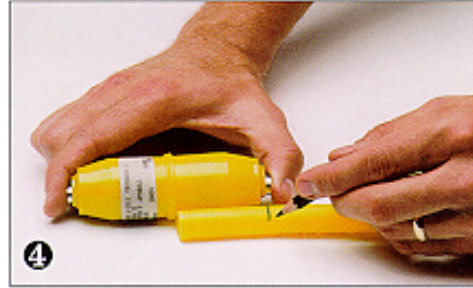
Easy-to-install Permasert system

In addition to saving time and money, using a Perfection Gas Distribution System instills the confidence of knowing you will repeatedly achieve a safe gas-tight connection. Our easy

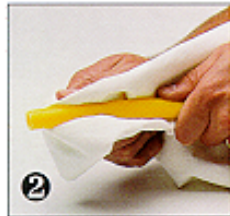
five-step installation procedure assures you of consistent positive connections that prevent pull-out of the pipe or tubing.



Cut the PE piping so that the end is square.



Use a soft felt pen, crayon or grease pencil to mark the stab depth as indicated on your Permasert package instructions. The stab depth is the approximate distance from the edge of the fusion bead to the end of the fitting body.



Wipe with a clean dry cloth. Inspect the last several inches of PE piping for damage. If any, cut again to remove damage area.



Use the Perfection chamfering tool for a proper O.D. chamfer. This chamfer permits the PE piping to be completely stabbed without affecting the internal seals.



Stab the PE piping into the Permasert fitting so that the stab depth mark is visible:

- Within 1/8" of moisture seal on 1/2" CTS and 1" CTS sizes
- Within 1/4" on all other sizes through 1-1/4" CTS
- Approximately 3/8" on 1-1/4" IPS and 2" IPS sizes

The PE piping must bottom out in the fitting. Pressure test the joint in accordance with your standard procedures. The reference mark can move outward up to an additional 3/8" during pressure testing.



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COUPLING/AHA/5M/0596

FIGURE VI-2

Example of a manufacturer's procedure for installing a specific coupling.

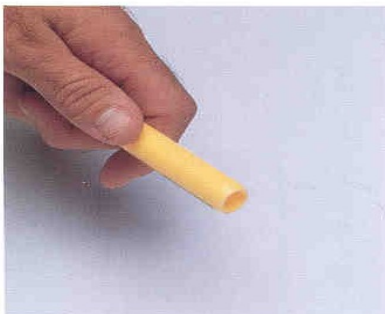
ASSEMBLY INSTRUCTIONS



1 Check the pipe being used to be certain of correct pipe size. Cut pipe ends square.



4 Holding the end of the pipe against the collar on the fitting, mark pipe at the entrance of the fitting (this stab length is 1 7/8").



2 Chamfer end of pipe using a chamfering tool.



5 Stab pipe completely into fitting so that the mark on the pipe is flush or less from the fitting entrance.



3 Clean pipe thoroughly to assure there is no dirt, grease or oil in assembly area. Also, assembly area must be free of severe scratches.

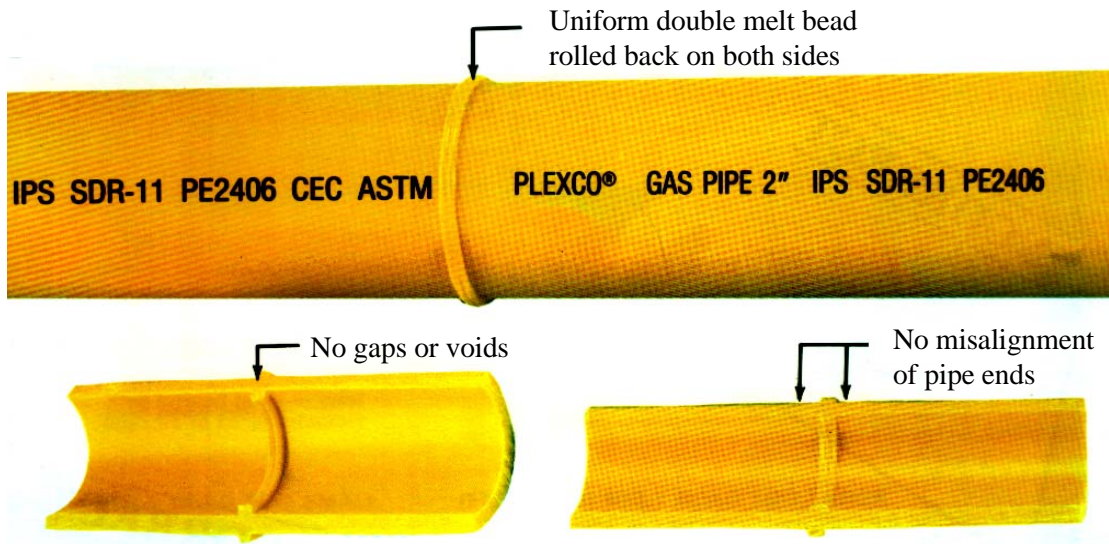
6 Repeat steps 1 thru 5 for the other end of coupling to complete the joint.

7 Pressure test the joint before putting it into service.

FIGURE VI-3

These are two types of fusion joints.

BUTT FUSION JOINT



SADDLE FUSION JOINT

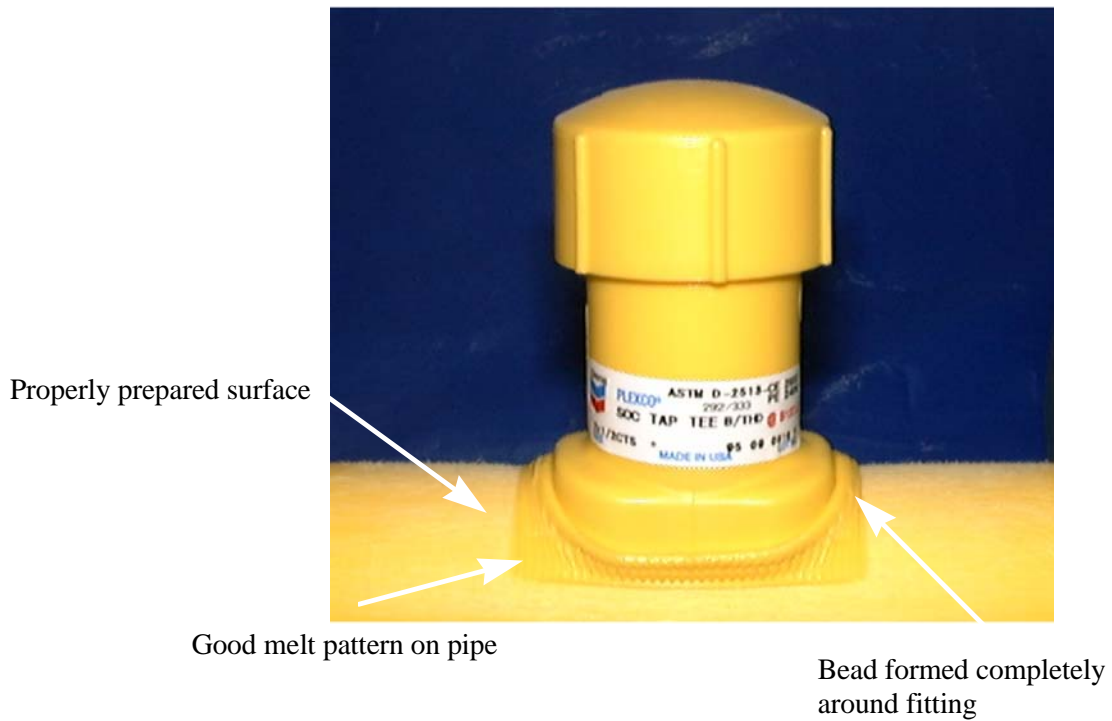
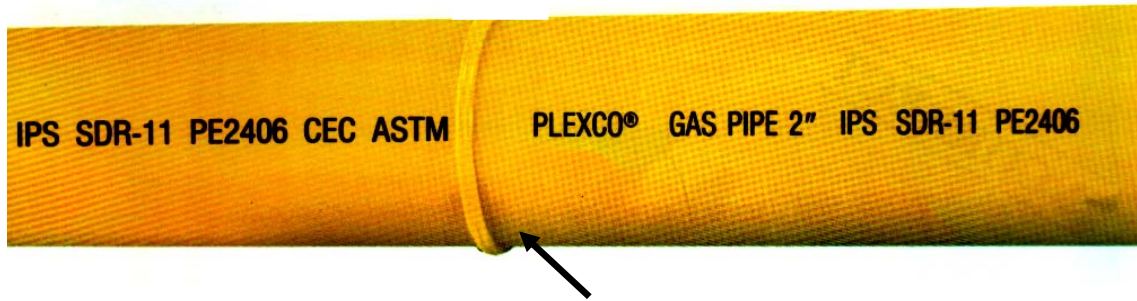


FIGURE VI-4

Bead (melted and fused portion of plastic pipe)



Close up of a well made butt fused joint made with ASTM PE2406 pipe.

Note: This is for illustration purposes only. Use picture and instructions in pipe manufacturer's manual.

FIGURE VI-5

An example of a socket fused joint with polyethylene pipe listed in ASTM D2513.

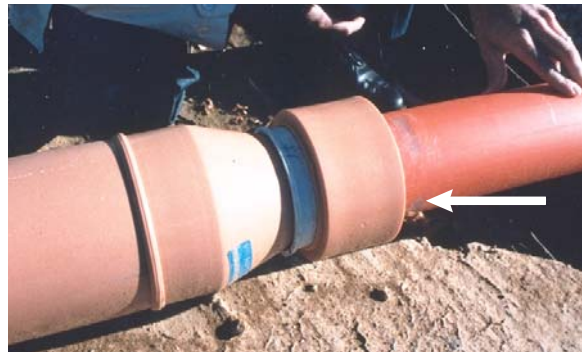


FIGURE VI-6

An example of a saddle service tee joint made with PE pipe listed in ASTM D2513.

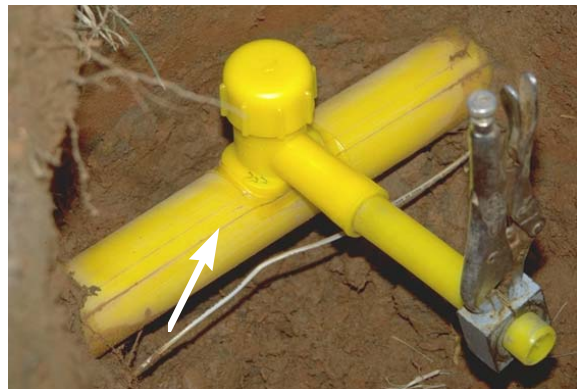
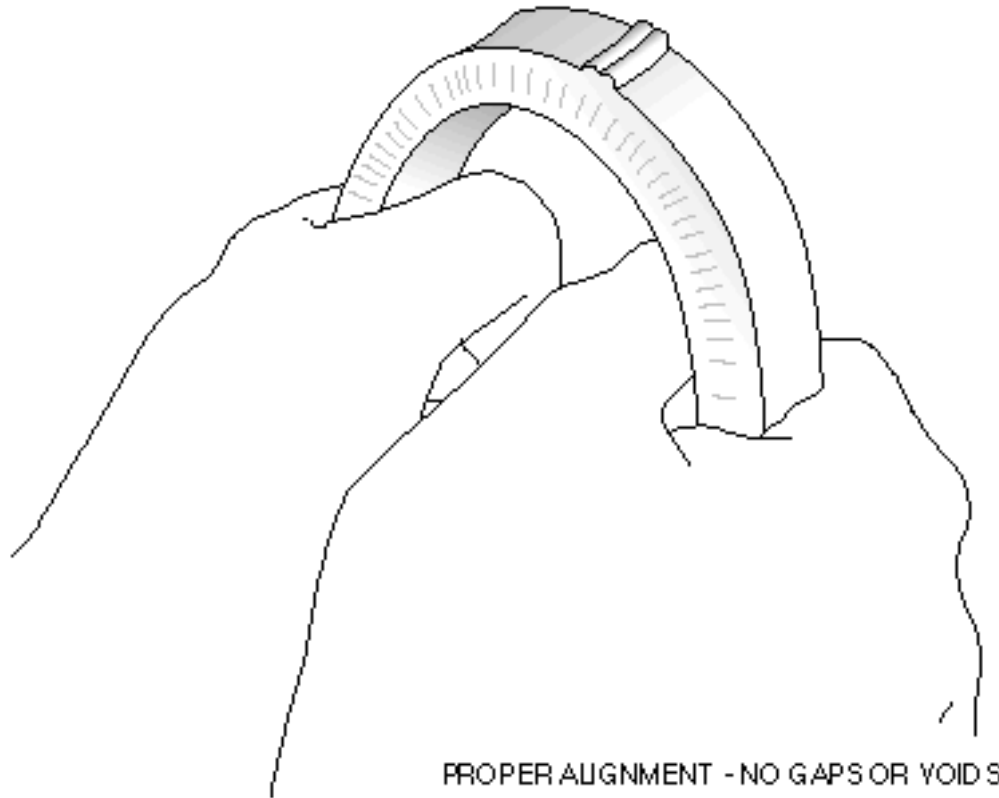
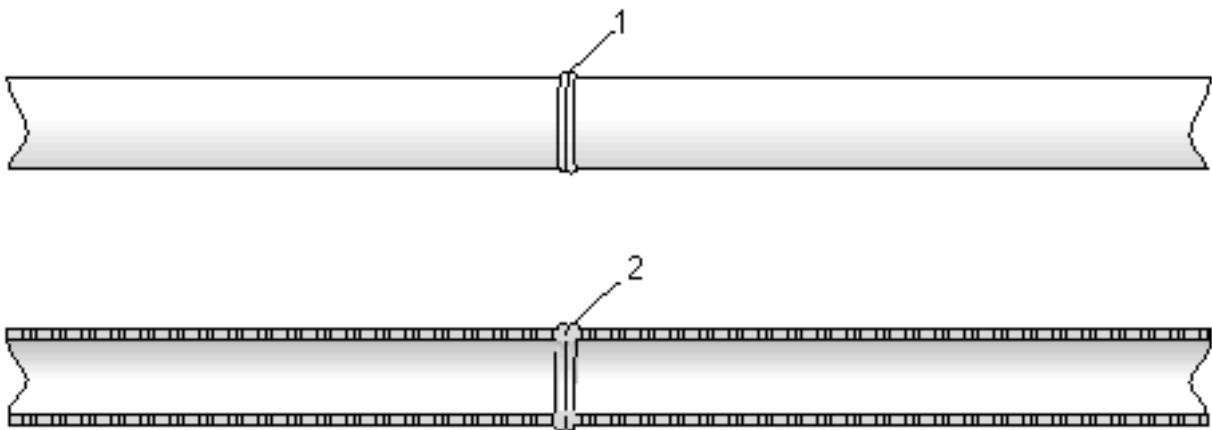


FIGURE VI-7

BUTT FUSION OF PIPE: ACCEPTABLE APPEARANCE



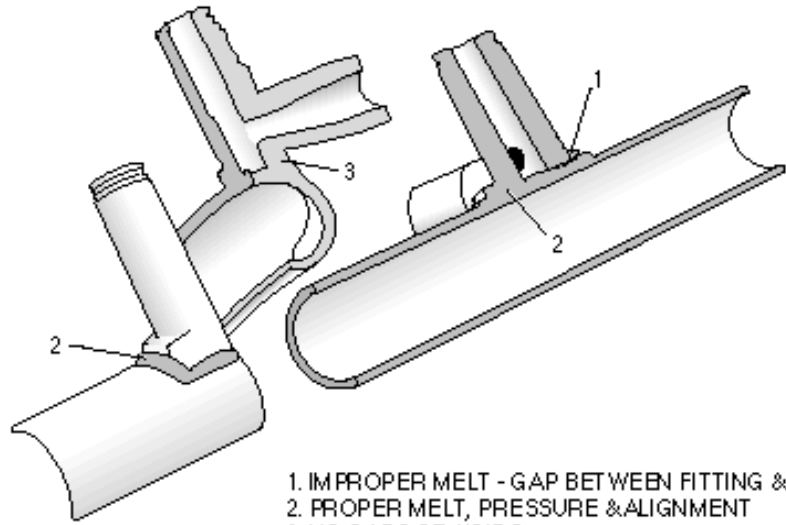
BUTT FUSION OF TUBING: ACCEPTABLE APPEARANCE



1. PROPER DOUBLE ROLL BACK BEAD
2. PROPER MELT, PRESSURE AND ALIGNMENT

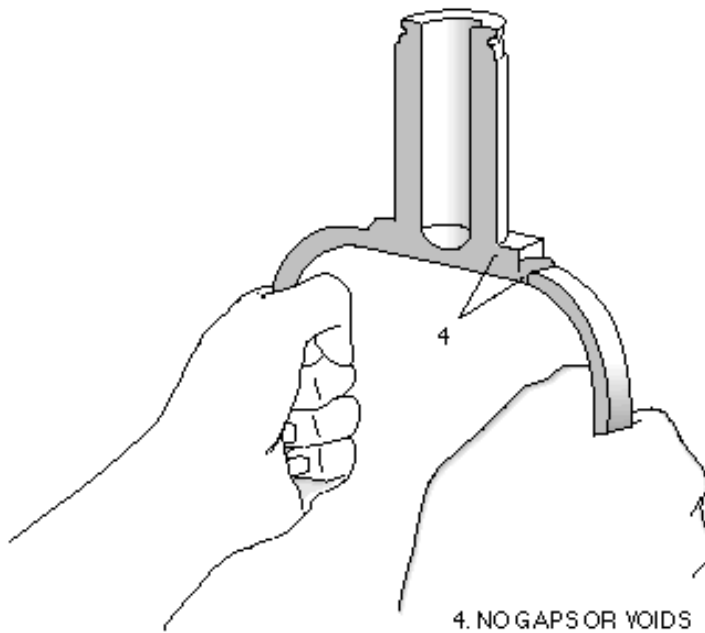
FIGURE VI-8

SIDEWALL FUSION: ACCEPTABLE APPEARANCE



- 1. IMPROPER MELT - GAP BETWEEN FITTING & PIPE
- 2. PROPER MELT, PRESSURE & ALIGNMENT
- 3. NO GAPS OR VOIDS

SIDEWALL FUSION: ACCEPTABLE APPEARANCE



- 4. NO GAPS OR VOIDS

The general guidelines to follow when installing plastic pipe are listed below:

1. Install plastic pipe manufactured under the ASTM D2513 specification. The pipe must have ASTM D2513 marked on it.

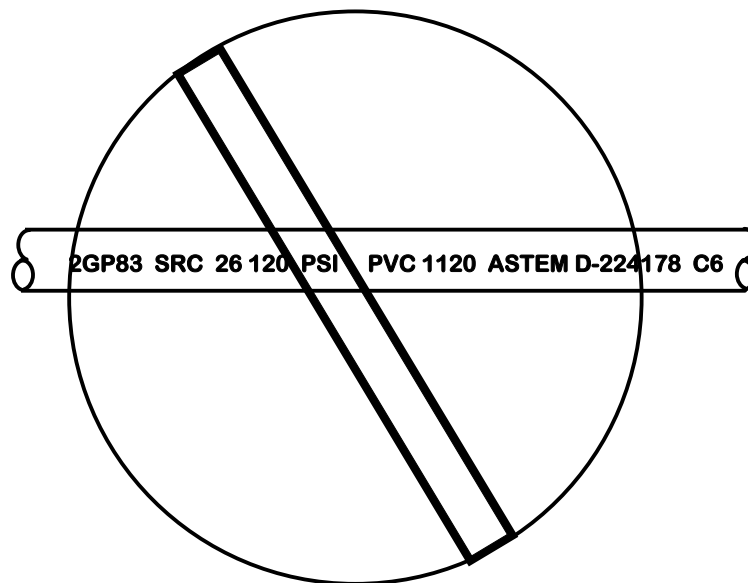
FIGURE VI-9



This is a properly marked PE pipe. ASTM D2513 is clearly marked on the pipe. If ASTM D2513 is not marked on a pipe, do not purchase it.

FIGURE VI-10

This is an example of PVC pipe not qualified for gas piping. It was manufactured according to ASTM D2241. The pipe is qualified for use as water pipe, not gas piping. Remember to look for the ASTM D2513 marking on the pipe.



2. Make each joint in accordance with written procedures that have been proven by test to produce strong gas-tight joints.

The manufacturer of the pipe or fitting should supply the operator with the procedures for each product in the manufacturer's manual. When installing the pipe, make certain that these procedures are followed. A qualified person must make all joints.

3. Install properly designed valves in a manner that will protect the plastic material. Protect the pipe from excessive twisting, shearing, or cutting loads when the valve is operated. Protect from any secondary stresses that might be induced through the valve or its enclosure.
4. Prevent pullout and joint separation. Plastic pipe must be installed in such a manner that expansion and contraction of the pipe will not cause pullout or separation of the joint. Operators unfamiliar with plastic pipe should have a qualified person perform all joining procedures.
5. When inserting plastic pipe in a metal pipe, make allowance for thermal expansion and contraction. Make an allowance at lateral and end connections on inserted plastic pipes, particularly those over 50 feet in length. End connections must be designed to prevent pullout caused by thermal contraction. Fittings must be able to restrain a force equal to or greater than the strength of the pipe. To minimize the stress caused by thermal contraction, pipes inserted in the summer should be allowed to cool to ground temperature before tie-ins are made. Inserted pipes, especially those pulled in, should be relaxed, mechanically compressed, or cooled to avoid initial tensile stress. Operators unfamiliar with proper insertion techniques must have a qualified person develop the procedures.
6. Repair or replace imperfections or damages before placing the pipe in service.
7. Install all plastic mains and service lines below ground level. Where the pipe is installed in a vault or other below-grade enclosure, it must be completely encased in gas-tight metal pipe with fittings that are protected from corrosion. Plastic pipe installation must minimize shear and other stresses. Plastic mains and service lines that are not encased must have an electrically conductive wire or other means of locating the pipe. Plastic lines must not be used to support external loads.

FIGURE VI-11

The following is an example of an illegal installation which does not meet federal safety standards. This is a picture of plastic pipe installed aboveground. Remember: **BURY PLASTIC PIPE!**



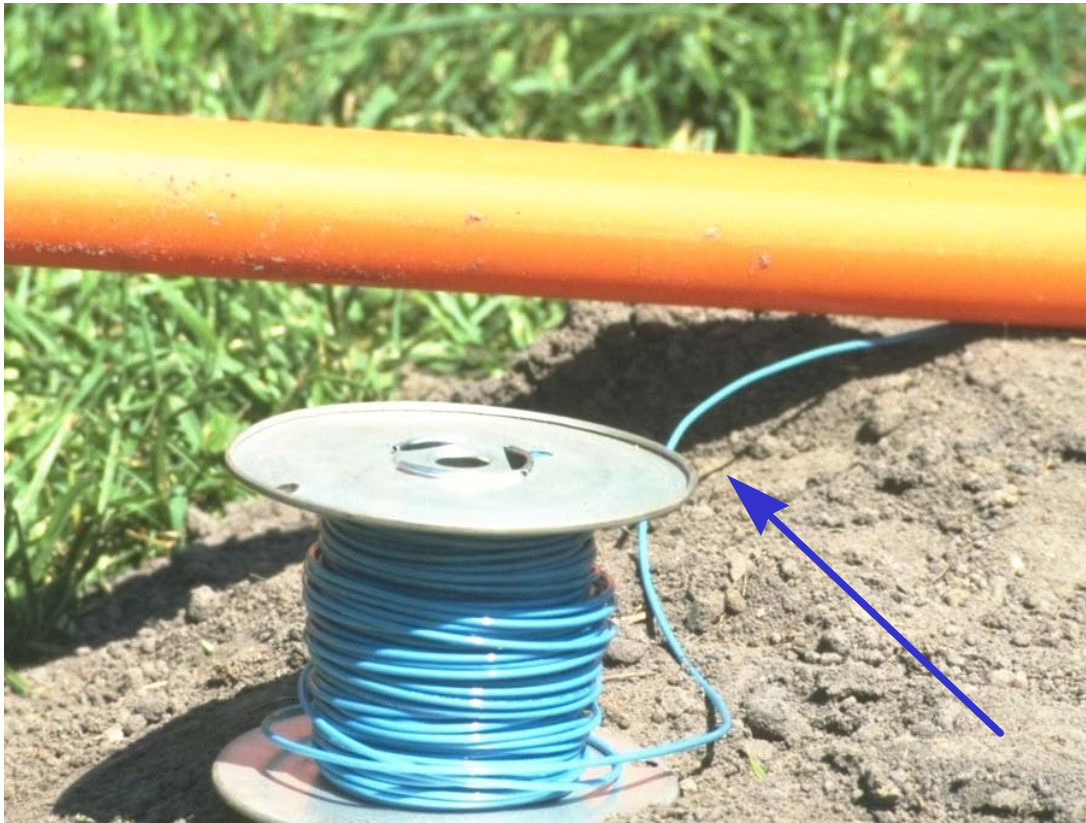
FIGURE VI-12

These are other examples of improper installations. Note that a trench and bell hole was dug but the operator never buried the pipe. Keep in mind that plastic pipe loses some of its strength when exposed to sunlight for a long period of time.



FIGURE VI-13

Below is an example of metallic wire used to help locate buried plastic pipe. Pipe locators can detect metal but not plastic. Therefore, metallic wire must be buried along with the plastic pipe. A pipe locator can then detect the buried metallic wire and the adjacent plastic pipe.



8. Test installed plastic pipe to 100 psig for at least 1 hour.
9. Ensure that plastic pipe is continually supported along its entire length by properly tamped and compacted soil. To prevent any shear or other stress concentrations use external stiffeners at connections to main, valves, meter risers, and other places where compression fittings might be used.
10. In laying of plastic pipe, ensure adequate slack (snaking) in the pipe to prevent pullout due to thermal contraction.
11. Lay plastic pipe and backfill with material that does not contain any large or sharp rocks, broken glass, or other objects that could cut or puncture the pipe. Where such conditions exist, suitable bedding (sand) and backfill must be provided.
12. Take special care to prevent coal tar type coatings or petroleum base tape from contacting the plastic pipe. It can cause plastic pipe to deteriorate.

13. Static electricity can ignite a flammable gas-air atmosphere. When working with plastic pipe of any kind where there is (or there may be) the possibility of a flammable gas-air atmosphere, take the following precautions:

- Use a grounded wet tape conductor wound around, or laid in contact with, the entire section of the exposed piping.
- If gas is already present, wet the pipe starting from the ground end with a very dilute water and detergent solution. Apply tape immediately and leave it in place.
- Wet the tape occasionally with water. Where temperatures are below freezing (0°C/32°F) add glycol to the water to maintain tape flexibility. Ground the tape with a metal pin driven into the ground.
- Do not vent gas using an ungrounded plastic pipe or tubing. Even with grounded metal piping, venting gas with high scale or dust content could generate an electric charge in the gas resulting in an arc from the dusty gas cloud back to the pipe which could ignite the gas. Vent gas only at a downwind location remote from people or flammable material.
 - **NOTE:** Dissipating the static charge buildup with wet rags, a bare copper wire, or other similar techniques may not be as effective as the above procedure. In all cases, use appropriate safety equipment such as flame resistant and static free clothing, breathing apparatus, etc.

14. Ensure that adequate and appropriate maps and records are retained after system installation.

REPAIR METHODS: PLASTIC AND METAL

Replacement of gas lines and repair of leaks are highly specialized and potentially hazardous operations. A qualified person must only conduct them.

Leaks in service lines or mains may be repaired by cutting out a short length of pipe containing the leak and replacing it with a new, pretested segment of pipe. Mechanical couplings are commonly used for this purpose (see FIGURE VI-2). Remember that written procedures must be followed for each joint. The procedures can be obtained from the manufacturer of the mechanical coupling. If the operator intends to make the repair with a mechanical coupling, the written procedures must be incorporated into the operations and maintenance plan.

Small leaks in steel service lines or mains, such as those resulting from corrosion pitting, must be repaired with an appropriate leak clamp applied directly over the leak. All bare metal pipe and fittings installed below ground must be properly coated and cathodically protected before backfilling.

If several leaks are found and extensive corrosion has taken place, the most effective solution is to replace the entire length of deteriorated pipe. Normal installation practices must be followed. They include priming and wrapping of all bare metallic piping and fittings, proper grading of lines to the main, cathodic protection, etc.

Leaking metal pipe can often be replaced by inserting PE pipe manufactured according to ASTM D2513 in the existing line and making the appropriate connections at both ends. Again, operators are cautioned that allowance for thermal expansion and contraction must be made at lateral and end connections. Operators unfamiliar with insertion techniques, including proper anchoring and offset connections, should have a qualified contractor perform this work. Some PE pipe manufacturers provide procedures for installation of their products by insertion.

One source of failures in plastic pipe is breaks associated with the transitions between plastic and metal pipes at mechanical fittings. The primary source of the problem is inadequate support of the plastic pipe. It is critical to firmly compact soil under plastic pipe to provide proper support. In practice, however, it is laborious, time consuming, and difficult to achieve adequate compaction under such joints. Further, as the soil settles, stress may build and the insert sleeve will cut through the pipe. For example, an insert sleeve must be used in the plastic pipe to provide proper resistance to the clamping pressure of mechanical fittings. This internal tubular sleeve must extend beyond the end of the mechanical fitting. If the pipe is not properly supported at that point, the end of the insert sleeve may shear off the plastic pipe. This source of failure in plastic pipe can be reduced or eliminated by using a properly designed outer sleeve to prevent stress concentrations at the point where the plastic pipe leaves the mechanical fitting.

The most prevalent cause of breaks or leaks in plastic pipe is "third-party" damage, usually by an excavator breaking or cutting the pipe. Plastic pipe is more vulnerable to such breaks than steel pipe. The lower strength of plastic pipe, however, is not necessarily a disadvantage. For example, if digging equipment hooks and pulls a steel pipe it may not break, but may be pulled loose from a connection at some distance from the digging. The resulting leaks could go undetected for a period of time and may result in a serious incident. Although there is no assurance that the plastic pipe will not also pull out, it is more likely to break at the point of digging, where the break can be detected and repaired. After a leak has been repaired with a coupling or a clamp, a soap-bubble test must be conducted to ensure the leak is repaired.

ALL SOURCES OF IGNITION SHOULD BE KEPT AWAY FROM THE LEAK REPAIR AREA. OPEN FLAMES SHOULD NEVER BE USED TO DETECT A GAS LEAK OR TO TEST THE ADEQUACY OF A REPAIR JOB.

MATERIALS AND EQUIPMENT QUALIFIED FOR USE IN NATURAL GAS SYSTEMS

The pipeline safety regulations list many different materials that are qualified for gas service. The materials and specifications listed in this manual are those most commonly used in natural gas distribution systems. Not all qualified materials or specifications are included in this section. The operator of a small natural gas system is referred to 49 CFR Part 192 for further information.

It is important for an operator to know the material make-up and operating pressure of an existing gas pipeline system. The operator must develop, or have a consultant develop, a list of qualified materials for construction and repair of the system. Installation procedures must be included for each type of material used in the system. This can be accomplished by including or referencing manufacturers' "gas product installation manuals" in the operations and maintenance plan.

When purchasing material for use in a natural gas pipeline system, it is important to check the marking of the material. The marking on the material will help identify whether the material is qualified for gas service. Of course, a natural gas pipeline system consists of both pipe and fittings. Therefore, an operator must select materials that are compatible with each other. This chapter will cover the most common specifications and standards used by manufacturers for pipes, valves, flanges, regulators, and other equipment commonly used in natural gas distribution systems.

PIPE

Steel and plastic pipe specifications applicable to operators of small natural gas systems are included in this manual. Pipe specifications are listed below. Be sure to check Appendix A of 49 CFR Part 192 for the current specifications and standards.

API 5L - Steel pipe

ASTM A53 - Steel pipe

ASTM D2513 - Thermoplastic pipe and tubing

Operators are cautioned that the actual maximum allowable operating pressure (MAOP) of a new or replacement pipe in a natural gas system is determined by a pressure test performed on the pipeline system by the operator before it is put in service. It is also recommended that threaded pipe not be installed underground.

When purchasing PE plastic pipe, the pipe must be marked ASTM D2513. Plastic pipe with this marking is the only PE pipe suitable for gas service.

Plastic pipe and tubing should be protected at all times from damage by crushing, piercing, or extended exposure to direct sunlight. As a rule of thumb, never store plastic pipe outdoors for more than six months. It should be placed inside or covered to protect it from exposure to direct

sunlight. It is a good idea to obtain the manufacturer's recommendation on how long the pipe can be exposed to sunlight before it loses physical strength (see 49 CFR §192.321 for more information).

In recent years, the vast majority of natural gas companies and operators of natural gas system have been installing ASTM D2513, PE pipe. Some of the reasons PE pipe is being installed are flexibility, good joining characteristics, durability, ease of installation, and cost. The PE type designations most often used are PE 2406, and PE 3408 (see FIGURE VI-14).

FIGURE VI-14

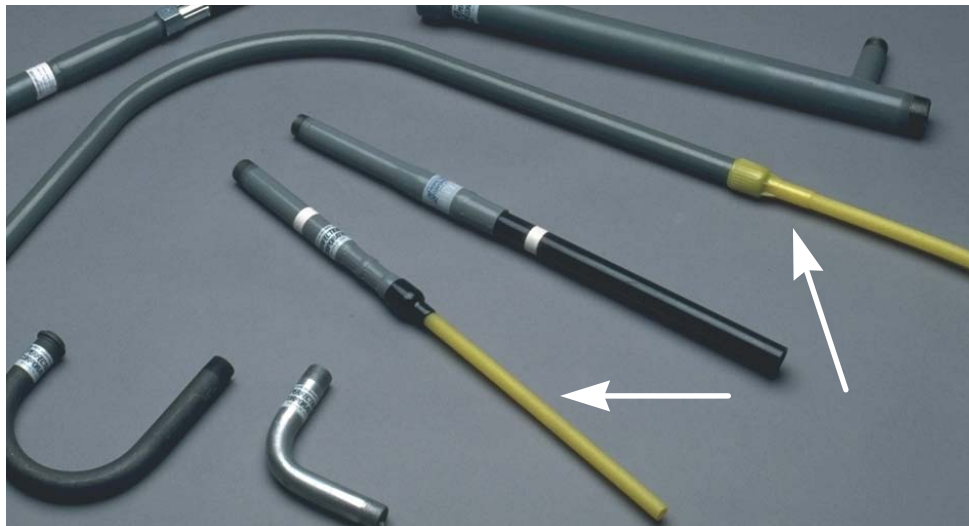
Below is a picture of 4-inch SDR 11 PE pipe manufactured according to ASTM D2513. When using plastic pipe in the underground piping system, make sure it has ASTM D2513 stamped on it.



An anodeless riser is a transition fitting that permits plastic service lines to be brought above ground in compliance with 49 CFR §192.375. The regulations require plastic services to be installed below ground level, except that it may terminate above ground, outside of buildings, if the plastic pipe is protected from deterioration and damage and it is not used to support external loads. Anodeless risers are readily available from various manufacturers and suppliers and are either fully fabricated from the manufacturer, or are field-fabricated by the installer, as is the case with service head adapter risers. Typically, the external protective casing is pre-bent, epoxy coated or galvanized, schedule 40 steel pipe. The plastic gas piping (inside the casing) must extend to an aboveground point for the riser to qualify as anodeless. Otherwise, the riser casing becomes a buried steel pipe gas carrier and is required to comply with Subpart I of 49 CFR Part 192. In most cases there is a grade level or “do not bury” label to indicate the bury depth to the installer. The outlet typically is provided with tapered pipe threads, or in the case of commercial or industrial risers, a bolted flange for attachment to the meter valve. The PE piping inlet, designated as the “pigtail,” is provided ready for connection to the service line. This service connection is accomplished either by heat fusion or, if so specified, with a mechanical coupling already attached to the pigtail for additional installation convenience.

FIGURE VI-15

Examples of anodeless service risers. There are many different manufacturers of anodeless risers. The primary advantage of an anodeless riser is that it does not have to be cathodically protected because the outside steel casing is not the gas carrier. The plastic inside the steel casing is the gas carrier. When purchasing anodeless risers, make sure that they meet all DOT requirements. When installing steel risers connected to plastic pipe by a transition fitting, make sure that the steel riser is coated and cathodically protected.



Most PE pipe manufacturers subscribe to the "Standard Dimension Ratio" (SDR) method of rating pressure piping. The SDR is the ratio of pipe diameter to wall thickness. An SDR 11 means the outside diameter (O.D.) of the pipe is eleven times the thickness of the wall.

For high SDR ratios the pipe wall is thin in comparison to the pipe O.D. For low SDR ratios the wall is thick in comparison to the pipe O.D. Given two pipes of the same O.D., the pipe with the thicker wall will be stronger than the one with the thinner wall. High SDR pipe has a low-

pressure rating; low SDR pipe has a high-pressure rating. The operator should check the manufacturer's specific pressure rating for each specific pipe. Do not use pipe with SDR values greater than 11.

PE pipe must be joined by either the heat fusion method (butt, socket, or electrofusion) or by a mechanical coupling. Each joining procedure and each person making joints must be qualified.

For information about local suppliers of plastic gas pipe, contact the local gas utility.

VALVES

A valve may not be used under operating conditions that exceed the applicable pressure-temperature rating. The valve will be stamped with the maximum working pressure rating (psig). Never operate valves at pressures that exceed their rating. The maximum working ratings are applicable at temperatures from -20°F to 100°F. Metal valves will often be stamped with the symbols "WOG." This means that they are suitable for service for water, oil, or gas. Sometimes just the letter "G" (for gas) appears. The valves must be rated for at least 100 psig.

The manufacturer's name or trademark must be included on a valve. Operators must maintain manufacturers' manuals, which include installation, operation, and maintenance procedures, for each type valve in the gas system. These manuals and procedures should be incorporated or referenced in the operations and maintenance plan.

Plastic valves purchased for gas service must comply with the appropriate industry standard. The valves must be compatible with the plastic pipe used in the natural gas system. It is important that operators buy plastic valves only from suppliers who are knowledgeable about gas piping. Supplier information can be obtained from trade journals, local gas associations (state or regional), or local gas utilities (see enclosed handout).

FLANGES AND FLANGE ACCESSORIES

Each flange or flange accessory must meet the minimum requirements found in 49 CFR §192.147. Operators must verify that metal flanges purchased for their system meet these requirements. This can be done by checking the markings on the flange. The markings are similar to those on the valves.

REGULATORS AND OVERPRESSURE PROTECTION EQUIPMENT

There are many different manufacturers and models of gas regulators and overpressure equipment (relief valves) for use in gas pipeline systems.

Regulators and overpressure protection equipment must be sized to ensure that overpressure or low-pressure conditions do not occur in the gas system. Manufacturers of gas regulators and relief valves have manuals that contain formulas and charts for each of their models or types of equipment. These formulas and charts are necessary to properly size regulators and relief valves. A qualified person must install the equipment. Operators who do not have a technical background should rely on a consultant or the equipment manufacturer representative to size the equipment. Check with the state for additional local requirements. See the enclosed handout for further information.

It is important to obtain the manufacturer's operation and maintenance instructions for each type of regulator and relief valve used in the gas pipeline system. The instructions must be incorporated into the operations and maintenance plan. CHAPTER II is a primer on basic concepts on pressure regulation, regulators, and relief devices.

OTHER EQUIPMENT

A natural gas operator may need additional equipment to operate a natural gas system. This additional equipment may include:

- pipe-to-soil meters;
- pipe locators;
- gas leak detection equipment;
- industry publications.

An illustration of a pipe-to-soil meter is in CHAPTER III. Additional information on gas leak detection equipment and pipe locators is found in CHAPTER IV. The local gas utility or gas association is a good source of assistance.

WELDING REQUIREMENTS

How can an operator determine whether pipeline welding is performed as required?

1. Welding must be performed in accordance with written welding procedures qualified to produce acceptable welds. For typical pipeline welding, standard API 1104 is most often relied on. The welding procedures should include:
 - a. Records of the complete results of the procedural qualification test
 - b. Procedural specification
 - (1) Identifying the process
 - (2) Identifying the materials
 - (3) Identifying the wall thickness groups
 - (4) Identifying the pipe diameter groups
 - (5) Showing a joint design sketch
 - (6) Designating filler metal and number of beads
 - (7) Designating electrical characteristics
 - (8) Designating flame characteristics
 - (9) Designating positions or roll welding
 - (10) Designating direction of welding
 - (11) Designating maximum time lapse between passes
 - (12) Designating type of line-up clamp and removal criteria
 - (13) Designating type of cleaning tool used
 - (14) Specifying preheat and post heat practices
 - (15) Designating composition of gas and range of flow rate
 - (16) Designating type and size of shielding flux
 - (17) Designating range of speed of travel for each pass
 - c. Essential variables
Most changes in b. require requalification of the welding procedure. (Refer to API 1104, paragraph 2.4.)
 - d. Welding and testing of test joint
 - (1) Preparation of specimen
 - (2) Destructive tests - butt welds
 - (a) Tensile strength test
 - (b) Nick break test
 - (c) Root and face bend test
 - (d) Side bend test
 - (3) Destructive test - fillet welds: Break in weld as specified
2. Welders who are qualified for the welding procedure to be used must perform welding.
 - a. The welder shall be qualified under one of the applicable requirements specified.
 - (1) Transmission pipelines
 - (a) API 1104, Section 3; or
 - (b) ASME Boiler and Pressure Vessel Code, Section IX
 - (2) Distribution pipeline
 - (a) API 1104, Section 3;

- (b) ASME Boiler and Pressure Vessel Code, Section IX; or
 - (c) 49 CFR Part 192, Appendix C, Section I (not acceptable for service line to main connection welding).
- (3) Service line to main connections
 - (a) API 1104, Section 3;
 - (b) ASME Boiler and Pressure Vessel Code, Section IX; or
 - (c) 49 CFR Part 192, Appendix C, Sections I and II.
- b. Welder qualification under API 1104, Section 3.
 - (1) Perform qualification test as specified in the written welding procedure in the presence of the company's representative.
 - (2) Essential variables (certain changes require re-qualification).
 - (a) For single qualification refer to API 1104, paragraph 3.11; or
 - (b) For multiple qualification refer to API 1104, paragraph 3.21.
 - (3) Welding and testing of test joint
 - (a) Preparation of specimen(s)
 - (b) Visual examination
 - (c) Destructive test - butt welds
 - Determine if all or part of these tests is required:
 - 1 Tensile strength test (*optional*)
 - 2 Nick break test
 - 3 Root and face bend test
 - 4 Side bend test
 - (d) Destructive tests - fillet welds: Break in weld as specified.
 - (e) Visual inspection

NOTE: Nondestructive radiographic inspection of butt welds only can be done in lieu of (3)(c) above. This is the operator's option. The standards of acceptability for radiographic inspection are specified in API 1104, paragraph 6.0.

- (4) Keep the following records:
 - (a) Detailed test results for each welder.
 - (b) List of qualified welders and the procedures(s) for which they are qualified.
- c. Welder qualification under 49 CFR Part 192, Appendix C, Section I
 - (1) Perform qualification test on pipe 12 inches or less in diameter
 - (2) Use position welding
 - (3) Preparation must conform to written welding procedure
 - (4) Destructive test. - root bend test
 - (5) Visually inspect
 - (6) Keep the following records:
 - (a) Detailed test results for each welder
 - (b) List of qualified welders under this procedure
- d. Welder qualification under of 49 CFR Part 192, Appendix C, Sections I and II
 - (1) Perform c. above
 - (2) Weld service line connection fitting to a pipe typical of the main using similar position as one would in actual production welding
 - (3) Destructive test - break, or attempt to break, the fitting off the run pipe

- (4) Keep the following records:
 - (a) Detailed test results for each welder
 - (b) List of qualified welders under this procedure
- e. Remain qualified under API 1104, Section 3 or ASME Boiler and Pressure Vessel Code, Section IX, if:
 - (1) Within the preceding six months, welder has welded with the particular welding process (either test or production welding is acceptable), and welder has made a weld and had it tested satisfactorily either destructively or nondestructively. (Refer to 2b(3) for required procedure.)
- f. Remain qualified under either 49 CFR Part 192, Appendix C, Section I or II, if:
 - (1) Within the preceding 7½ months but at least twice each year, welder has had one production weld cut out, tested, and found acceptable in accordance with the initial qualification test; or,

NOTE: Welders who work only on service lines 2 inches or smaller in diameter may be tested in each 6-month period under 49 CFR Part 192, Section III, Appendix C in lieu of f(1) above, but at the same intervals.

- (2) Within the preceding 15 months, but at least once each year, welder has requalified under 49 CFR Part 192 Appendix C

3. Production welding

- a. Use a welder qualified in a qualified welding procedure.
- b. The following items should be part of the written welding procedure:
 - (1) Weather protection - 49 CFR §192.231
 - (2) Preparation - 49 CFR §192.235
 - (3) Visual Inspection - 49 CFR §192.241
 - (4) Nondestructive Testing (under specified conditions) - 49 CFR §192.243. Must meet standards of acceptability in API 1104, Section 6.
- c. Miter joint restrictions

The use of miter joints is restricted as follows:

 - (1) If MAOP produces a hoop stress of 30 percent or more SMYS, the joint cannot deflect the pipe more than 3 degrees.
 - (2) If MAOP produces a hoop stress of more than 10 percent SMYS but less than 30 percent, the joint cannot deflect the pipe more than 12.5 degrees and must have at least one pipe diameter separation from another miter joint.
 - (3) If MAOP produces a hoop stress of 10 percent of SMYS or less, the joint cannot deflect the pipe more than 90 degrees.
- d. Repair or removal of defect requirements is as follows:
 - (1) Remove or repair all welds that fail to pass the nondestructive test requirements (standards of acceptability in API 1104, Section 6).
 - (2) Remove all welds that contain cracks that are more than 8 percent of the weld length.
 - (3) Repairs must have the defect removed down to clean metal and the segment to be repaired must be preheated if conditions exist which would adversely affect the quality of the weld repair. Inspect the repaired weld.

- (4) Repair of a crack, or any defect in a previously repaired area, must be in accordance with written weld repair procedures that have been qualified under this guidance manual.

PLASTIC PIPE INSTALLATION CONCERNS – BRITTLE LIKE FRACTURES

FIGURES VI-16 through VI-19 illustrate plastic service line connections to gas mains. There have been accidents due to the failure of the plastic pipe in certain types of installations. These installations are associated with older polyethylene pipe (1960s through early 1980s), which may be vulnerable to fractures and brittle-like cracking. The key areas of concern are where the pipe may not be properly supported in a transition area, which may cause excessive bending of the pipe.

The transition area is where the plastic pipe is connected to a fitting, valve, or riser. As the earth settles, inadequately supported plastic pipe may be subjected to high bending stresses and possible failure. Figures VI-16 through VI-19 show the use of protective sleeves in the transition areas. Protective sleeves, along with attention to adequate backfill and support, can help to distribute excessive stresses. The design of a protective sleeve is dependent on type of soil, size of pipe, composition of the backfill, and size of the access trench or bell hole. Therefore, it is imperative that pipeline operators review the specific sleeving and support instructions provided by the pipe manufacturer.

Excessive bending of pipe in non-transition areas can also result in excessive stresses that can lead to plastic pipe failure. If the pipe is installed with very tight bends, the pipe wall can be stressed beyond manufacturers recommendations. This can result in brittle-like fracture of the pipe wall. Every manufacturer has a recommended maximum bending radius for each type and size of pipe. The maximum bending radius is reduced for pipe spans that contain a fusion or mechanical joint. Therefore, it is imperative that pipeline operators review the maximum bending limits for each type of pipe.

Backfill material should consist of sand or native soil containing no sharp rocks or other foreign objects. Backfill material containing sharp rocks has caused several accidents. Proper backfill and support are essential to the installation and safe, long-term performance of plastic pipe.

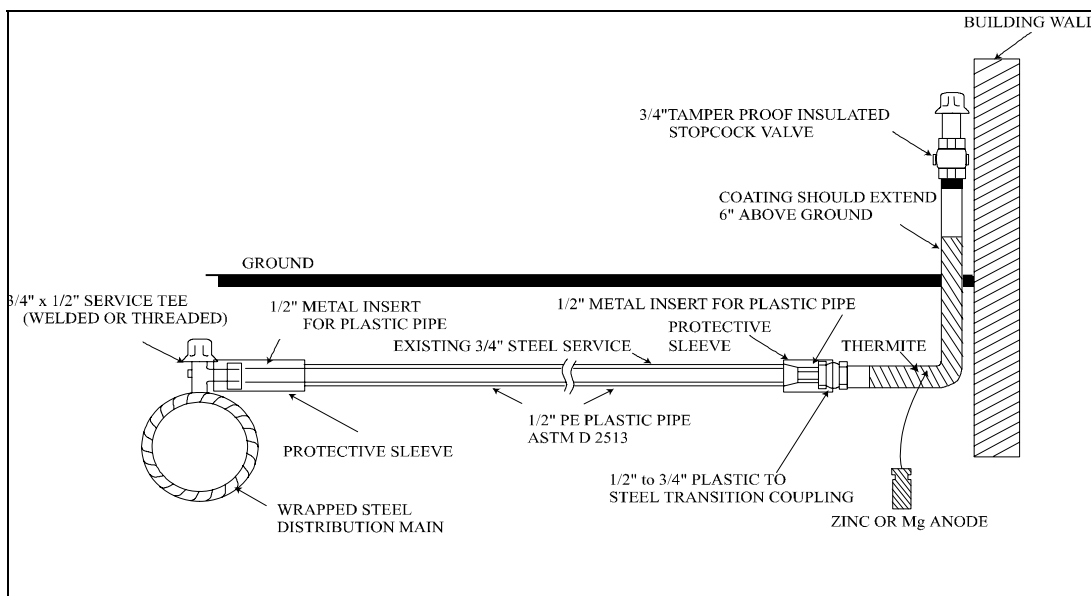
**ADDENDUM 1 – INSERT ON PAGE VI-28
APPROVED BY NAPSRS – JUNE 26, 2003**

COMMON CONSTRUCTION PRACTICES

The following (FIGURES VI-16 AND VI-17) illustrate a steel to plastic pipe connection using a mechanical coupling. There are other sizes of connections. Refer to specific manufacturer's instructions for the proper couplings and coupling procedures.

FIGURE VI-16

Below is an example of a 1/2" plastic pipe inserted into a 3/4" existing service line (for illustration purposes only).



Elevation

ALTERNATE SERVICE CONNECTION

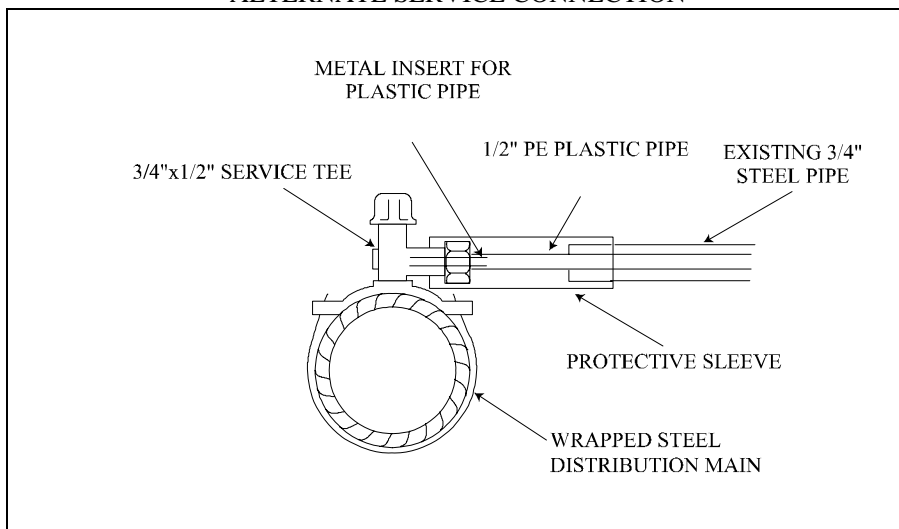
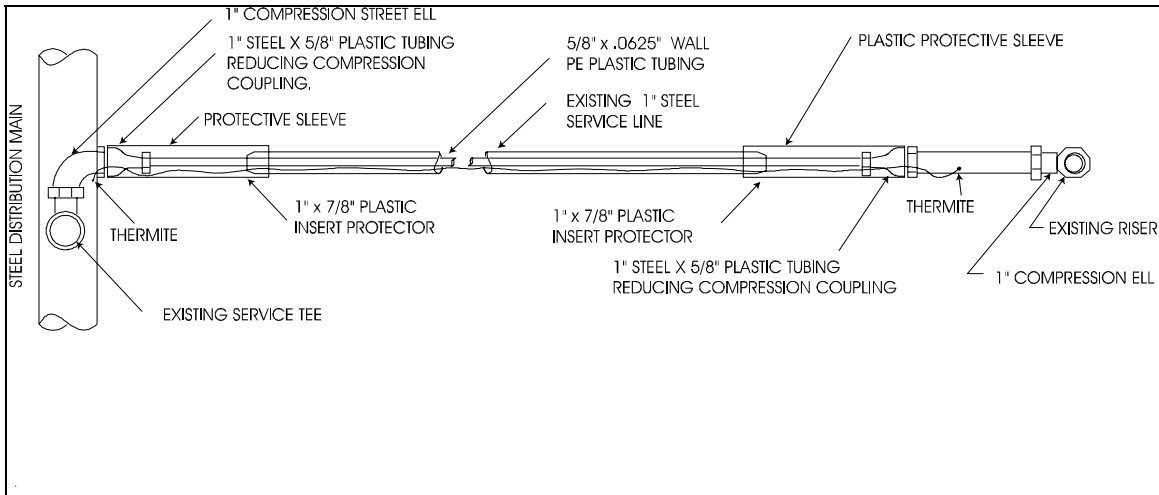
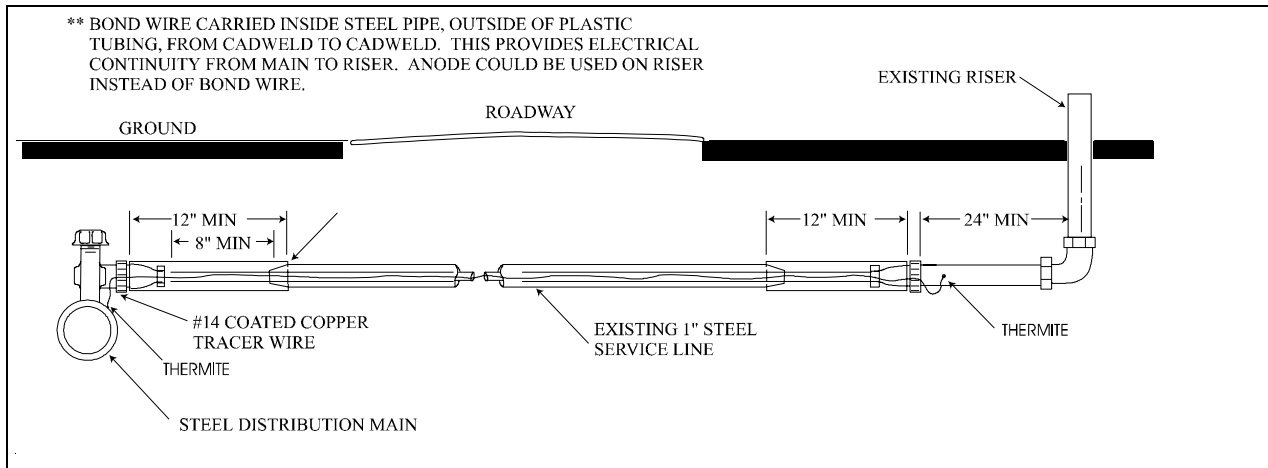


FIGURE VI-17

Below is an example of a 5/8" PE plastic tubing inserted into a existing 1" metallic line (for illustration purposes only).



Plan



Elevation

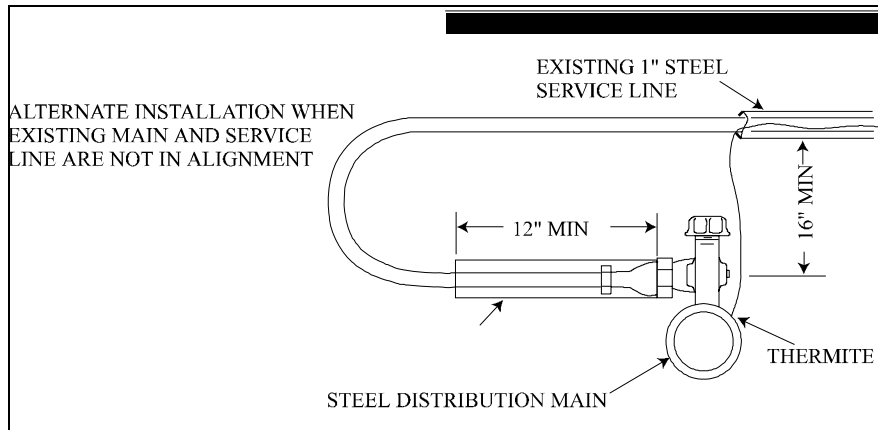


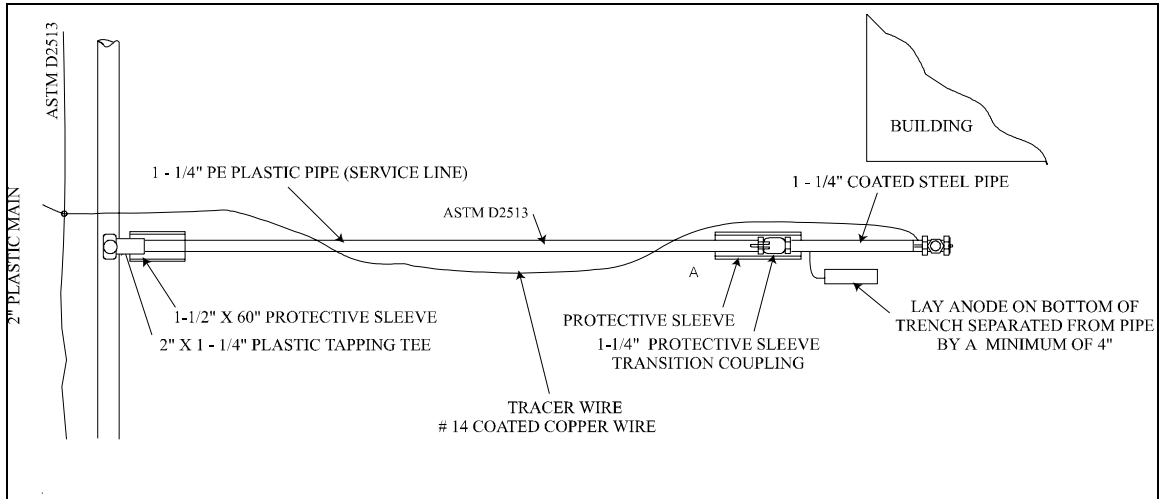
FIGURE VI-18

Below is an example of a ½” plastic pipe inserted into an electrofusion coupling which is electrofused onto a 2” electrofusion saddle fitting.

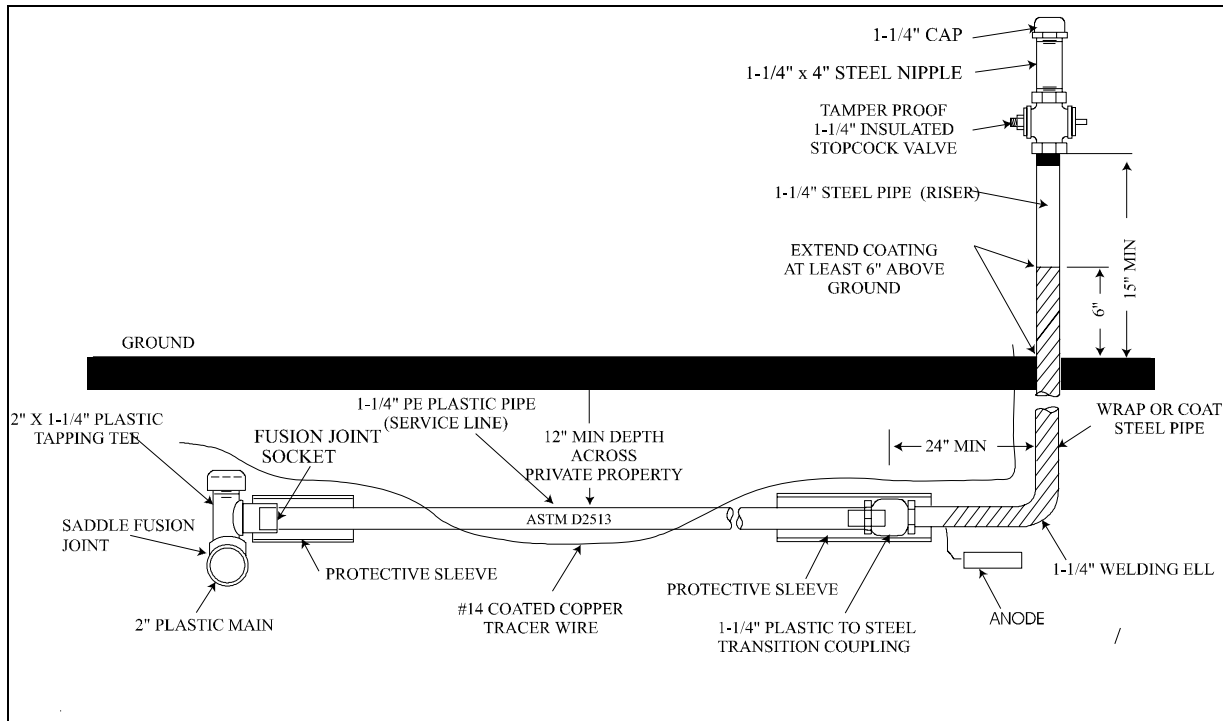


FIGURE VI-18A

An example of a 1 1/4" plastic service line from a 2" PE plastic main (for illustration purposes only).



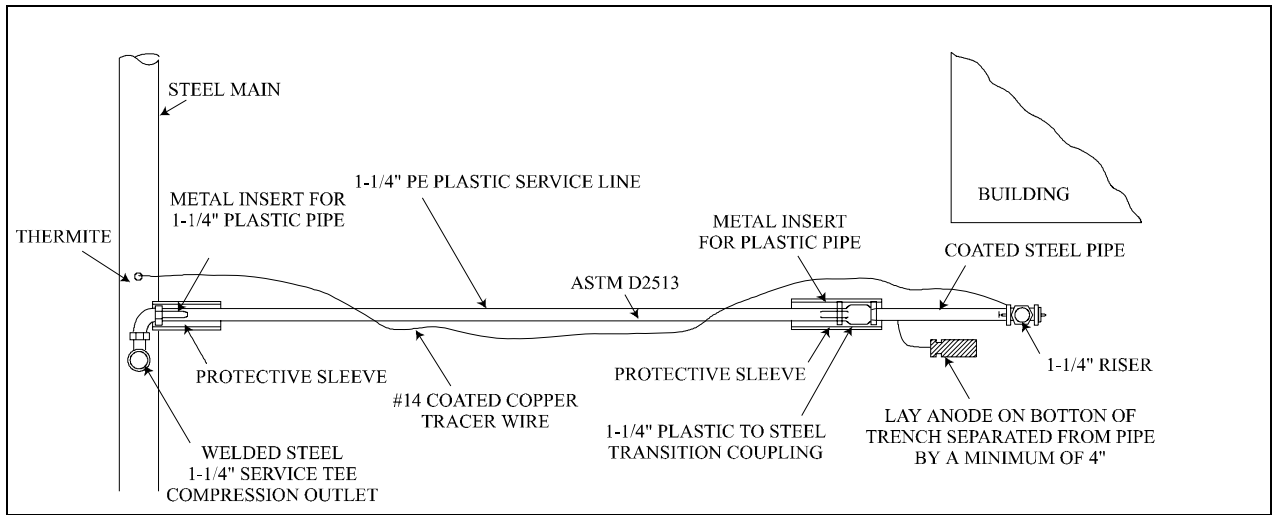
Plan



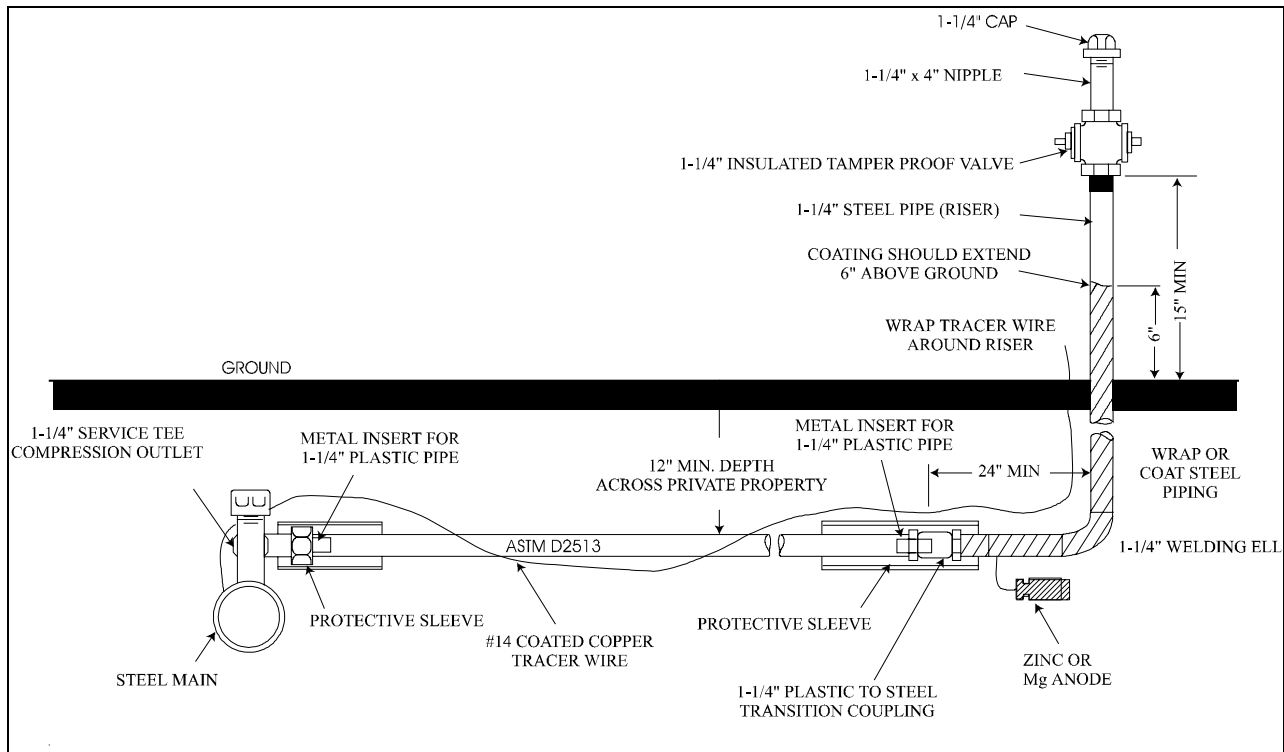
Elevation

FIGURE VI-19

An example of a 1 1/4" PE plastic service line from a steel main (for illustration purposes only).



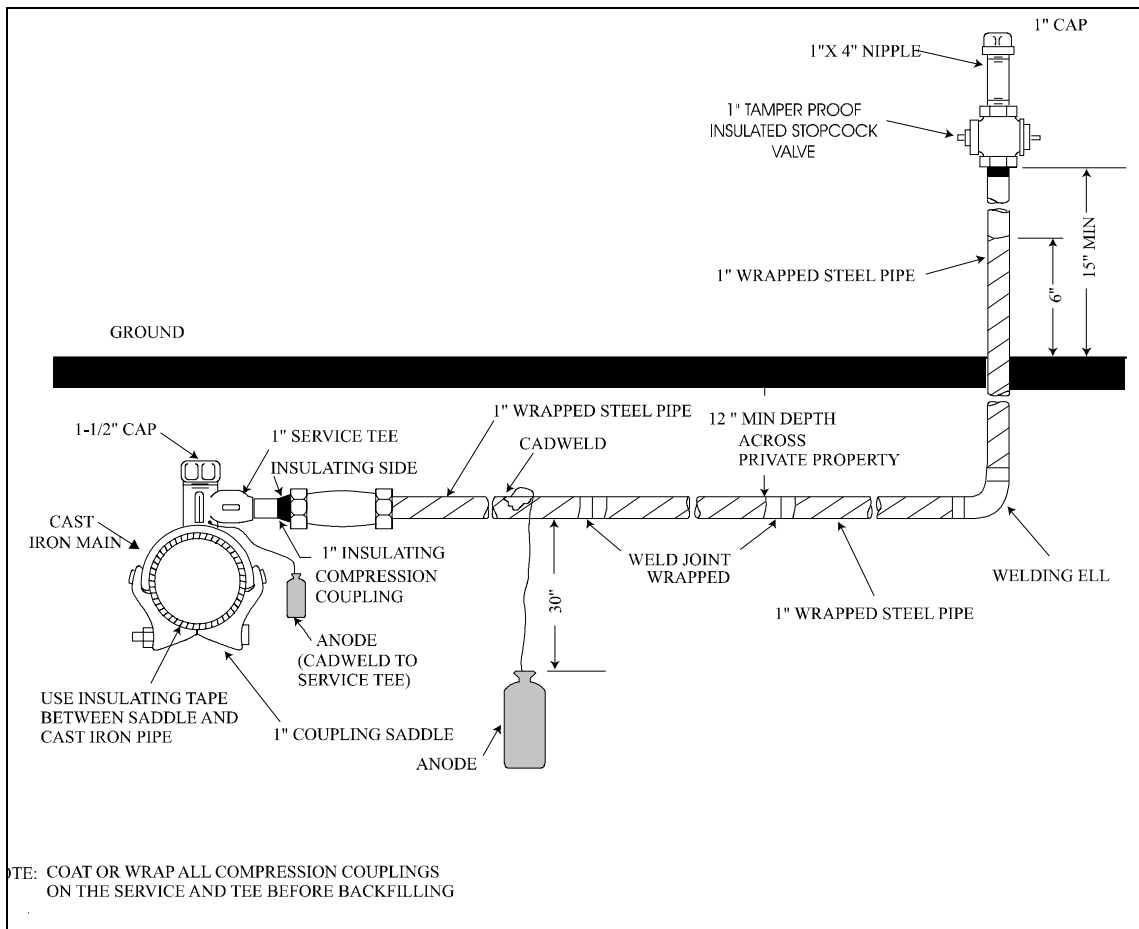
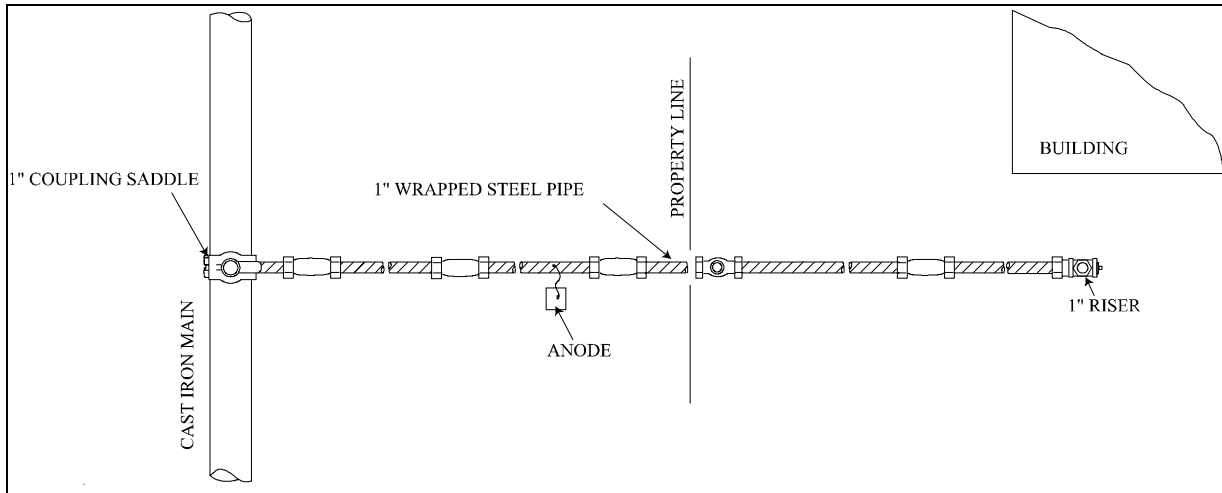
Plan



Elevation

FIGURE VI-20

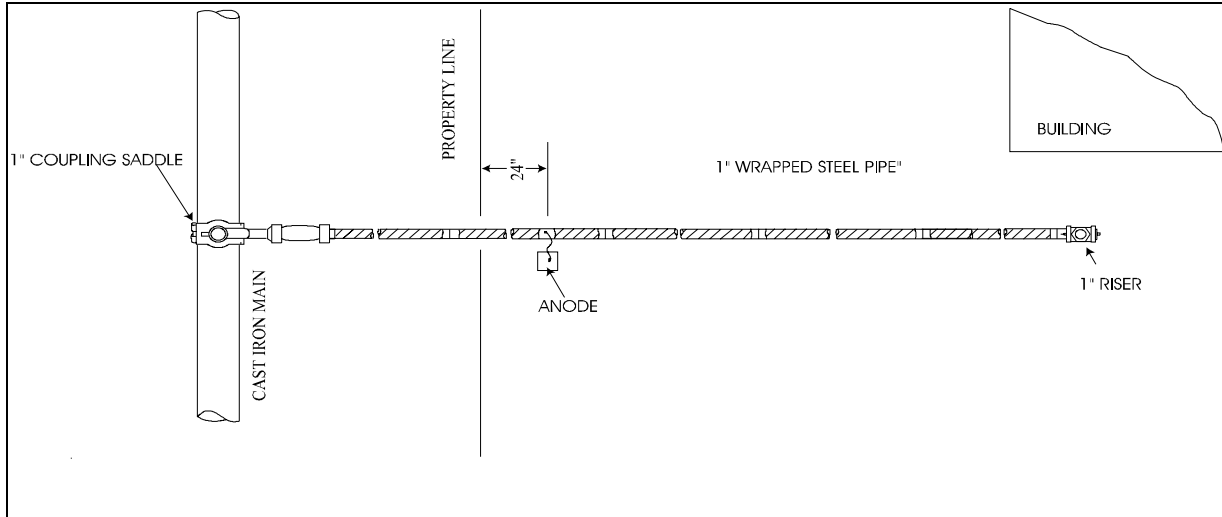
An example of non-welded 1" service line from a cast iron main (for illustration purposes only).



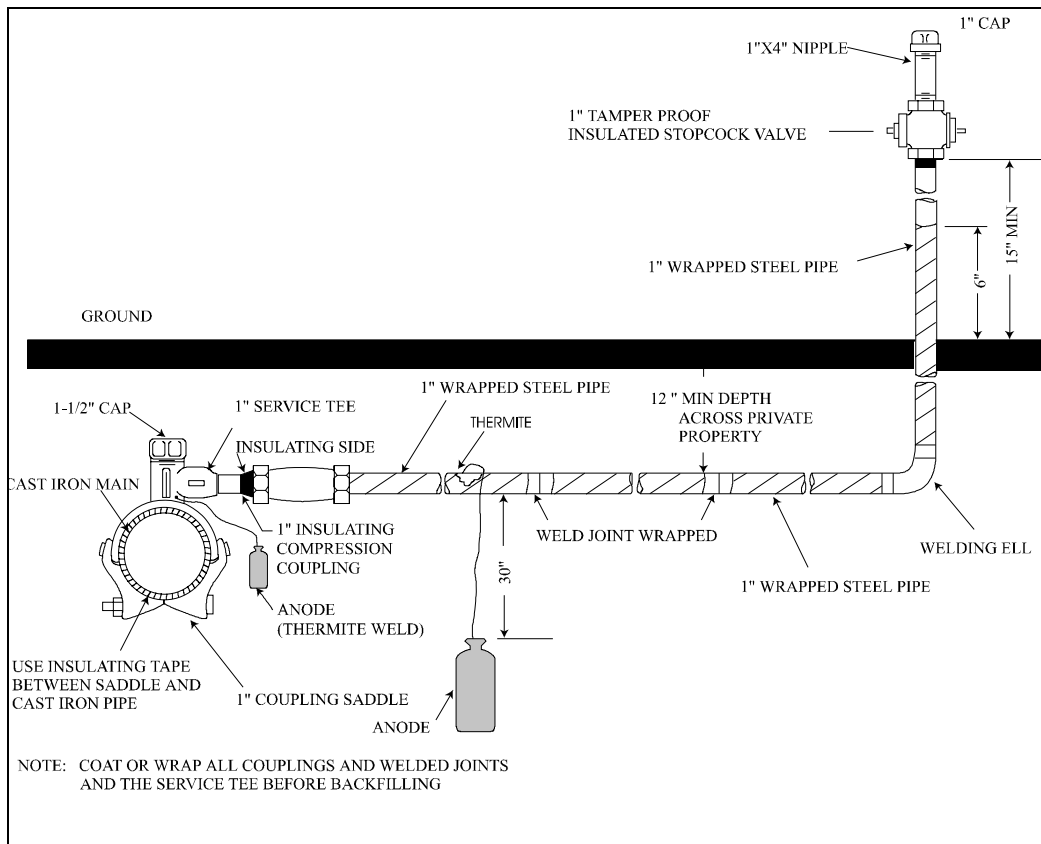
Elevation

Figure VI-21

An example of a welded 1" steel service line from a cast iron main (for illustration purposes only).



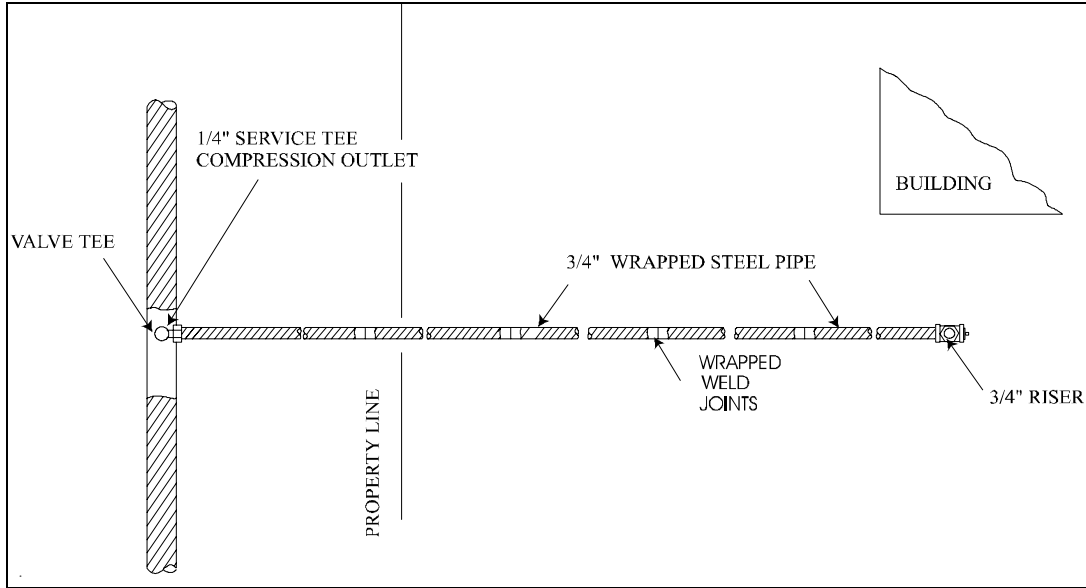
Plan



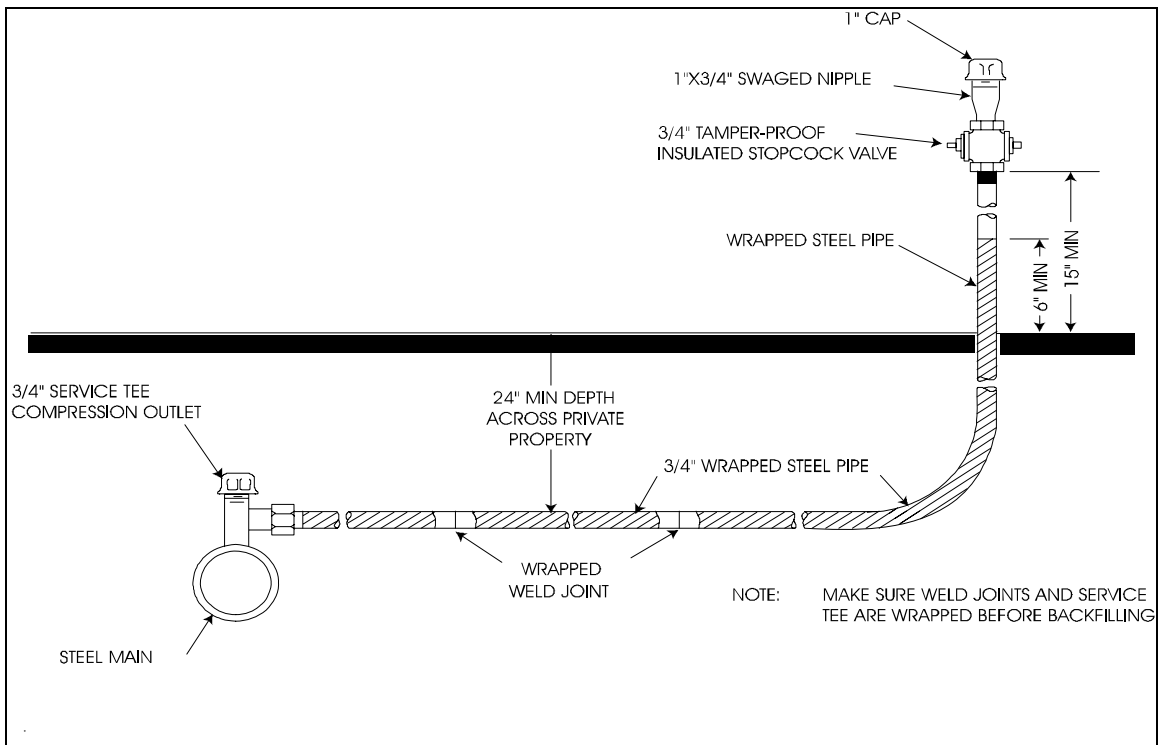
Elevation

FIGURE VI-22

Below is an example of a welded $\frac{3}{4}$ " service line from a steel main (for illustration purposes only).



Plan



Elevation

The following two pages (FIGURES VI-23A AND 23B) illustrate a steel to plastic connection using a coupling. There are other sizes of connections. Refer to specific manufacture's instructions for the proper couplings and coupling procedures.

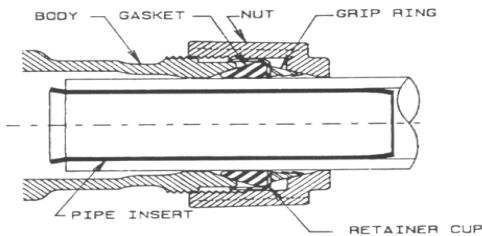
FIGURE VI-23A

DRESSER®

INSTALLATION INSTRUCTIONS

Style 90 "Universal" Couplings & Fittings

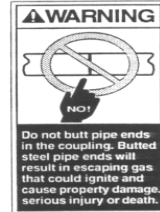
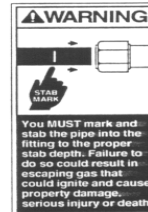
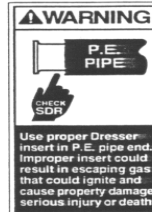
For P.E. to P.E., P.E. to Steel & Steel to Steel
(For use on polyethylene pipe listed in ASTM D2513)



1. Clean steel pipe ends to bare metal removing oil, dirt, loose scale, and rust. Polyethylene pipe must be free of dirt, longitudinal scratches, grooves & burrs for a distance of 4" when using 5" long bodies or fittings & 7" on 10" long bodies.
2. On all P. E. pipe ends, the recommended Dresser insert stiffener must be installed. Before inserting in pipe end, each insert should be checked to ensure that the SDR indicated on the branding corresponds to the SDR of the pipe being used.
3. Remove plastic identification plug from nut, then loosen nut (DO NOT DISASSEMBLE) and check inside of the fitting to assure gasket and grip ring are loose and free of dirt or foreign matter.

4. Apply soap-water to the gaskets, only when installing on steel pipe (ethylene glycol may be added in freezing weather).
5. Mark each pipe 2" from pipe end. Stab the pipe end(s) into the fitting or coupling until the mark on the pipe is even with the edge of the nut or inside the nut.
CAUTION: A minimum of 1/2" is required between the pipe ends or pipe end and pipe stop in fitting when connecting steel pipe(s).
6. Tighten nut(s) independently while holding the body from rotating with a 100 lb. minimum pull on the recommended wrench size.

Nominal Pipe Size (I.D.)	Wrench Size
3/4"	14"
1"	18"
1-1/4"	18"
1-1/2"	24"
2"	24"



Product Rating For Couplings With Same Pipe Diameter On Both Ends (For Reducing Sizes, The Rating For The Smallest Diameter Applies)

Pipe Size		Max. Sealing Pressure (See Note 2)	Max. Steel Pipe Pullout Resistance	Polyethylene Pipe Pullout Resistance Up To The Max. Wall Listed In Table Meets Or Exceeds The Requirements Specified In D.O.T. 192.283(b) (See Note 1)	
Nom.	O.D.			Type 2306	Type 3406/3408
3/4"	1.050	150 P.S.I.	1300 lbs.	SDR 11	Sch. 40
1"	1.315	150 P.S.I.	2100 lbs.	SDR 11	SDR 9.3
1-1/4"	1.660	150 P.S.I.	3200 lbs.	SDR 10	SDR 9.3
1-1/2"	1.900	150 P.S.I.	3700 lbs.	----	SDR 11
2"	2.375	150 P.S.I.	6600 lbs.	SDR 9.3	SDR 9.3

NOTE 1 - Pullout resistance is based on using Dresser reinforcing pipe inserts.
NOTE 2 - Unless noted on body.

DMD **DRESSER** DMD DIVISION, DRESSER INDUSTRIES, INC.
41 FISHER AVENUE
BRADFORD, PENNSYLVANIA 16701