

## **CHAPTER IV CONSTRUCTION AND REPAIR**

This chapter is designed to help the LP gas operator meet the construction and repair requirements set by the pipeline safety regulations. It outlines construction, pipe handling and pressure testing requirements for installation of a safe system. It explains the procedures to qualify a person to make a pipe joint. It gives directions for finding "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 in NFPA 58 by reference into 49 CFR Part 192, the gas pipeline safety regulations. Components meeting the requirements are qualified for gas service and are marked with the "approved" markings (See Chapter III). In addition, manufacturers usually develop procedures for joining their products and joining other materials to their products. Manufacturers' product manuals provide procedures for installation and operation that should be incorporated in the operator's operations and maintenance plans.

### **PLANNING AHEAD**

It is essential that an LP gas operator knows the types of material and various elements of the gas piping system. A piping system consists of pipe, tanks, 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 types and locations 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 materials must rely on a qualified person to identify the components. These investigations may require the operator to engage a consultant if adequate in-house expertise is lacking.

## **PIPE INSTALLATION, REPAIR AND REPLACEMENT: GENERAL COMMENTS**

Gas lines must be installed with at least 18 inches of cover. This can be reduced to 12 inches where damage to the pipe is not likely. If the minimum buried depth cannot be met, the pipe must be installed in conduit or bridged (shielded).

Installation of gas pipes must be conducted by qualified personnel. 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 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 IV-1 for examples of manufacturer's instructions for a mechanical coupling. Include the manufacturer's procedures in the operations and maintenance plans.
- Handling pipe properly without damaging the outside coating is imperative. 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 as well as all areas of damaged coating.
- Test new pipe for leaks before backfilling.
- 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 which could scrape the coating or dent the pipe.
- Cathodically protect steel pipes.
- Electrically insulate dissimilar metals. (See Chapter VIII for illustrations.)

If welding steel is necessary in a pipeline, review NFPA 58 which requires that welding must be performed in accordance with ASME Section IX of the Boiler and Pressure Vessel Code. Welders must be qualified in accordance with ASME IX. 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 pipe is the only plastic pipe that can be used for LP gas piping. PE plastic pipe must be manufactured according to standard ASTM D2513 and marked with that number.

Plastic pipe is not permitted for aboveground installation. Plastic pipe must be buried or inserted. The operator must include written joining procedures in the 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 it is not certified by the manufacturer or supplier for qualified joining procedures.

If a contractor installs PE plastic pipe, the operator is still 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 which meet the manufacturers' recommended joining procedures for each type of pipe and fitting used.

According to the pipeline safety regulations, a person making and inspecting joints must be qualified. No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by making a specimen joint from pipe sections joined according to the procedure 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 re-qualified 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 IV-1

## 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.



1 Cut the PE piping so that the end is square.



4 Use a soft felt tip 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.



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



3 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.



5 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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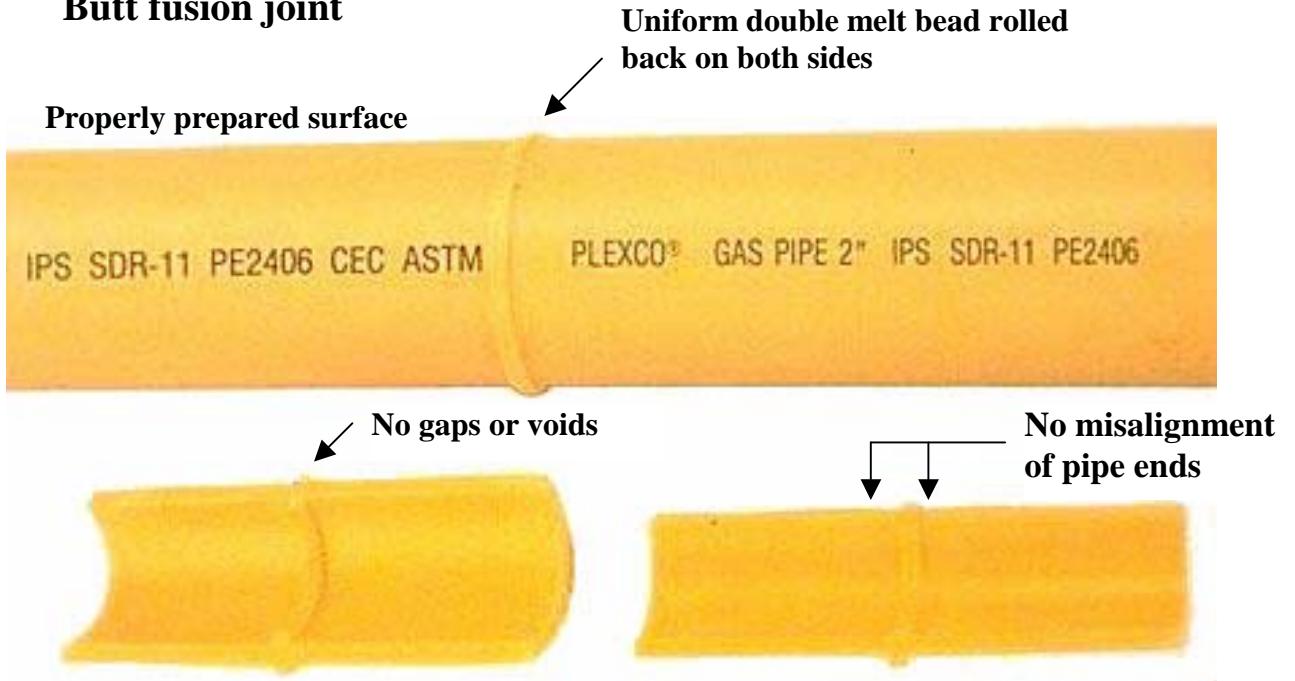
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COUPLING/ANALOG/66

Figure IV-2

These are two types of fusion joints.

### Butt fusion joint



### Saddle fusion joint

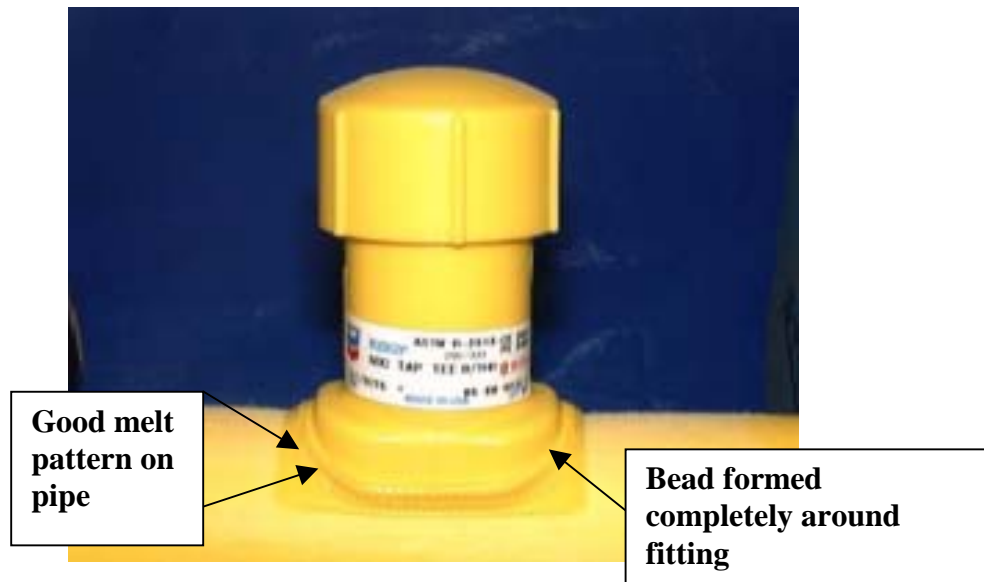


Figure IV-3

Bead (melted and fused portion of plastic pipe)



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

Figure IV-4

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

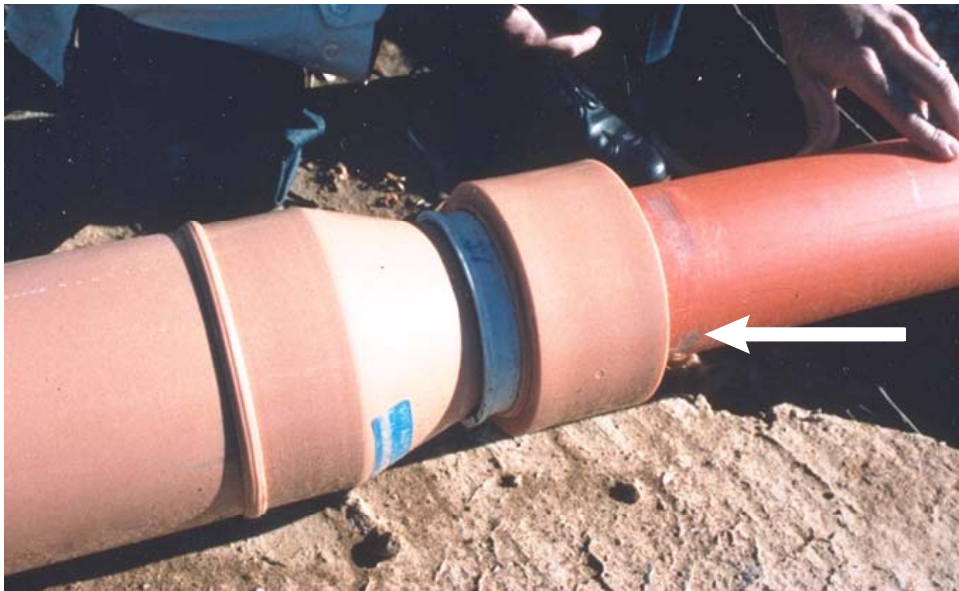


Figure IV-5

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

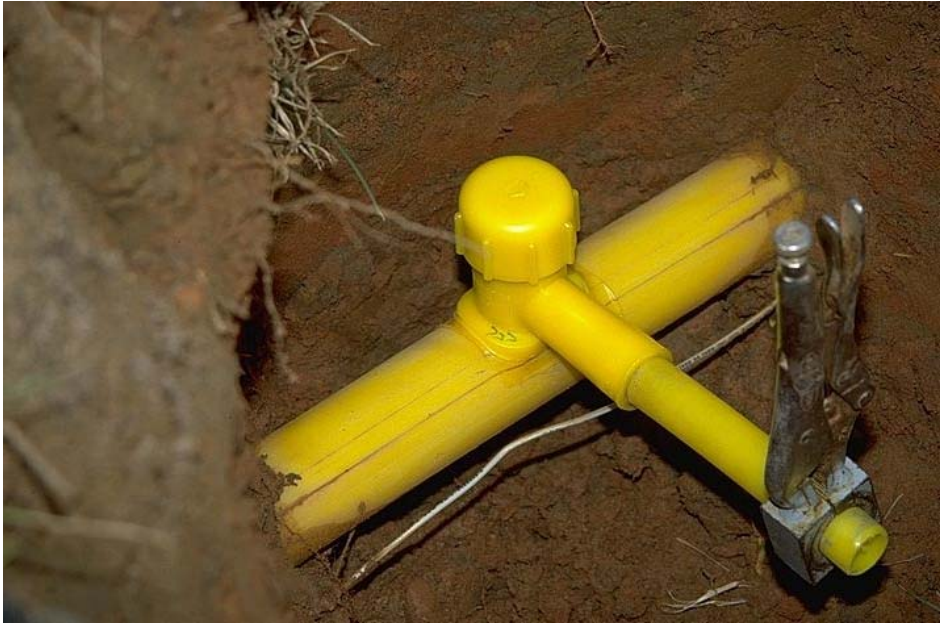
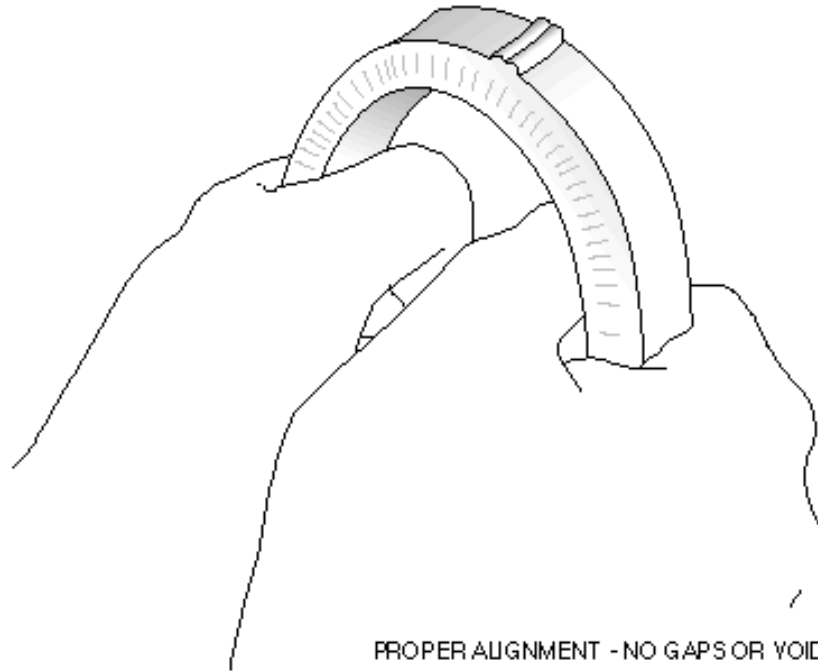


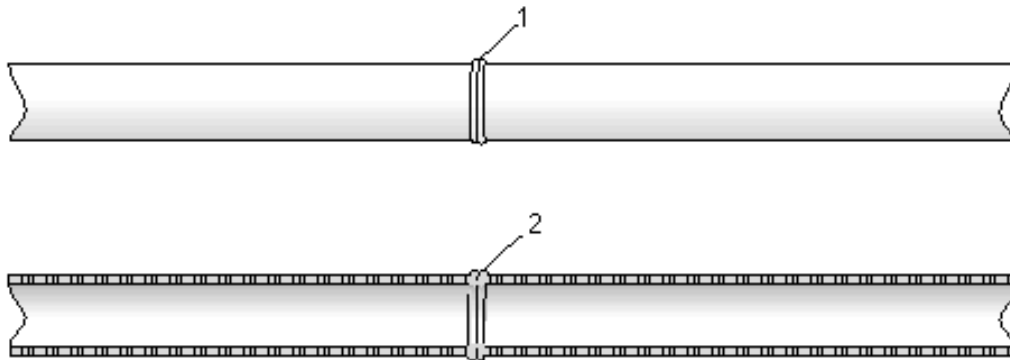
Figure IV-6

BUTT FUSION OF PIPE: ACCEPTABLE APPEARANCE



PROPER ALIGNMENT - NO GAPS OR VOIDS

BUTT FUSION OF TUBING: ACCEPTABLE APPEARANCE



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

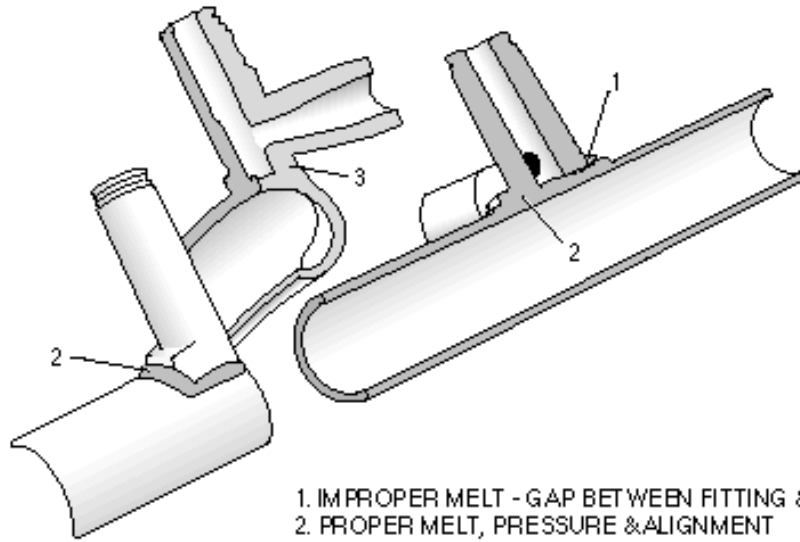


Figure IV-7

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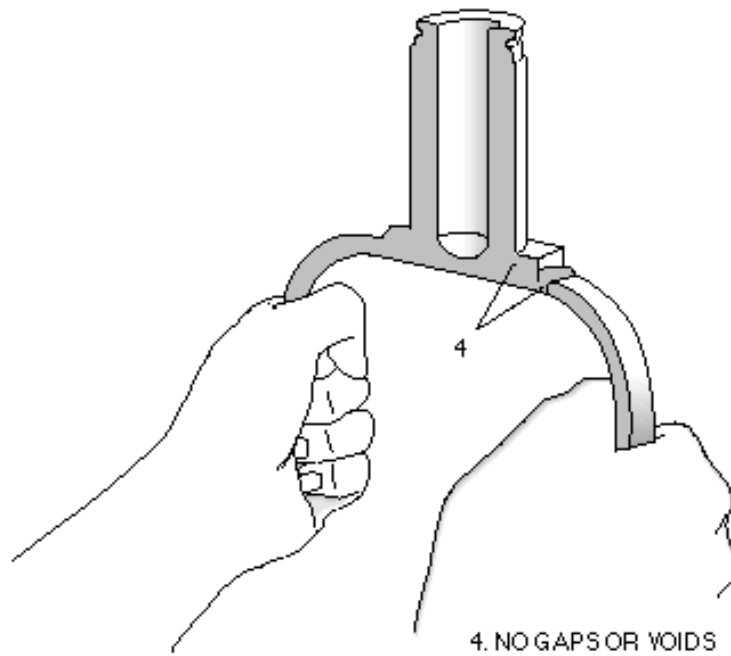
SIDEWALL FUSION: ACCEPTABLE APPEARANCE



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SIDEWALL FUSION: ACCEPTABLE APPEARANCE



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.

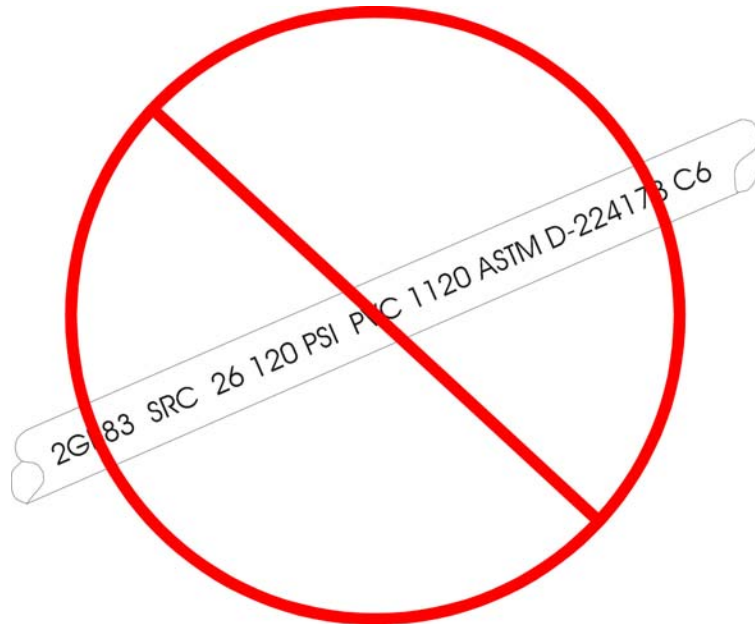
Figure IV-8



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 IV-9

An example of pipe not qualified for gas piping. This is PVC pipe. 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. All joints must be made by a qualified person.

3. Install properly designed valves in a manner which 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 which 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 used must be able to restrain a force equal to or greater than the strength of the pipe. To minimize the stresses 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. NFPA 58 requires that the wire not be in direct contact with the pipe. It is recommended that a 6" separation be maintained. Plastic lines must not be used to support external loads.

Figure IV-10

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



Figure IV-11

This is an example of another improper installation. Note that a trench 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 IV-12

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. 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 mains, valves, meter risers and other places where compression fittings might be used.
9. In laying plastic pipe, ensure adequate slack (snaking) in the pipe to prevent pullout due to thermal contraction.
10. Lay plastic pipe and backfill with material that does not contain any large or sharp rocks, broken glass or other objects which could cut or puncture the pipe. Where such conditions exist, suitable bedding (sand) and backfill must be provided.
11. 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.
12. 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 an approved solution recommended by the pipe manufacturer. 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 and an arc could result from the dusty gas cloud back to the pipe and 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.
13. After installation, ensure that adequate and appropriate maps and records are retained.

### **REPAIR METHODS - PLASTIC AND METAL**

Replacement of gas lines and repair of leaks are highly specialized and potentially hazardous operations. They should be attempted only by persons with adequate LP gas pipeline qualifications.

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 segment of pipe. The pipe segment is commonly attached to the existing line with mechanical couplings, welds, PE fusion, etc. at each end. NFPA 58 requires, if PE pipe is used to replace a section of steel pipe, a tracer wire should be installed to connect the steel pipe ends in order to maintain continuity. Remember that written procedures are required to 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, then 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, by replacing a section of pipe or by another acceptable engineering method that can restore the serviceability of the pipe. All steel 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. The normal installation practices must be followed. They include priming and wrapping of all steel piping, fittings, cathodic protection, etc.

Leaking metal pipe can often be replaced by inserting polyethylene 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 of the polyethylene pipe manufacturers provide procedures for installation of their products by insertion.

One source of failure 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 will act as a shear. 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. This is usually caused 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. Then, 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. A CGI/barhole survey of the piping in the vicinity may be considered to ensure no remote pullouts/leaks have occurred.

**IT SHOULD BE EMPHASIZED THAT 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.**