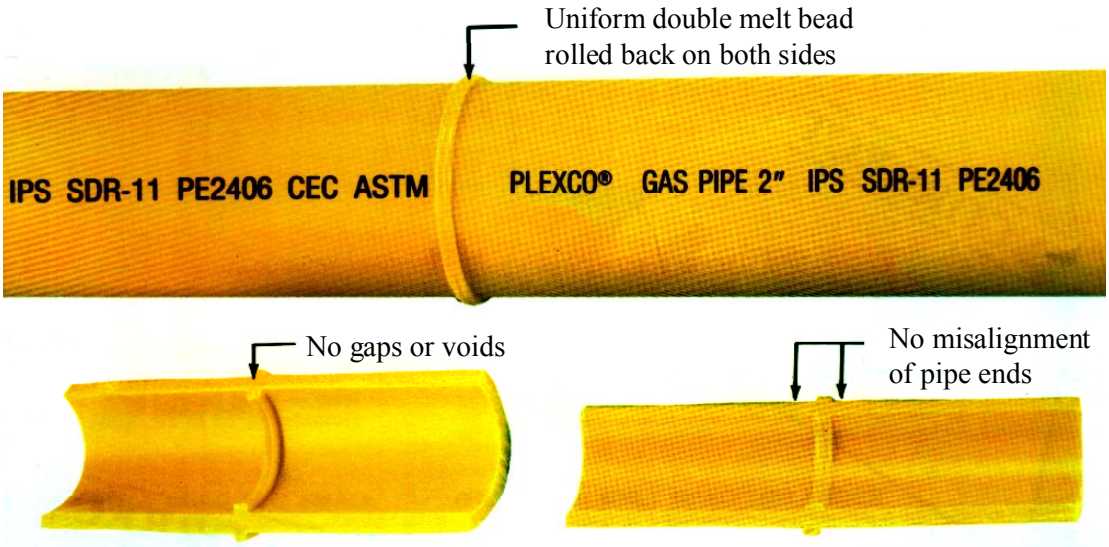
FIGURE VI-3
These are two types of fusion joints.

BUTT FUSION JOINT



SADDLE FUSION JOINT

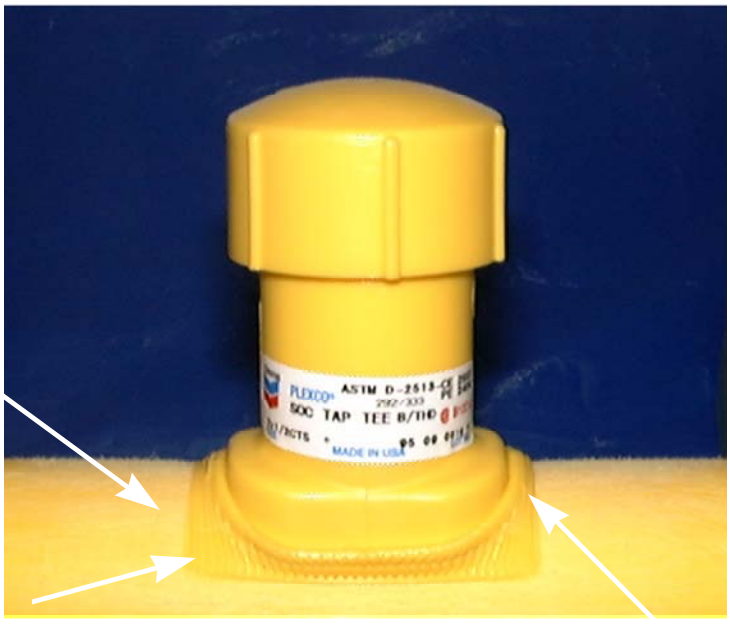
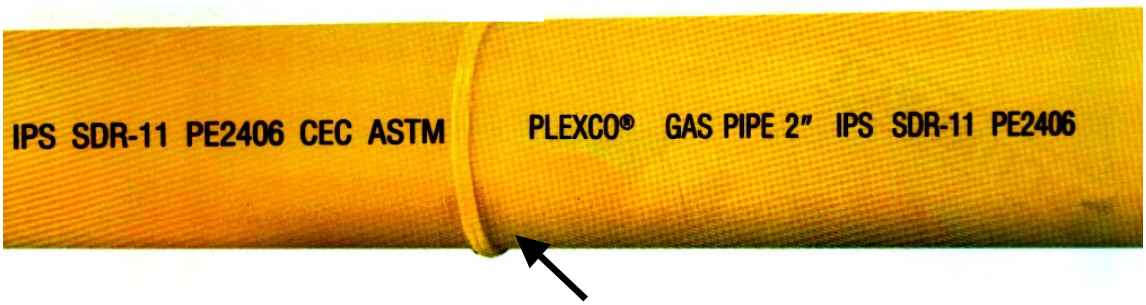


FIGURE VI-4

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.

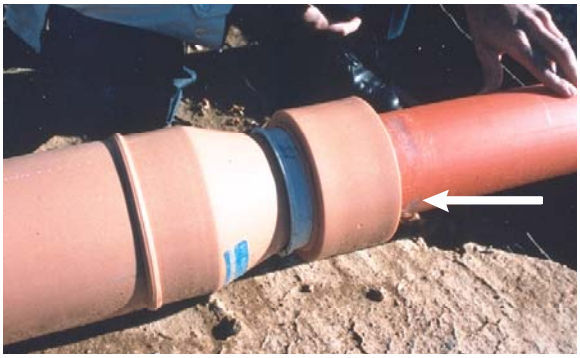


FIGURE VI-6

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

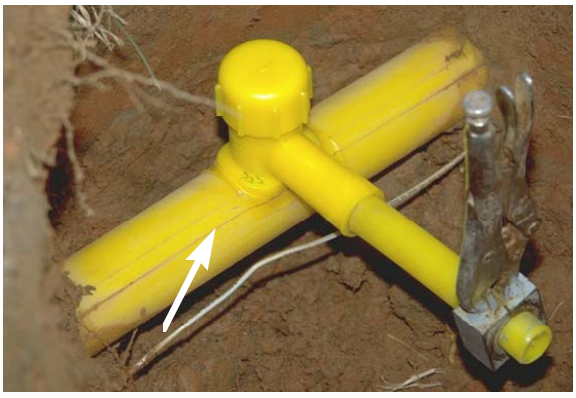
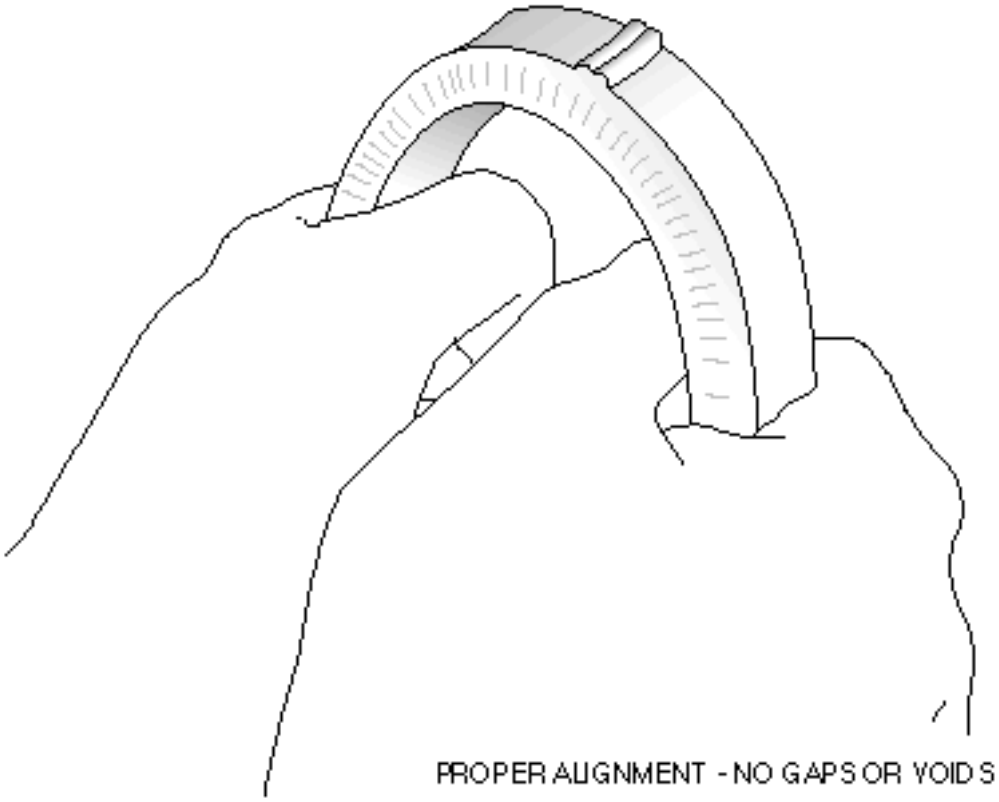


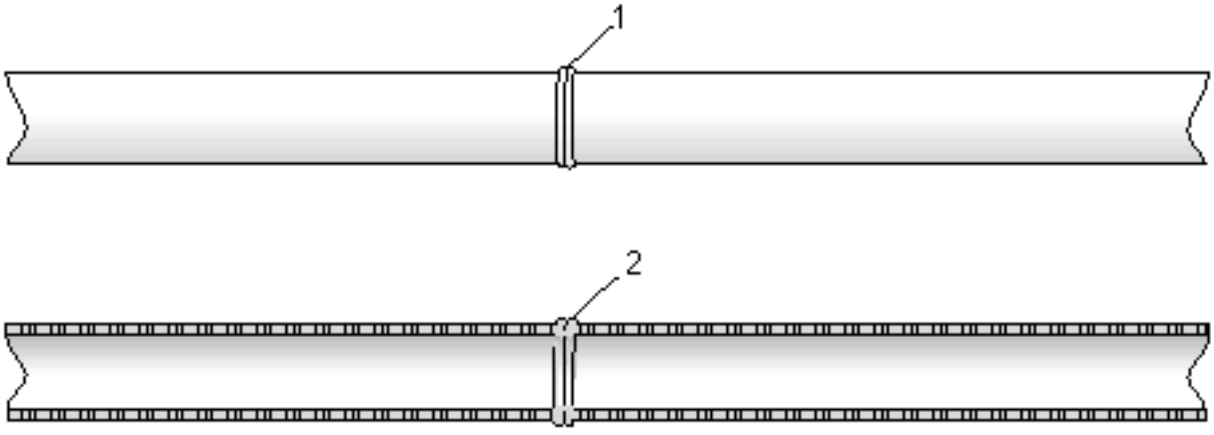
FIGURE VI-7

BUTT FUSION OF PIPE: ACCEPTABLE APPEARANCE



PROPER ALIGNMENT - NO GAPS OR VOIDS

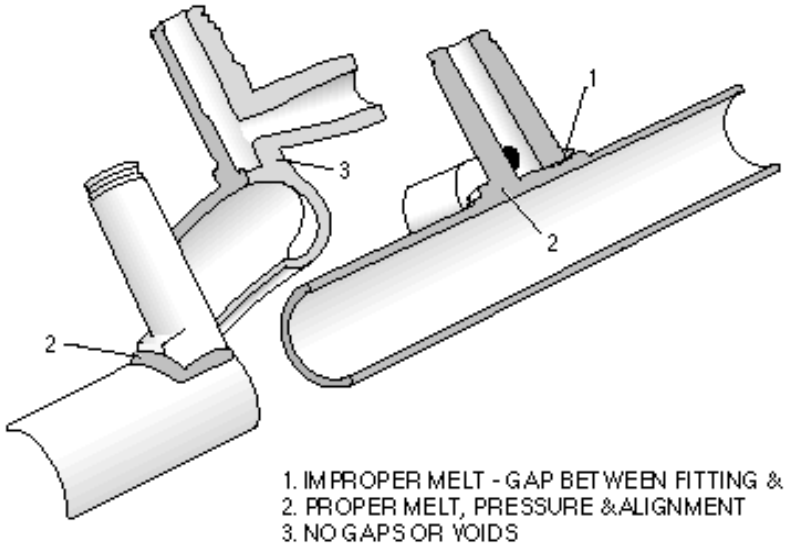
BUTT FUSION OF TUBING: ACCEPTABLE APPEARANCE



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

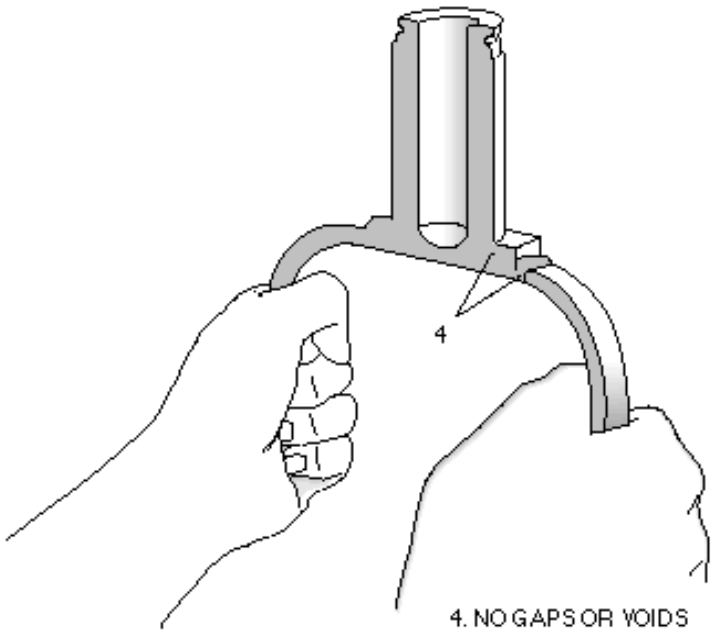
FIGURE VI-8

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:

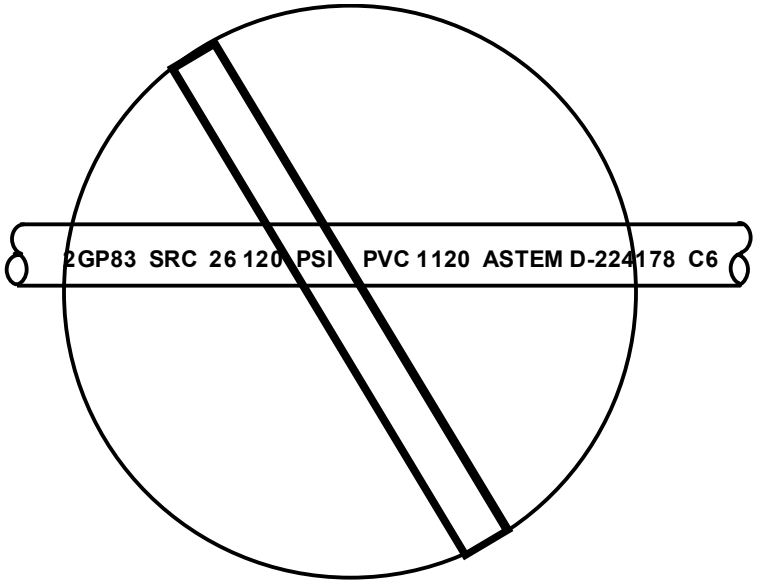
1. Install plastic pipe manufactured under the ASTM D2513 specification. The pipe must have ASTM D2513 marked on it.

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!**

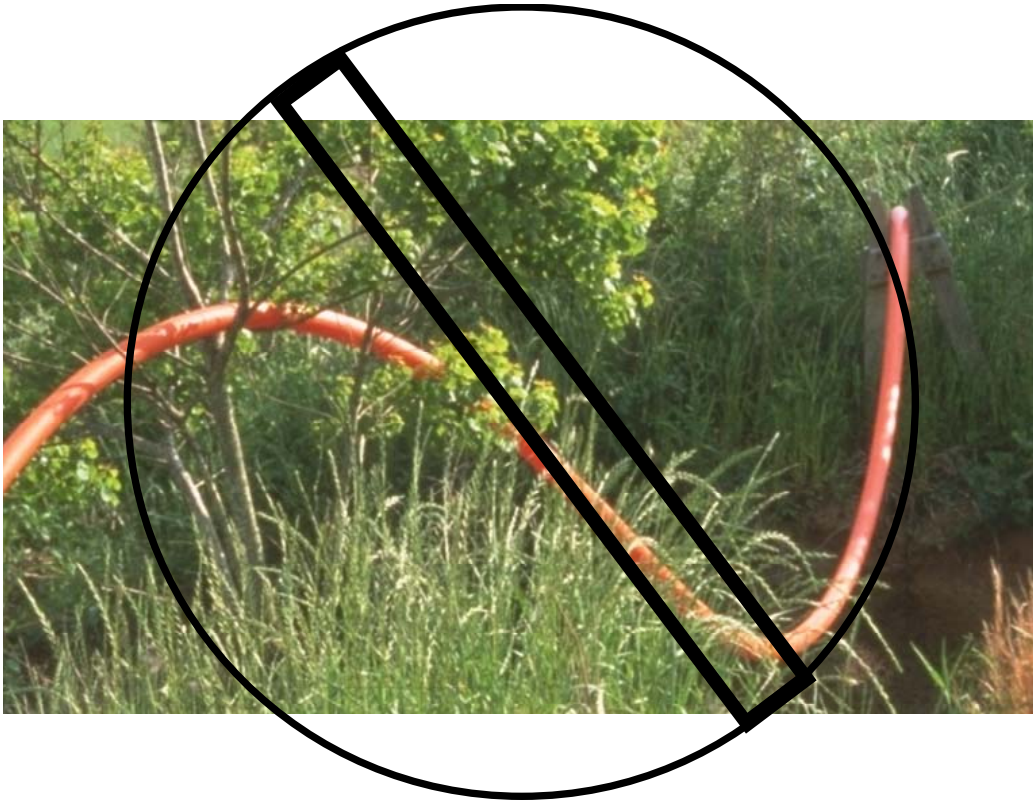
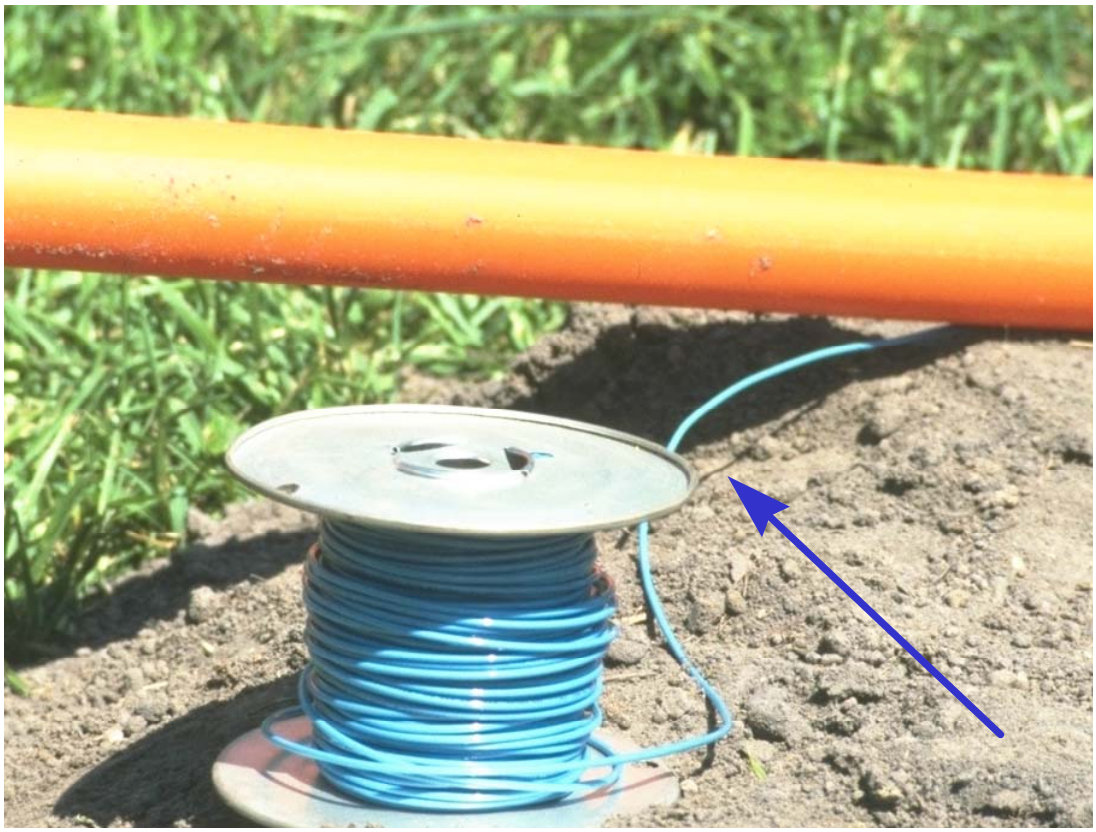


FIGURE VI-12

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 sheer 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.

<u>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.</u>