YELLOWPIPE™ PE 2406
Polyethylene Pipe

Qualification Procedures for making heat fusion joints

Chevron Plexco®

BULLETIN NO. 105Y

Contents

This bulletin is intended to be used as a guide for heat fushion techniques for polyethylene pipe. It is not intended to be used as installation instructions, and should not be substituted in place of the advice of a professional design engineer.

PLEXCO® YELLOWPIPE™ PE 2406 GAS PIPE

PLEXCO® YELLOWPIPE™ PE 2406 Gas Pipe is produced to APWA/ULCC standards for color coding of gas distribution lines. Since the color orange is increasingly being used to indicate communication and TV cables, YELLOWPIPE gives your underground lines a highly visible indication as a gas pipe installation. YELLOWPIPE is made from the same PE resin as our PE 2406 orange gas pipe, so fusion procedures are the same.

YELLOWPIPE™
An immediate and highly visible indicator which establishes the pipe in the ground as a gas pipe installation.

YELLOWPIPE™
Readily identifiable as PLEXCO PE2406 Gas Pipe, thus assuring the installer will select the proper fusion procedures.

YELLOWPIPE™
Fusion procedures the same as our PE2406 orange gas pipe.

YELLOWPIPE™
Recommended maximum outdoor storage life of four years.

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Fusion Qualification Procedures

This bulletin is intended to serve as an aid for the training of personnel as qualified installers of PLEXCO polyethylene pipe in compliance with the regulations of the Department of Transportation, Materials Transportation Bureau, contained in the Code of Federal Regulations Title 49, Part 192. Section 192.285 of these regulations details the procedure to be used to qualify persons to join plastic pipe.* As part of this qualification process, the trainee must make sample fusion joints in accordance with the applicable qualified fusion procedure. The resultant fused joints must have the same visual appearance as correctly made fusion joints described and illustrated in this bulletin. In addition, each joint must be cut into at least 3 longitudinal strips, each of which is visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area; and deformed by bending, torque, or impact such that if failure occurs it does not occur in the joint area. Refer to Bulletin 101 *Fusion Procedures* for complete fusion procedures.

The pictures in this bulletin are of correctly and incorrectly made socket, saddle and butt fusion joints. They are presented to assist the user in evaluating heat fusion joints.

PLEXCO polyethylene pipe and fittings should be joined *only* by the heat fusion method. DO NOT attempt to join by threading or with solvent cements. If you use mechanical fittings, instructions for their use should be obtained from the fittings manufacturer.

A fusion joint is made in four simple steps:

1. Be sure that the surfaces of the fusion tools, pipe and fittings are free of contaminants prior to use.

2. Heat the surfaces to be joined – both the pipe and fittings – simultaneously at a prescribed temperature for a specified time.

3. Remove the heater – bring melted surfaces together.

4. Hold until solidified.

*192.285D Each operator shall establish a method to determine that each person making joints in plastic pipelines in his system is qualified in accordance with CFR 49,192.285.

Before you begin fusing, here are some points to remember:

1. All heater surfaces have a thin layer of non-stick coating that is easily scratched or scraped off. This coating prevents melted PE from adhering firmly to the heater surfaces but occasionally it, too, must be cleaned.

Metal tools should NEVER be used to clean the heater surfaces because they scratch and remove the coating.

Wood implements and clean, dry, lint-free rags are recommended for cleaning. All-cotton rags are recommended because rags containing a substantial amount of synthetic fibers may melt and char against the heater surface.

If the non-stick coating becomes worn or scratched, the fusion surfaces of the heating unit should be recoated.

Melted PE adheres firmly to the heating iron and is more difficult to remove at places where the coating has been scraped off.

In addition, since the coating acts as an insulator, heat transfer in these uncoated areas is greater and local overheating can occur.

2. Just before using, wipe heaters to remove dirt and foreign material. Clean heaters as soon as possible after using with wood implements, and clean rags to remove melted or charred plastic.

3. Check the heater temperature with crayon indicators or surface pyrometer at least once a day to make sure the thermometer or other temperature measuring device is reading accurately.

Under heavy use conditions, check temperature twice a day.

4. NEVER lay a heating unit on the soil or grass when the heat cycle is completed. Return it to holder, if possible, or at least lay it on a board. Soil will contaminate the joint and is abrasive to the coating; grass may burn and char on the heater surface.

Important: All fusion Equipment must be in proper working order. Consult the manufacturer's operating manual for maintenance and service procedures. **Do not use defective equipment.**

Socket Fusion Joints

Procedure for Making Socket Fusion Joints

PREPARE PIPE ENDS

1. Using a pipe cutter, squarely cut off damaged or oval ends of pipe.

2. Use chamfering tool to remove the sharp corner at the pipe end. Remove burrs and chips inside pipe ends.

3. To prepare pipe for correct penetration into socket, place depth gauge down flush on end of pipe.

4. Place cold ring clamp around pipe, adjacent to depth gauge.

After securing cold ring clamp, remove depth gauge.

5. Fitting surfaces should be clean and dry — wipe with cloth — do not touch with hands.

6. The socket faces of the heating tool should be at $500^0 \pm 10^0$ F and clean.

7. First, firmly seat the socket fitting on the male face of the heating tool.

Then place the female face on the end of the pipe firmly against the cold ring clamp.

Heating time starts when the cold ring is bottomed out on the heater surface.

HEATING

Heat for the prescribed period of time, DO NOT TWIST PIPE, FITTING OR HEATING TOOL.

TABLE 1 — SOCKET FUSION TIME CYCLES

PIPE SIZE, IN.	*HEATING TIME CYCLE, SEC	COOLING TIME CYCLE, SEC
½ CTS	6- 7	20
1 CTS	9-10	20
½ IPS	6- 7	20
¾ IPS	8-10	20
1 IPS	10-12	20
1¼ IPS	12-14	30
2 IPS	16-19	30
3 IPS	20-24	40
4 IPS	24-28	40

**Guidelines only, exact time depends upon environmental conditions and condition of fusion equipment.*

8. Snap the heating tool and fitting from the melted pipe by holding upper part of tool handle with one hand and rapping sharply on the handle with the free hand.

Immediately remove fitting from heating tool.

9. Inspect the heated parts quickly to make sure all surfaces have been melted.

If melt is not complete, cut off melted pipe end, use a new fitting, and repeat fusion steps 1 through 8.

FUSION AND COOLING

10. Within 3 seconds after the heating tool has been removed, firmly push the melted fitting squarely onto the pipe until it makes firm contact with the cold ring clamp.

DO NOT TWIST OR ROTATE THE FITTING.

Hold the fitting firmly in place for total cooling time shown in Table 1 to insure proper alignment.

After waiting 3 additional minutes cooling time, remove the cold ring clamp and inspect the joint.

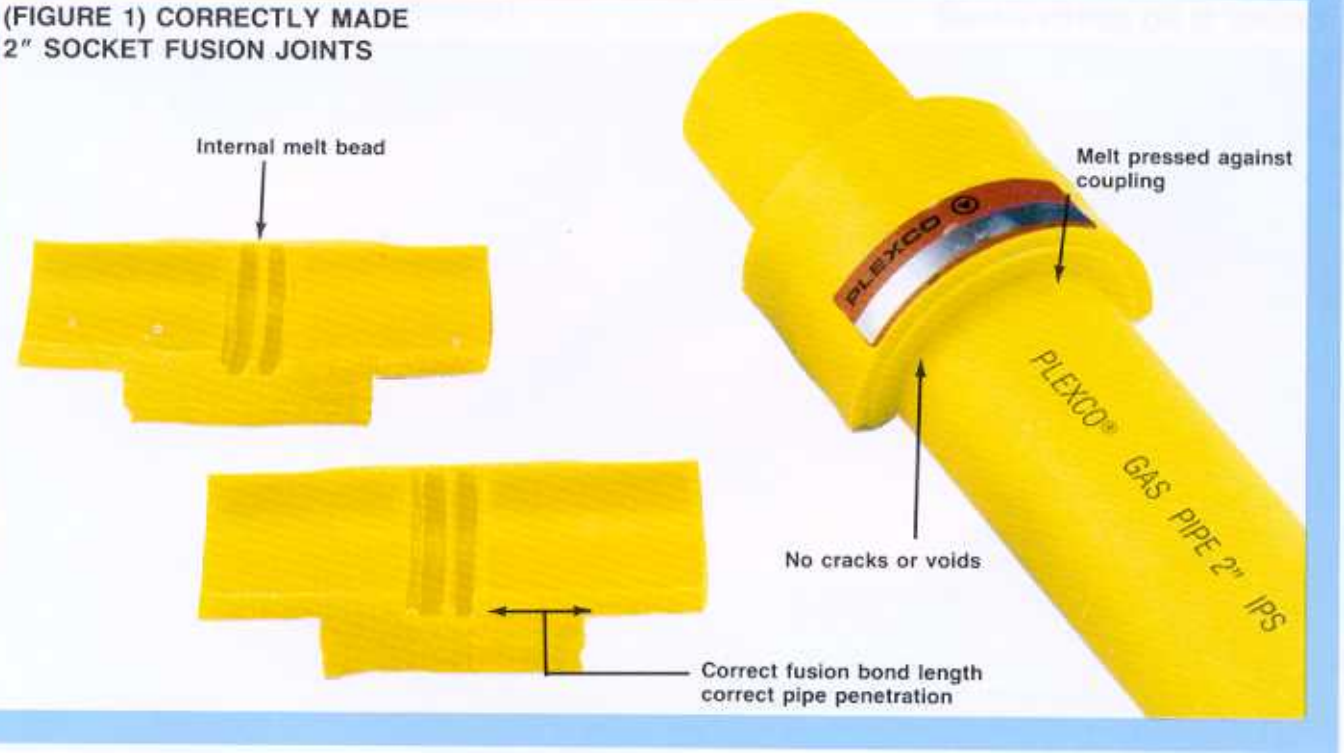
A good joint will have a uniform melt ring that is flat against the socket and perpendicular to the pipe.

There should be no gaps or voids between the fitting and the pipe.

11. Wait an additional 10 minutes to complete cooling before the pipe joint is tested or stressed during burial.

12. See Figure 1 for visual parameters of a proper fusion.

(FIGURE 1) CORRECTLY MADE
2" SOCKET FUSION JOINTS



(FIGURE 2) CORRECT
BEND TEST FOR SOCKET FUSION JOINT

Allow the joint to cool for at least one hour before subjecting it to a bend test.

Cut at least 3 strips 1" wide lengthwise through the socket so that about 8" of pipe remains on each side of the fitting.

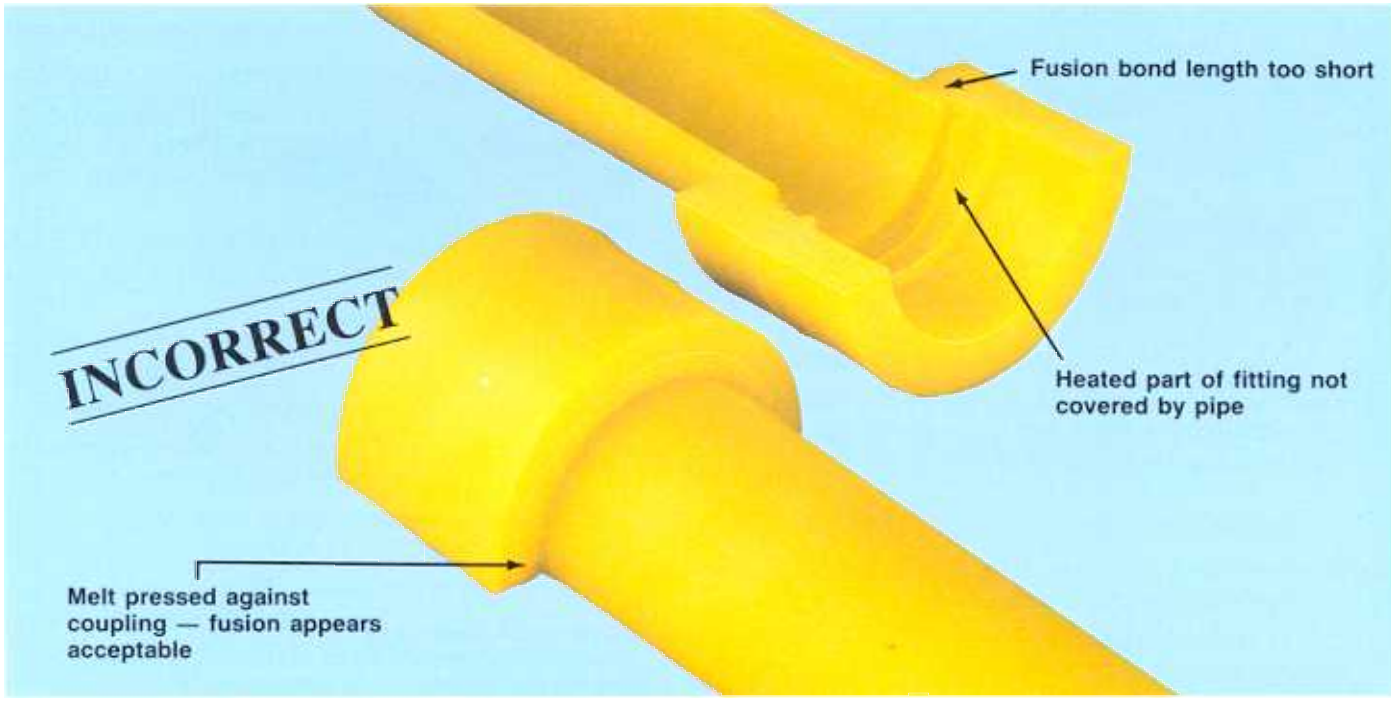
Hold each strip at the ends, and bend the sample as shown in Figure 2.

Continue to hold each sample in the bent position, and thoroughly examine the entire fusion area. If any separation, cracks or voids are observed, the fusion is not satisfactory.

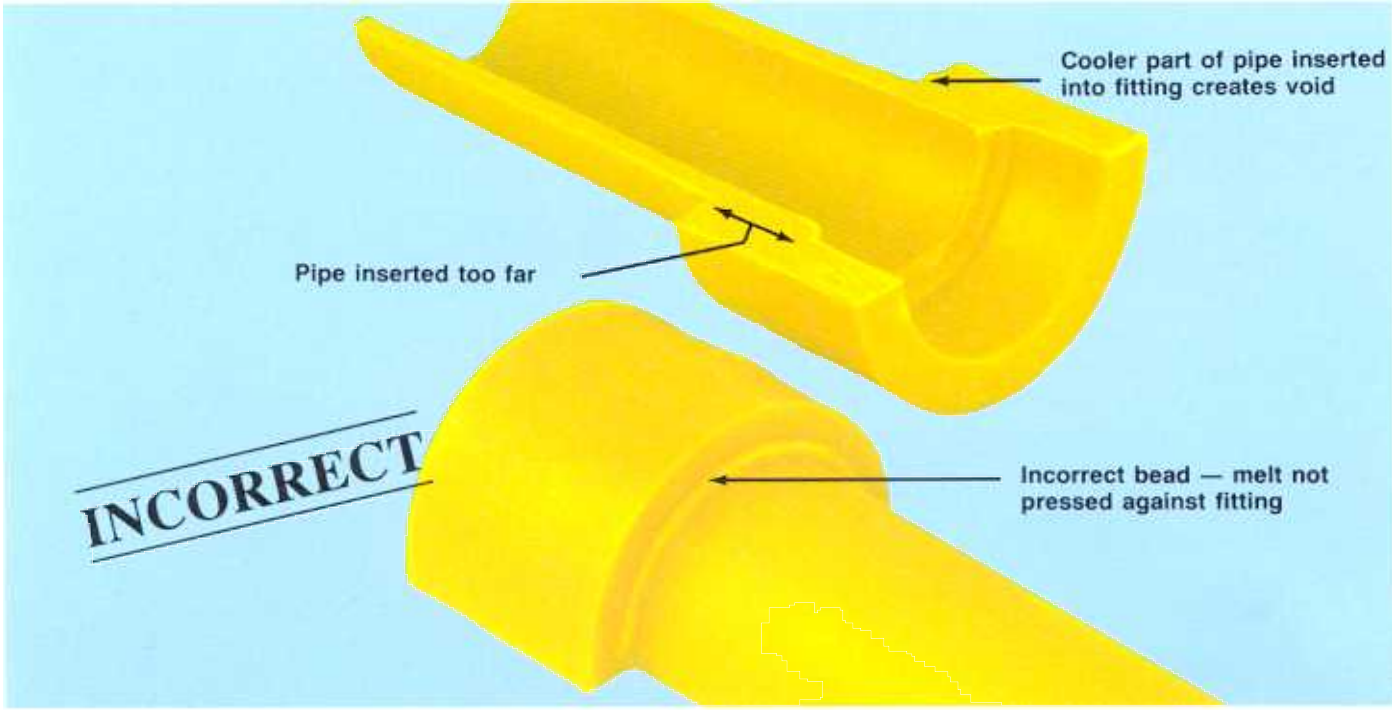
A joint is considered satisfactory if all bent samples are completely free of cracks or voids in the fusion area, as shown in Figure 2.

Socket Fusion Joints—Incorrectly made

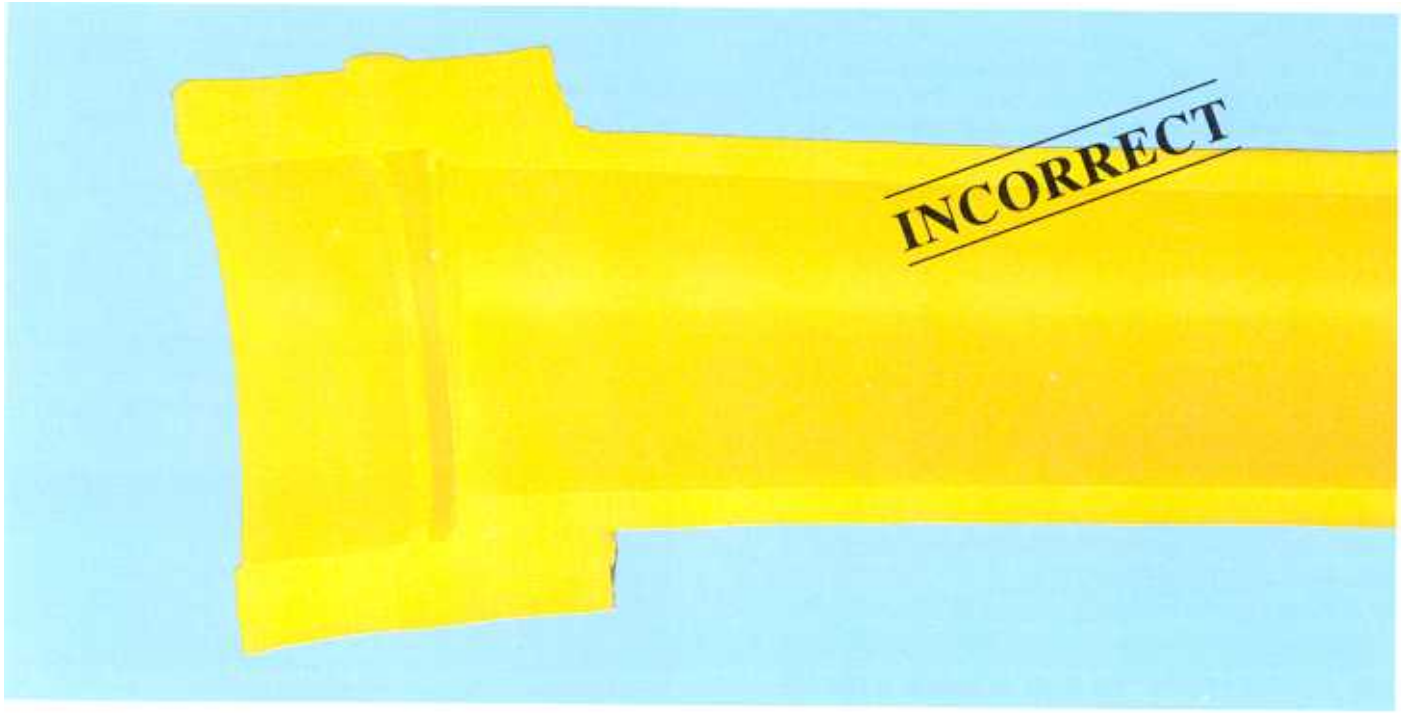
(FIGURE DEPTH GAUGE



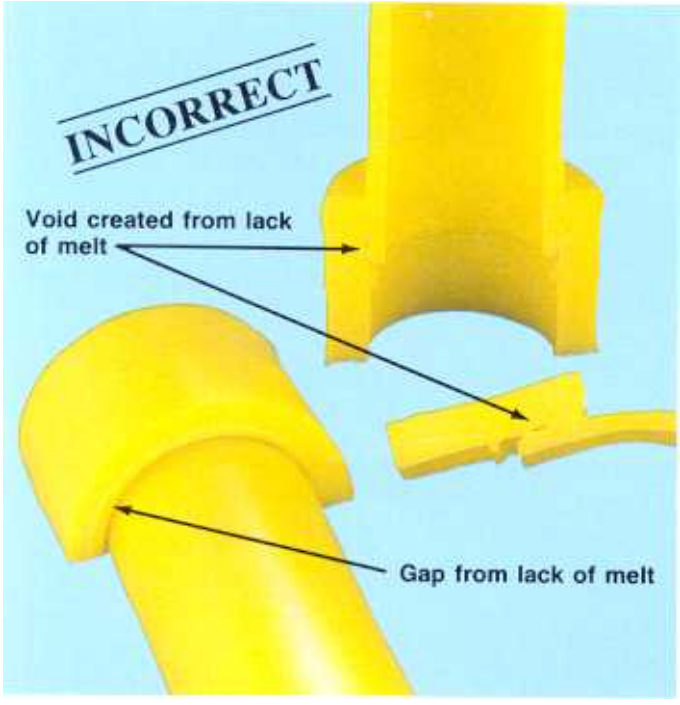
(FIGURE 4) NO COLD RING



(FIGURE 5) POOR ALIGNMENT (INCORRECT)



(FIGURE 6) MELT RUBBED OFF WHEN REMOVING HEATER



(FIGURE 7) MELT RUBBED OFF WHEN REMOVING HEATER

Saddle Fusion Joints

Procedure for Making Saddle Fusion Joints

It is recommended that an application tool be used when making saddle fusion joints. Variables in the installation procedure are more easily controlled when a tool is used than when the fusion is made manually. **When fusing on a pressurized main, the risk of blow-out can be reduced by using equipment that is in proper working order, following the manufacturer's operating instructions, using recommended fusion procedures and by using relieved-center heater faces when fusing High Volume Tapping Tees.**

1. Assemble application unit according to manufacturer's instructions and use bolster plates on 6" IPS and smaller mains.

2. Remove surface skin from the melt areas of the clean, dry pipe and saddle fitting by roughening with 50 to 60 grit utility cloth.

Brush away residue with dry rag after roughening.

3. With the heating surfaces of the tool at 500° ± 10°F place the tool in position on pipe.

Place fitting against heater faces and apply pressure.

Heat under pressure for time shown in Table 2 or 3.

TABLE 2 – TAPPING TEE AND SERVICE SADDLE FUSION TIME CYCLES

IPS PIPE SIZE, IN.	*HEATING TIME CYCLE, SEC	COOLING TIME CYCLE, SEC
1¼	**40-Saddle 25-pipe	60
2-8	40	60

***Use heat shield on pipe surface for first 15 seconds of this time cycle.*

TABLE 3 – HVTT AND BRANCH SADDLE FUSION TIME CYCLES

IPS PIPE SIZE, IN.	*HEATING TIME CYCLE, SEC	COOLING TIME CYCLE, SEC
2	50-60	120
3	70-80	120
4	70-80	180
6-8	80-90	180

**Guidelines only, exact time depends upon environmental conditions and condition of fusion equipment.*

With experience, the iron can be rocked slightly and slowly as the melt forms—do not rock excessively as this will enlarge the melt pattern on the pipe.

4. After proper melt time, raise fitting and remove heater from pipe.

DO NOT displace melt on pipe and fitting surfaces.

Check melt pattern on pipe and fitting – heated surfaces on fitting and pipe should be 100% melted with no cold spots.

(Use a mirror to check the melt on the under surface of the saddle base.)

5. If melt patterns are satisfactory, press the fitting on the pipe very quickly (within 3 seconds) with firm pressure until a melt bead of the following size appears around the entire base of the fitting:

PIPE SIZE	BEAD THICKNESS
1-1/4"	1/16"
2"	1/8"
3" *& larger*	larger than 1/8"

Adjust fusion unit to maintain pressure of fitting on pipe. See tip card for further information.

Allow fusion joint to cool for at least the times indicated in Table 2 or 3 before releasing pressure.

If melt pattern on fitting or pipe is unsatisfactory after heating, apply fitting to pipe and let cool. Remove cutter from tapping tee and cut off fitting top to avoid misuse later. Repeat procedure from Step 1.

6. After letting joint cool 3 minutes beyond that shown in the tables, remove application unit from pipe.

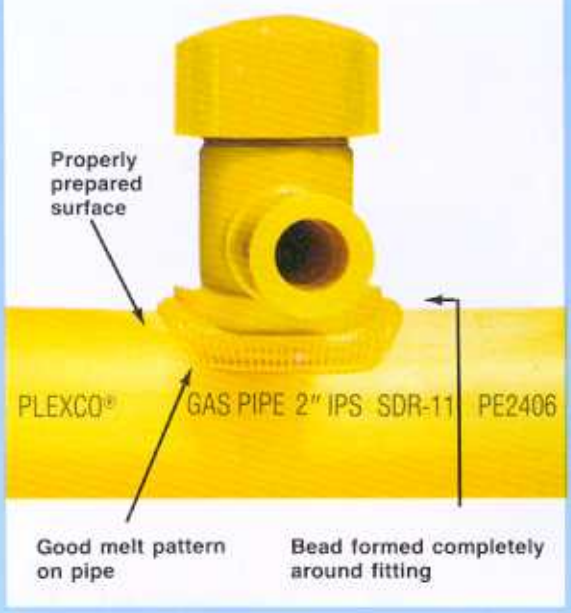
Visually check fitting for fusion melt bead around entire fitting base.

If fusion joint quality is unacceptable or doubtful, cut off fitting top and apply a new fitting to a new section of pipe.

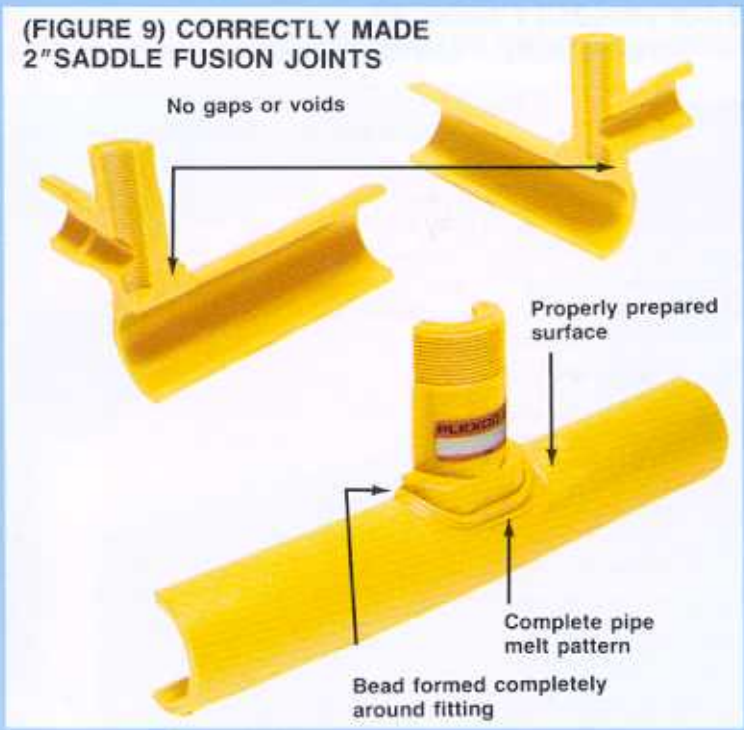
7. For standard tapping tees and service saddles, let fusion cool an additional 10 minutes prior to pressure testing and tapping the main. For high volume tapping, tee and branch saddles, allow an additional 30 minutes.

8. See Figures 8 and 9 for visual parameters of a proper fusion.

(FIGURE 8) CORRECTLY MADE
2" SADDLE FUSION JOINT



(FIGURE 9) CORRECTLY MADE
2"SADDLE FUSION JOINTS



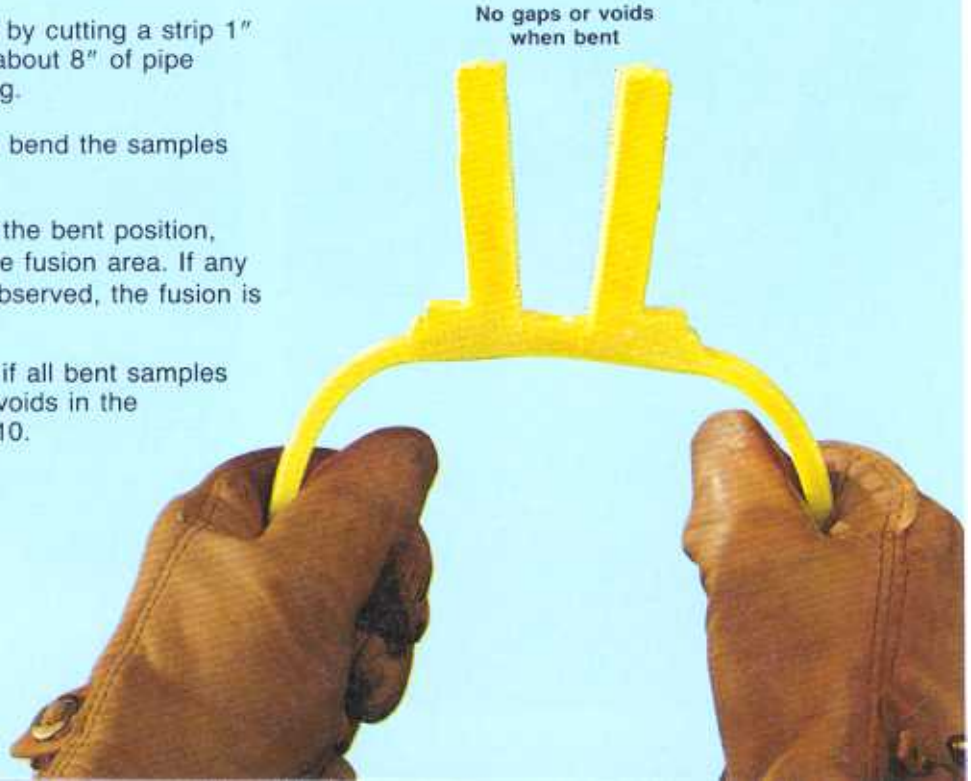
(FIGURE 10) CORRECT
BEND TEST FOR SADDLE FUSION JOINT

Cut the joint into at least 3 strips by cutting a strip 1" wide through the saddle so that about 8" of pipe remains on each side of the fitting.

Hold each strip at each end, and bend the samples as shown in Figure 10.

Continue to hold each sample in the bent position, and thoroughly examine the entire fusion area. If any separation, cracks or voids are observed, the fusion is not satisfactory.

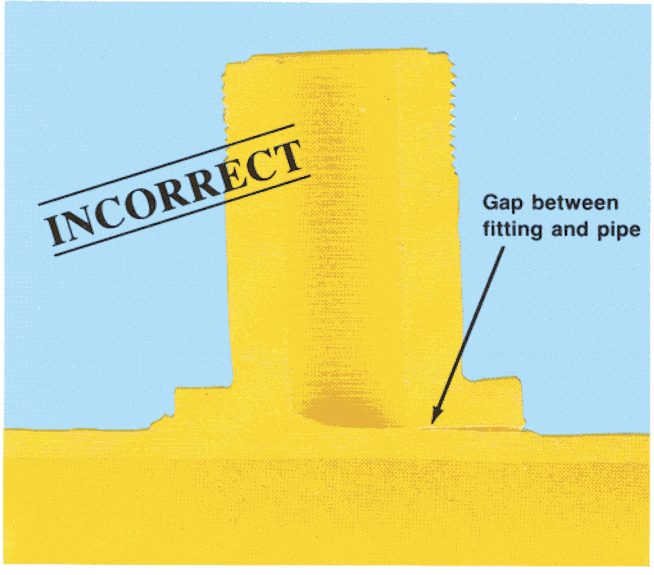
A joint is considered satisfactory if all bent samples are completely free of cracks or voids in the fusion area, as shown in Figure 10.



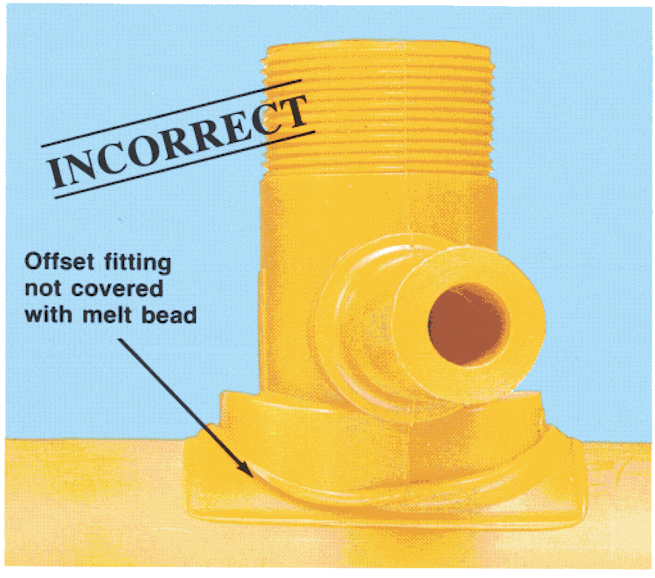
Saddle Fusion Joints—Incorrectly made

(FIGURE 11) COLD FUSION —
EXCESSIVE COOLING BEFORE JOINING

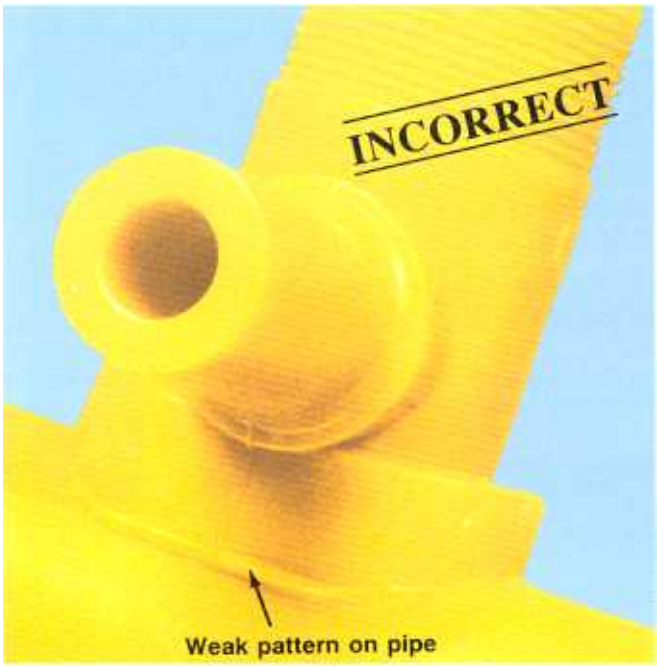
(FIGURE 12) POOR ALIGNMENT —
FITTING NOT FLAT ON PIPE



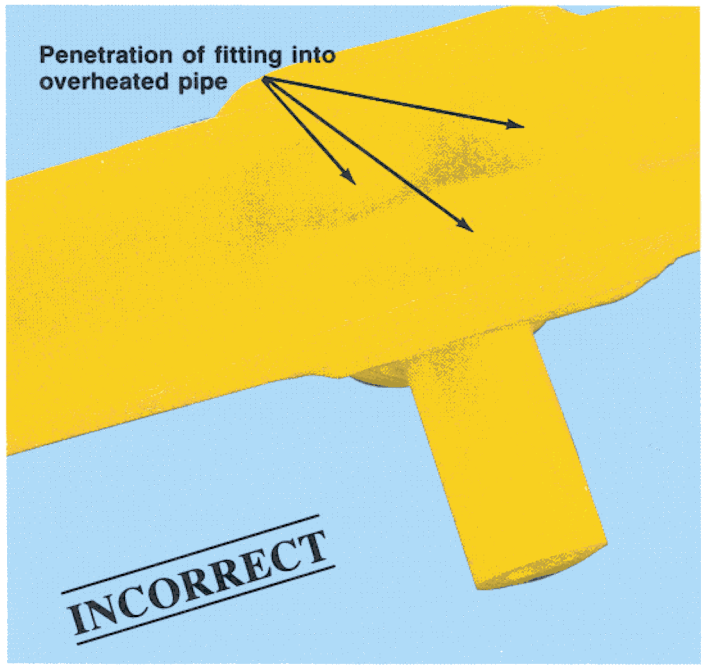
(FIGURE 13) POOR ALIGNMENT —
FITTING NOT SQUARE ON PIPE



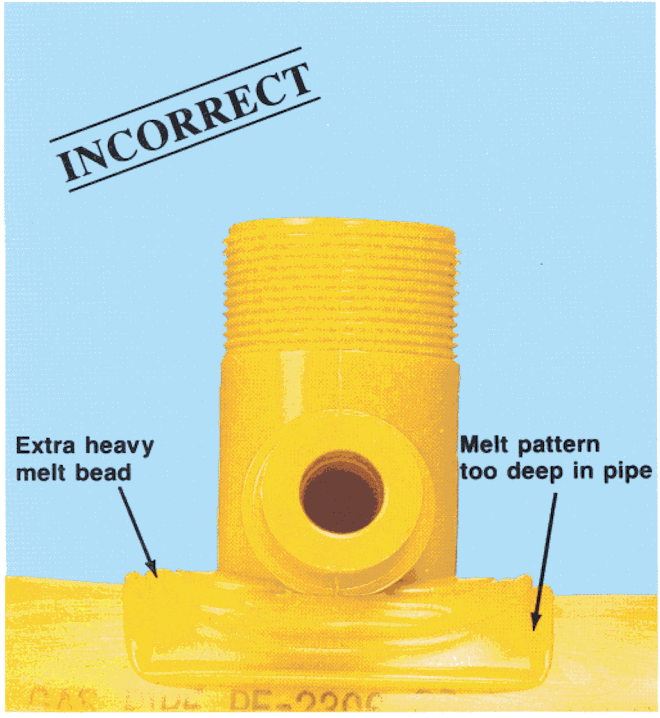
(FIGURE 14) INCOMPLETE PIPE MELT PATTERN



(FIGURE 15) OVERMELTING — INSIDE PIPE



(FIGURE 16) OVERMELTING — HEAT CYCLE TOO LONG



(FIGURE 17) EXCESSIVE COOLING BEFORE JOINING

Butt Fusion Joints

Procedure for Making Butt Fusion Joints

1. Clean each pipe end with a clean cloth. Place pipe ends into fusion machine. Bring ends together and check alignment.

2. Insert facing unit between pipe ends and lock onto guide rods. Face pipe ends to the stops.

3. Check alignment of pipe ends. Adjust high-low if necessary. If adjustment is made, reinsert facing unit and reface to the stops.

4. Check heater plate for temperature and wipe surface clean.

5. Insert heater plate between aligned ends and bring ends firmly in contact with plate, but DO NOT APPLY PRESSURE.

6. Heat for times shown below.

TABLE 4 — BUTT FUSION TIME CYCLES

IPS PIPE SIZE, IN.	Heating Time Cycle, sec* HEATER AT 500° ± 10° F	HEATER AT 440° ± 10°F	COOLING TIME CYCLE, SEC
1¼	14-17	25-30	60
2	16-19	40-48	60
3	20-24	50-60	75
4	24-29	55-66	90
6, SDR-11.5	40-48	90-108	180

**Guidelines only, exact time depends upon environmental conditions and condition of fusion equipment.*

7. Remove heater plate after achieving proper melt bead.

8. Bring melted ends together rapidly. DO NOT SLAM. Apply enough force to achieve a double roll back of each bead onto the pipe. Hold this pressure during cooling.

9. Allow the butt fusion to cool, under pressure, for the time shown in Table 4.

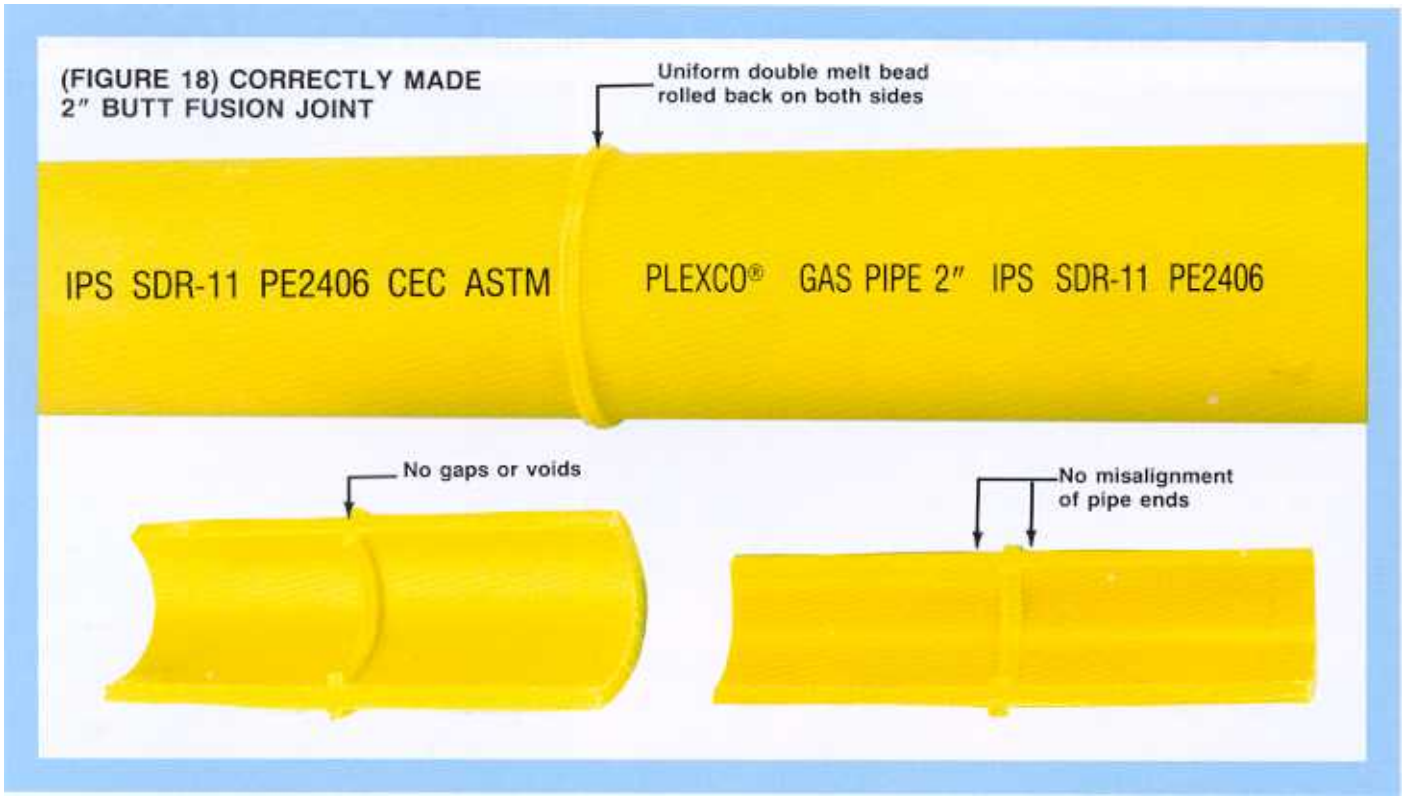
10. DO NOT remove the fused joint from the equipment for an additional 3 minutes after cooling time.

DO NOT test, stress, pull or lay in ground for 10 to 60 minutes after removal from fusion unit.

11. See Figure 18 for visual parameters of a proper fusion.

Each bead after fusion should have approximately the following diameters:

PIPE SIZE	SDR NO.	BEAD THICKNESS
1¼" IPS	10	1/16"
2" IPS	11	1/16" to 1/8"
3" IPS	11-11.5	1/8"
4" IPS	11-11.5	1/8"
6" IPS	11-11.5	3/16"
8" IPS and Larger	All	3/16" to ¼"



(FIGURE 19) CORRECT BUTT FUSION BEND TEST

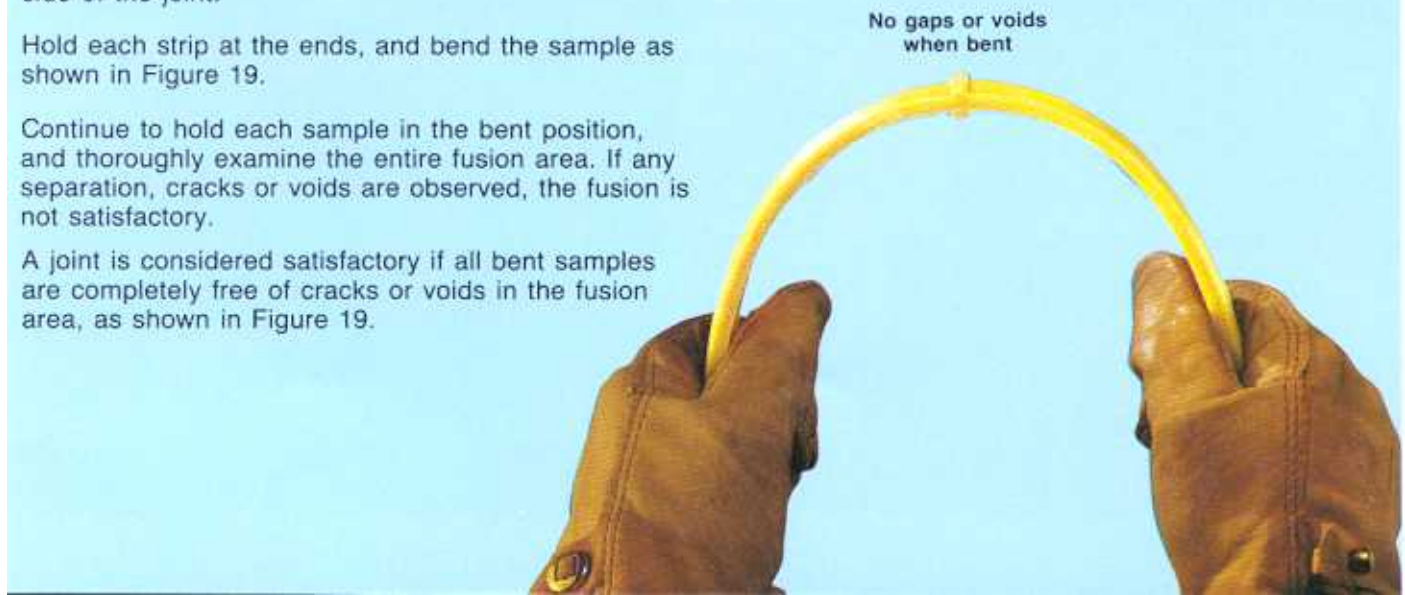
Allow the joint to cool for at least one hour before subjecting to a bend test.

Cut at least 3 strips 1" wide lengthwise through the butt fusion so that about 8" of pipe remains on each side of the joint.

Hold each strip at the ends, and bend the sample as shown in Figure 19.

Continue to hold each sample in the bent position, and thoroughly examine the entire fusion area. If any separation, cracks or voids are observed, the fusion is not satisfactory.

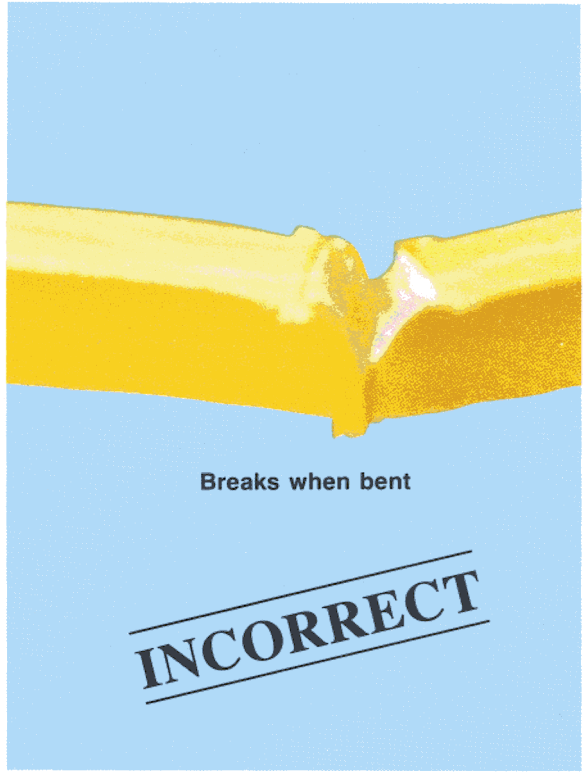
A joint is considered satisfactory if all bent samples are completely free of cracks or voids in the fusion area, as shown in Figure 19.



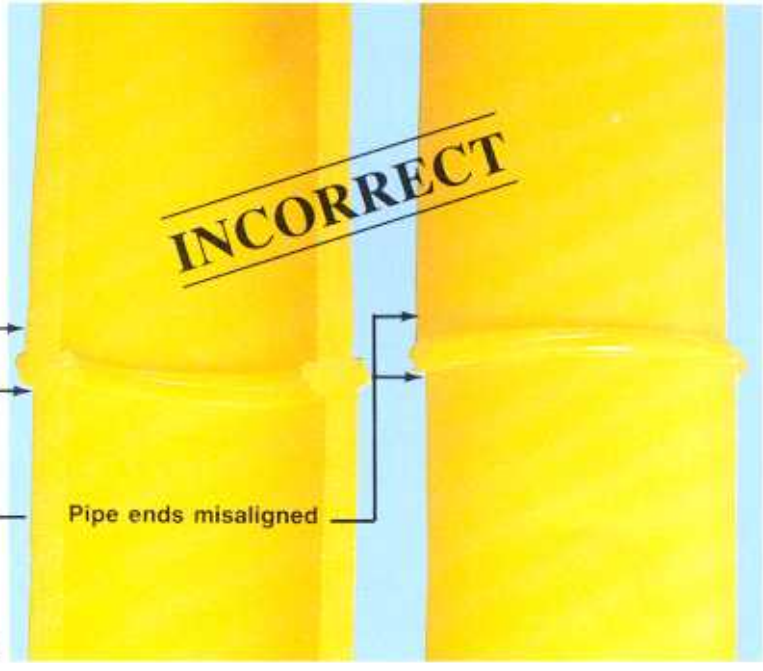
Butt Fusion Joints–Incorrectly made

(FIGURE 20) INCOMPLETE FACING

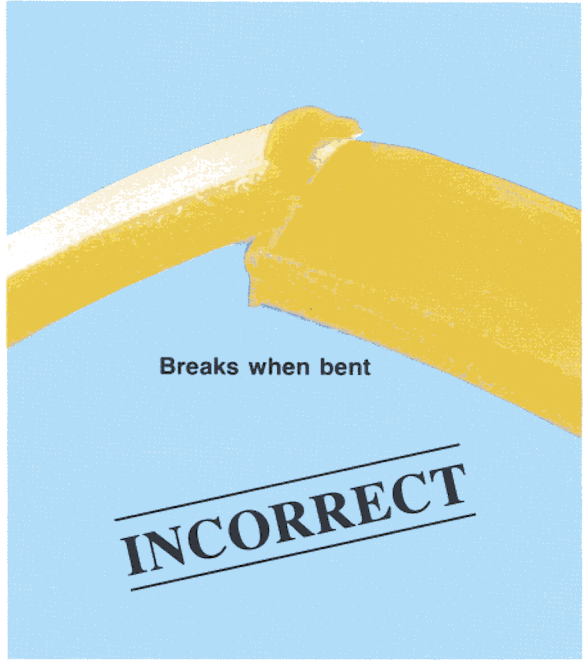
(FIGURE 21)
INCOMPLETE FACING BEND TEST



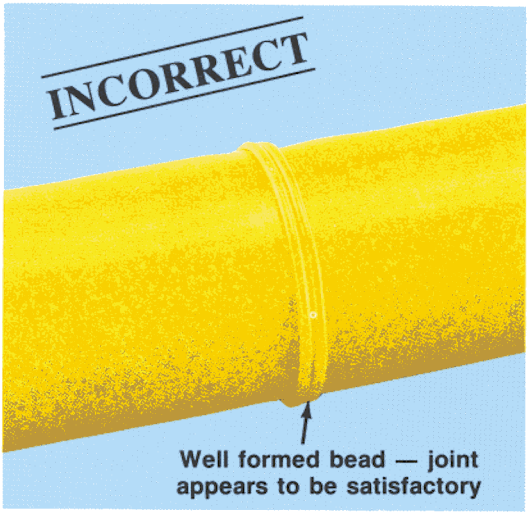
(FIGURE 22) POOR ALIGNMENT



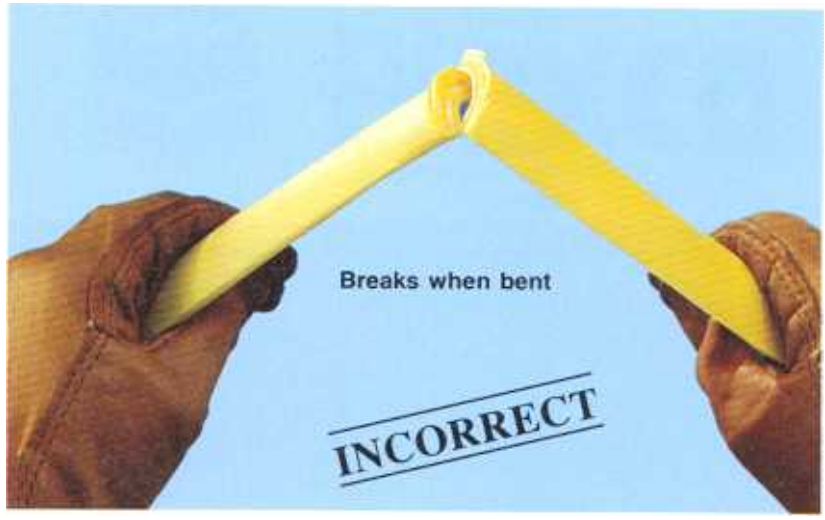
(FIGURE 23)
POOR ALIGNMENT BEND TEST



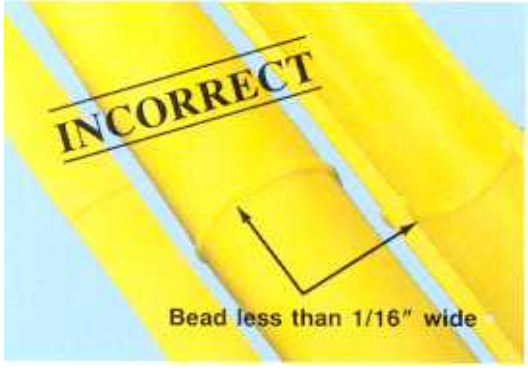
(FIGURE 24) "COLD JOINT" — EXCESSIVE PRESSURE DURING HEAT CYCLE



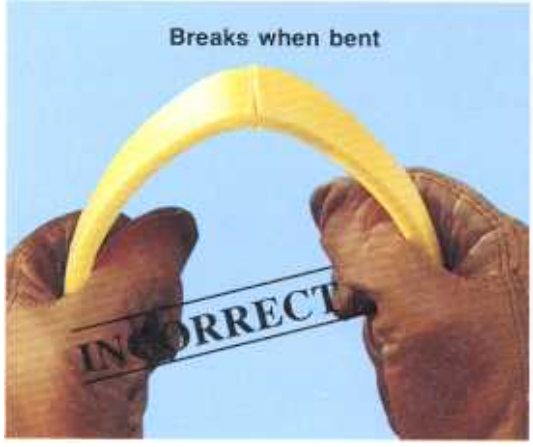
(FIGURE 25) COLD JOINT BEND TEST



(FIGURE 26) MELT BEAD TOO SMALL



(FIGURE 27) SMALL BEAD BEND TEST



(FIGURE 28) MELT BEAD TOO LARGE