DRISCOPIPE®

Heat Fusion Qualification Guide

Driscopipe® 8100 Gas Distribution Piping Systems

This brochure has been developed to assist those responsible for fusion joining Driscopipe® 8100 Gas Piping Systems in meeting the requirements of Title 49 of the code of Federal Regulations §192.285 as it applies to heat fusion.

The regulations require each operator to ensure that every individual performing fusion joining is qualified in the use of the recommended fusion procedure(s) by the following:

I. Appropriate training or experience in the use of the fusion procedure, and

II. Making a sample joint according to the procedure that passes the following inspections and tests:

A. The joint must be visually examined during and after joining, and found to have the same appearance as a photograph or sample of an acceptable joint that was joined in accordance with the procedure; and

B. The joint must be tested or examined by one of the following methods:

1. Pressure and tensile test as described in 49 C.F.R. §192.283; or
2. Ultrasonic inspection and found to be free of flaws that would cause failure; or
3. Cut into at least three longitudinal straps, each of which is:
   a. Visually examined and found to be free of voids or unbonded areas on the cut surface of the joint, and
   b. Deformed by bending, torque or impact and if failure occurs, it must not initiate in the joint area.

C. A person must be requalified under an acceptable procedure, if, during any twelve month period he –

1. Does not make any joints under the procedure; or
2. Has three joints or three percent of the joints he has made, whichever is greater, that are found unacceptable by testing under 49 C.F.R. §192.513.

This brochure provides photographs of acceptable and unacceptable joints and illustrates the use of cut straps for inspection and testing of the joint. The fusion procedures recommended in this brochure have been qualified in accordance with 49 C.F.R. §192.283, and are certified to produce a joint as strong as the pipe. Individuals who demonstrate their ability to follow the recommended fusion procedures and produce acceptable fusion joints as illustrated in this brochure should meet the requirements for qualification under 49 C.F.R. §192.285 as it applies to heat fusion of the Driscopipe 8100 Gas Piping Systems.

Note: Section 192.283 "Plastic Pipe; Qualifying Joining Procedures", Section 192.285 "Plastic Pipe; Qualifying Persons to Make Joints", Section 192.287 "Plastic Pipe; Inspection of Joints", and Section 192.513 "Test Requirements for Plastic Pipelines" of Title 49 of the Code of Federal Regulations are shown on pages 12 and 13 of this brochure.

Static Electricity: Static electricity charges are generated on polyethylene pipe by friction, particularly during the handling of pipe in storage, shipping and installation. The flow of air or gas containing dust or scale will also build up significant static charges, as will the flow of dry materials through the pipe, such as in the case of gravity flow grain chutes. These charges are a safety hazard, particularly in areas where there is leaking gas, or an explosive atmosphere.

Plastic pipe is a non-conductor of electricity and the static charge will remain in place until some grounding device comes close enough to allow it to discharge.

The discharge of these static electric charges generally happens when workmen touch the pipe themselves or upon application of mechanical tools to the pipe. The result of the discharge will vary from an insignificant physical shock to possible ignition of a flammable gas-air mixture. The most effective and simple method to minimize the hazard to the discharge is to apply a film of water to the work surface, to drain away the static electricity. A ground wire on the plastic pipe will only discharge from that point, since the plastic is a non-conductor.

When workmen must enter a bellhole to hot tap a line or make emergency repairs to a damaged or leaking line, it is important that all safety precautions be observed. The exposed working surface of the polyethylene line should be doused with water before entering the area and a wet cloth should be kept on the pipe to drain off static charge build up while working on the line.

Heat Fusion Joining: High Integrity, High Reliability

Driscopipe 8100 Very High Molecular Weight, High Density Gas Distribution Systems is joined by the heat fusion technique commonly called "butt" and "sidewall" fusion. Pioneered and developed by Phillips Petroleum Company, these are simple, visual procedures with straightforward, uncomplicated instructions. Both fusion techniques are recognized in the industry as joining systems of very high integrity and reliability, and are cost effective. Butt fusion does not require couplings. Joints are stronger than the pipe itself in both tension and pressure conditions.

The first fusion equipment for high density polyethylene was designed, developed and built by Phillips in the mid-1950s following its first commercial production of high density polyethylene piping material. Heat fusion joining proved so successful that Phillips rapidly developed more sophisticated equipment and continued this developmental activity through the late 60s. Since that time, with Phillips guidance, other firms have developed an extensive line of fusion equipment that is readily available. There are literally millions of Driscopipe fusion joints in service today giving dependable, trouble-free performance. The modern day heat fusion joint is basically the same joint made in 1956 . . . only the fusion equipment has evolved to gain efficiency, reliability,and convenience.

Butt fusion joints may easily be cut out and redone, if necessary, to achieve a quality joint. The butt fusion joining system has been so successful that it is the "standard" joining system for polyethylene. The Driscopipe 8100 black on yellow bead appearance greatly enhances the visual inspection of the butt fused joints.

Butt Fusion of Pipe
Acceptable Appearance

1. Proper double roll-back bead
2. Proper melt, pressure and alignment
3. Proper alignment – no gaps or voids

Butt Fusion Procedure for Pipe, Tubing & Fittings

1. Clean each pipe end with a clean cotton cloth.
2. Square (face) end of each pipe to be fused.
3. Check line-up of pipe ends. Adjust high-low. Check for voids and gaps. Check heater plate for proper temperature, and clean surface with a clean cotton cloth.
   Surface Temperature: 475°F – 500°F
4. Insert heater plate between aligned ends and bring ends firmly in contact with plate, but *DO NOT APPLY PRESSURE* while achieving melt pattern. Watch for proper melt.

Pipe Size	Proper Melt
1 1/4" & smaller	1/16" Melt Flow
2"	1/8" Melt Flow
3"	3/16" Melt Flow
4" or larger	3/16" – 1/4" Melt Flow

5. Remove heater plate after achieving proper melt.
6. Bring melted ends together rapidly. *DO NOT SLAM.* Apply enough pressure to form a double roll-back bead.
7. Allow the butt fusion joint to cool properly (until finger can remain comfortably on bead) while maintaining pressure.

Remember

Install proper inserts in fusion unit for the pipe, tubing or fittings being joined. A quality butt fusion joint has a complete double roll-back bead and is made in accordance with this procedure.

Heater plates should be double checked with a tempilstik or pyrometer for correct *surface temperature* (475°F–500°F).

Butt Fusion Qualification Procedure

1. Observe the joining process to determine that the proper procedure is being followed.
2. Visually inspect the joint and compare it to a sample or picture of an acceptable joint.
3. Allow the joint to cool for at least one hour.
4. Cut the sample through the joint area, lengthwise of the pipe, into at least three straps.
5. Visually inspect the cut surface of the pipe wall at the joint for voids or unbonded areas.
6. Bend the sample 180°.
7. If flaws are observed in the joint, compare the appearance with pictures of poor joints, recheck the procedure and make another joint.

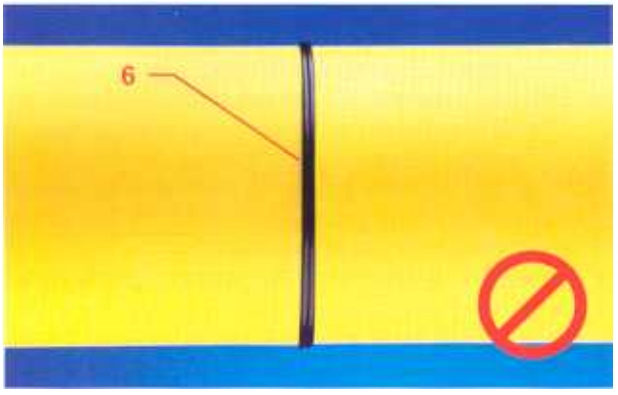
Butt Fusion of Pipe

Acceptable Appearance

4. Proper double roll-back bead
5. Proper melt, pressure and alignment

Butt Fusion of Pipe

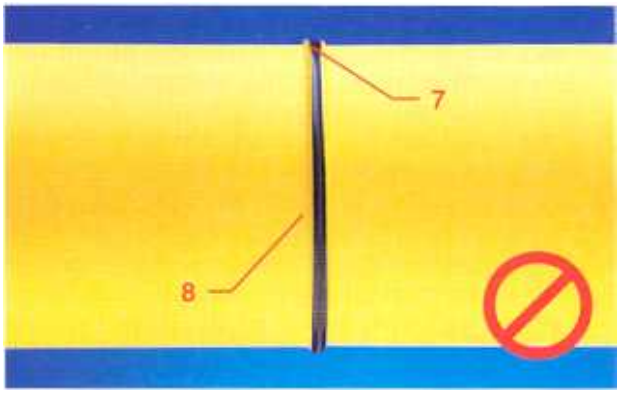
Unacceptable Appearance: Insufficient Melt



6. Melt bead too small for 2-inch and larger mains

Butt Fusion of Pipe

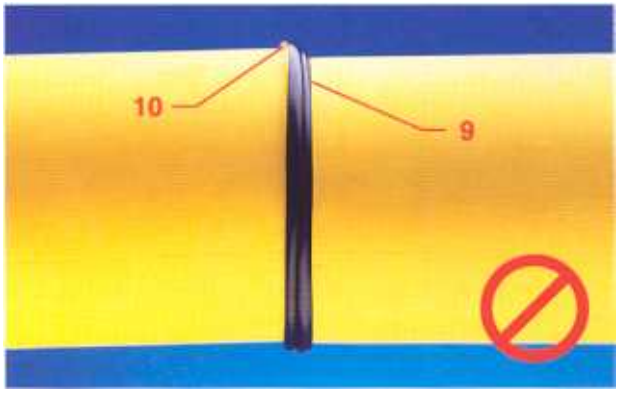
Unacceptable Appearance: Inadequate Roll Back



7. Insufficient fusion pressure – "V" shaped melt appearance
8. Inadequate roll back of bead

Butt Fusion of Pipe

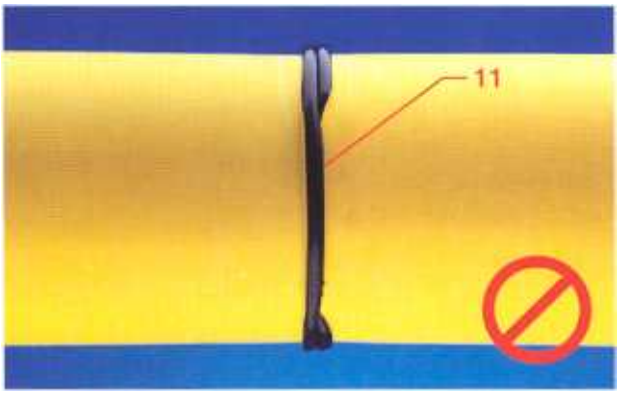
Unacceptable Appearance: Improper Alignment



9. Inadequate roll back of bead due to improper alignment
10. "High-low" condition

Butt Fusion of Pipe

Unacceptable Appearance: Incomplete Face Off



11. No melt bead caused by incomplete face off

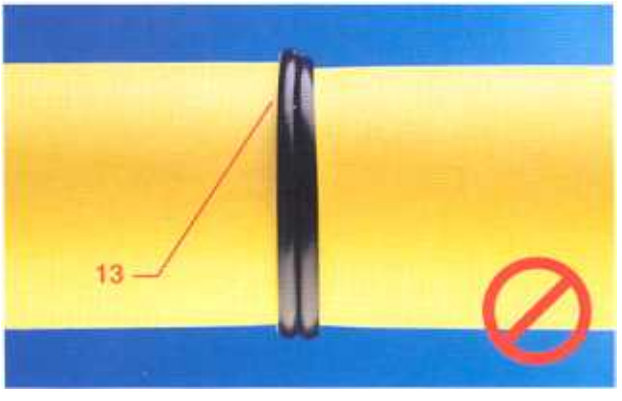
Butt Fusion of Pipe

Unacceptable Appearance: Cold Joint

12. Pressure during heat soak

Butt Fusion of Tubing

Unacceptable Appearance



13. Excessive melt, improper alignment and/or excessive pressure

Sidewall Fusion Procedure

1. Install fusion machine on the pipe (main).
2. Clean the pipe with a clean cotton cloth. Prepare surface of pipe by roughing with 60 grit or coarser utility cloth.
3. Prepare saddle base of tee (side fitting) by cleaning and roughing with 60 grit or coarser utility cloth.
4. Align fitting on main and tighten clamp (insert adapter) on fitting stem while applying slight pressure on movable clamp handle.
5. Check saddle base for square alignment on main.
6. Clean face of heater adapters with a clean cotton cloth. Raise movable clamp with fitting. Roll in and center heater plate with adapter between base of fitting and main.
7. Apply a strong, firm, continuous pressure until complete melt can be seen on main. Release pressure to light pressure. Continue heat soak cycle on fitting and main. Watch base of fitting for melt:

Main Size	Heat Soak Cycle Fitting Base Bead Size
1 1/4" & smaller	1/16" Melt Flow
2"	1/8" Melt Flow
3"	3/16" Melt Flow
4" or larger	3/16" – 1/4" Melt Flow

8. Raise movable clamp and cleanly remove heater plate.
9. Bring melted surfaces together rapidly. *DO NOT SLAM*, apply continuous progressive pressure until proper fusion bead is formed. Maintain pressure until joint has cooled (until finger can remain comfortably on bead).

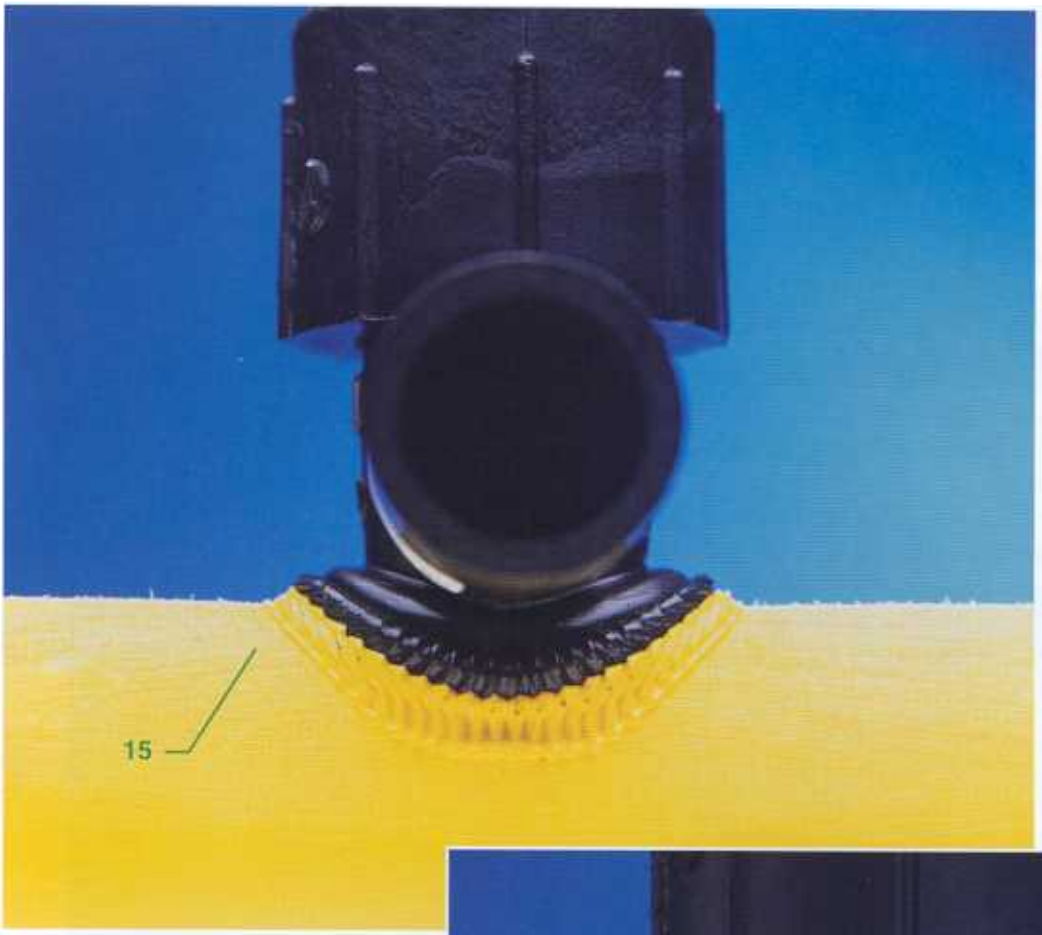
Sidewall Fusion

1 1/4 Inch Pipe: Acceptable Appearance

1. Proper melt, pressure and alignment. Note black on yellow appearance using serrated heater plates.

Sidewall Fusion

2 Inch or Larger Pipe: Acceptable Appearance



15. Proper pipe surface preparation
16. Proper melt, pressure and alignment

Sidewall Fusion

2 Inch or Larger Pipe: Acceptable Appearance

17. Proper pipe surface preparation
18. Proper melt, pressure and alignment
19. Acceptable pipe to fitting fusion joint

Sidewall Fusion

Acceptable Appearance

20. Proper melt, pressure and alignment
21. No gaps or voids

Sidewall Fusion

1 1/4 Inch Pipe: Unacceptable Appearance: Insufficient Melt

Sidewall Fusion

2 Inch or Larger Pipe: Unacceptable Appearance: Misaligned

22. Melt bead too small and insufficient fusion pressure
23. Misaligned fitting, third bead covered over

Sidewall Fusion

2 Inch or Larger Pipe: Unacceptable Appearance: Excessive Melt and Pressure

24. Melt bead is above base of fitting
25. Incomplete pipe surface preparation

Fusion Parameters

Acceptable fusion joints depend on visual verification of adequate melt and pressure parameters as outlined in the Driscopipe procedure. The following force gauge readings and heat soak time cycles are suggested to obtain the optimum sidewall fusion.

After the melt pattern is established, the pressure should be reduced to "0" during the heat soak time cycle. After the joint is made, the fusion pressure ranges listed should be maintained until the joint has solidified with the fusion unit left in place until the joint has cooled thoroughly. The pressure shown is actual pressure. To obtain the gauge pressure, contact the fusion unit manufacturer.

Remember

Install proper sidewall and fitting inserts in fusion unit for the pipe and fittings being joined.

Be sure correct sidewall adapters are installed on heater plate.

A quality side fusion joint has a uniform, well-aligned appearance all around and is made in accordance with this procedure.

Heater plate should be checked periodically with a tempilstik or pyrometer for correct surface temperature (475 – 500°F).

Heating Time Cycles for Driscopipe® 8100 Pipe*

Main Size (inches)	Pressure to Establish Melt Pattern (psi)	Heat Soak Time (sec)	Fusion Pressure (psi)
Driscopipe® 8100 – Standard Base 1" IPS Outlet or below Tapping Tee			
1 1/4	200 – 225	7 – 12	100 – 120
2	225 – 250	10 – 20	120 – 140
3	250 – 275	15 – 30	140 – 160
4	275 – 300	20 – 35	150 – 175
6	300 – 325	20 – 40	170 – 190
8	300 – 325	25 – 45	180 – 200
Driscopipe® 8100 – Large Base 1" IPS Outlet or below Tapping Tee			
2	420 – 460	15 – 25	420 – 460
3	510 – 560	25 – 40	510 – 560
4	560 – 610	35 – 55	560 – 610
6	610 – 660	45 – 70	610 – 660
8	660 – 700	55 – 85	660 – 700
Driscopipe® 8100 – 1 1/4" IPS Outlet Tapping Tee			
2	390 – 430	15 – 25	390 – 430
3	420 – 460	30 – 50	420 – 460
4	460 – 500	45 – 70	460 – 500
6	500 – 530	50 – 80	500 – 530
8	530 – 570	60 – 90	530 – 570
Driscopipe® 8100 – 2" IPS Outlet Tapping Tee			
2	250 – 275	15 – 25	250 – 275
3	275 – 300	50 – 70	275 – 300
4	300 – 325	80 – 120	300 – 325
6	350 – 400	140 – 180	350 – 400
8	400 – 450	200 – 240	400 – 450
Driscopipe® 8100 – Large Base 2" IPS Outlet Tapping Tee			
2	375 – 425	20 – 30	375 – 425
3	400 – 450	90 – 120	400 – 450
4	400 – 500	170 – 200	400 – 500
6	500 – 600	230 – 250	500 – 600
8	800 – 900	240 – 300	800 – 900

* Heating time cycles are to be used as a guide only. The actual time required to develop adequate melt for joining will depend on temperature and wind conditions. Acceptable visual indications of adequate melt are required regardless of the timing cycle indicated.

Sidewall Fusion Qualification Procedure

1. Observe the joining process to determine that the proper procedure is being followed.
2. Visually inspect the joint and compare it to a sample or picture of an acceptable joint.
3. Allow the joint to cool for at least one hour.
4. Cut the sample through the joint area, lengthwise of the pipe, into at least three straps.
5. Visually inspect the cut surface of the pipe wall at the joint for voids or unbonded areas.
6. Bend the sample 180°.
7. If flaws are observed in the joint, compare the appearance with pictures of poor joints, recheck the procedure and make another joint.

Heating Time Cycles for Driscopipe® 8100 Pipe (continued)

Nominal Size (in) Main x Branch	Pressure to Establish Melt Pattern (psi)	Heat Soak Time (sec)	Fusion Pressure (psi)
Driscopipe® 8100 – Branch Saddles			
2 x 2	280 – 315	15 – 25	280 – 315
3 x 2	295 – 325	30 – 50	295 – 325
4 x 2	320 – 350	50 – 70	320 – 350
6 x 2	350 – 380	80 – 100	350 – 380
8 x 2	375 – 410	90 – 120	375 – 410
10 x 2	375 – 410	90 – 120	375 – 410
12 x 2	375 – 410	90 – 120	375 – 410
4 x 3	700 – 765	60 – 90	700 – 765
6 x 3	760 – 825	90 – 120	760 – 825
8 x 3	820 – 900	120 – 180	820 – 900
10 x 3	820 – 900	120 – 180	820 – 900
12 x 3	820 – 900	120 – 180	820 – 900
6 x 4	1275 – 1375	120 – 180	1275 – 1375
8 x 4	1375 – 1475	180 – 240	1375 – 1475
10 x 4	1375 – 1475	180 – 240	1375 – 1475
12 x 4	1375 – 1475	180 – 240	1375 – 1475
8 x 6	2925 – 3150	210 – 270	2925 – 3150
10 x 6	2925 – 3150	210 – 270	2925 – 3150
12 x 6	2925 – 3150	210 – 270	2925 – 3150
10 x 8	2925 – 3150	210 – 270	2925 – 3150
12 x 8	2925 – 3150	210 – 270	2925 – 3150

§192.283 Plastic Pipe; Qualifying Joining Procedures

(a) *Heat Fusion, Solvent Cement and Adhesive Joints.* Before any written procedure established under §192.273(b) is used for making plastic pipe joints by a heat fusion, solvent cement, or adhesive method, the procedure must be qualified by subjecting specimen joints, made according to the procedure, to the following tests:

(1) The burst test requirements of –

(i) In the case of thermoplastic pipe, paragraph 8.6 (Sustained Pressure Test) or paragraph 8.7 (Minimum Hydrostatic Burst Pressure) of ASTM D2513; or

(ii) In the case of thermosetting plastic pipe, paragraph 8.5 (Minimum Hydrostatic Burst Pressure) or paragraph 8.9 (Sustained Static Pressure Test) of ASTM D2517;

(2) For procedures intended for lateral pipe connections, subject a specimen joint made from pipe sections joined at right angles according to the procedure to a force on the lateral pipe until failure occurs in the specimen. If failure initiates outside the joint area, the procedure qualifies for use; and

(3) For procedures intended for nonlateral pipe connections, follow the tensile test requirements of ASTM D638, except that the test may be conducted at ambient temperature and humidity. If the specimen elongates no less than 25 percent or failure initiates outside the joint area, the procedure qualifies for use.

(b) *Mechanical Joints.* Before any written procedure established under §192.273(b) is used for making mechanical plastic pipe joints that are designed to withstand tensile forces, the procedure must be qualified by subjecting five specimen joints, made according to the procedure to the following tensile test:

(1) Use an apparatus for the test as specified in ASTM D638-77a (except for conditioning).

(2) The specimen must be such length that the distance between the grips of the apparatus and the end of the stiffener does not affect the joint strength.

(3) The speed of testing is 5.0 mm (0.20 in) per minute, plus or minus 25 percent.

(4) Pipe specimens less than 102 mm (4 in) in diameter are qualified if the pipe yields to an elongation of no less than 25 percent or failure initiates outside the joint area.

(5) Pipe specimens 102 mm (4 in) and larger in diameter shall be pulled until the pipe is subjected to a tensile stress equal to or greater than the maximum thermal stress that would be produced by a temperature change of 55°C (100°F) or until the pipe is pulled from the fitting. If the pipe pulls from the fitting, the lowest value of the five test results or the manufacturer's rating, whichever is lower must be used in the design calculations for stress.

(6) Each specimen that fails at the grips must be retested using new pipe.

(7) Results obtained pertain only to the specific outside diameter, and material of the pipe tested, except that testing of a heavier wall pipe may be used to qualify pipe of the same material but with a lesser wall thickness.

(c) A copy of each written procedure being used for joining plastic pipe must be available to the persons making and inspecting joints.

(d) Pipe or fittings manufactured before July 1, 1980, may be used in accordance with procedures that the manufacturer certifies will produce a joint as strong as the pipe.

[Amdt. 192-34A, 45 FR 9935, Feb. 14, 1980, as amended by Amdt. 192-34B, 46 FR 39, Jan. 2, 1981; 47 FR 32720, July 29, 1982; 47 FR 49973, Nov. 4, 1982]

§192.285 Plastic Pipe; Qualifying Persons to Make Joints

(a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by:

(1) Appropriate training or experience in the use of the procedure; and

(2) Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in paragraph (b) of this section.

(b) The specimen joint must be:

(1) Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and

(2) In the case of heat fusion, solvent cement, or adhesive joint:

(i) Tested under any one of the test methods listed under §192.283(a) applicable to the type of joint and material being tested;

(ii) Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or

(iii) Cut into at least three longitudinal straps, each of which is:

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

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

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

(1) Does not make any joints under that procedure; or

(2) Has three joints or three percent of the joints made, whichever is greater, under that procedure that are found unacceptable by testing under §192.513.

(d) Each operator shall establish a method to determine that each person making joints in plastic pipelines in his system is qualified in accordance with this section.

[Amdt. 192-34A, 45 FR 9935, Feb. 14, 1980, as amended by Amdt. 192-34B, 46 FR 39, Jan. 2, 1981]

§192.287 Plastic Pipe; Inspection of Joints

No person may carry out the inspection of joints in plastic pipes required by §§192.273(c) and 192.285(b) unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

[Amdt. 192-34, 44 FR 42974, July 23, 1979]

§192.513 Test Requirements for Plastic Pipelines

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 psig, whichever is greater. However, the maximum test pressure may not be more than two times the design pressure of the pipe.

(d) The temperature of thermoplastic material must not be more than 100°F during the test.

Note:

Title 49 CFR §192.285 has been amended and along with §192.287 has an effective date of April 1, 1988. Title 49 CFR §192.512 is also quoted and is presently effective.