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SPECIFICATION: **G-8123-22a**

TITLE: **HEAT FUSION JOINING OF POLYETHYLENE (PE) PLASTIC PIPE/TUBING AND FITTINGS FOR GAS MAINS AND SERVICES**

VOLUME: **2 (Section 7.0), 10, and Yellow Book**

COURSE ID: **GAS0452**

REQUIRED TRAINING GROUP: **Gas Construction, Emergency Response Force (ERF), Gas Development Lab, Per Diem, Gas Contractors, Gas Quality Control, TLC, Construction Management-Gas, Construction Services**

Each group listed is responsible for its own training which may be specific to a title/individual and not to the group in its entirety. Please check with your local training coordinator/department

Applicable Bulletins

B-24-14 – NGA 2025 Butt Fusion and Electrofusion Update

Administrative Revisions

Rev 22a (1/6/2025)

Cover Page	Added in the “Applicable Bulletins” box and added reference to Bulletin B-24-14.

SUBSTANTIVE REVISIONS: (See ★)

1) Section 5.0 - **Removed TR-33**"Generic Butt Fusion Joining Procedure fo Field Joining of Polyethylene Pipe" and **TR-41**"Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping," **and replaced with** GTI Project No. 23372.1.18, Qualification of Pipe Joining Procedures per 49 CFR 192.283.

2) Section 4.2 - **Removed "**visually acceptable butt fusion joints" **and replaced with** "the visual inspection acceptance guideline"

3) Section 7.2 - **Removed "**. See Appendix A of the Operation of Fusion Equipment" **and reworded** section.

4) Section 7.4 - **Removed** "found hydraulic chart pressures found in the Appendices" **and reworded** last sentence

5) Section 8.3 - **Removed "** . See Appendix B of the Operation of Fusion Equipment for**" and reworded** section

6) Section 12.0 - **Referenced** ASTM F2620-19 **and removed** ASTM F2620-13

Gas Operations Standards

TITLE: HEAT FUSION JOINING OF POLYETHYLENE (PE) PLASTIC PIPE/TUBING AND FITTINGS FOR GAS MAINS AND SERVICES

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TITLE: HEAT FUSION JOINING OF POLYETHYLENE (PE) PLASTIC PIPE/TUBING AND FITTINGS FOR GAS MAINS AND SERVICES

1.0 SCOPE

This specification details the requirements for heat fusion joining of polyethylene (PE) plastic pipe, tubing, and molded fittings for gas mains and services by butt fusion and branch saddle fusion.

See Gas Specification IP-27, “Installation of Electrofusion Fittings on Polyethylene (PE) Plastic Pipe/Tubing and Molded Fittings Using a Universal Electrofusion Processor” for the requirements to join PE plastic pipe, tubing, and molded fittings by electrofusion.

See Gas Specification IP-20, “Installation of Mechanical Fittings for Polyethylene (PE) Plastic Pipe and Tubing” for the requirements to join PE plastic pipe and tubing with mechanical fittings.

2.0 LEGAL REQUIREMENTS

Federal: 49 CFR Part 192, Sections 273, 281, 283, 285, and 287.

State: 16 NYCRR Part 255, Sections 273, 281, 283, 285, and 287.

National Safety Transportation Board (NTSB) Accident DCA14MP002, Safety Recommendations P-15-034 and P-15-035

3.0 OPERATOR QUALIFICATION

3.1 Span of Control means the ratio of nonqualified to qualified individuals allowed for a covered task to be performed. Nonqualified individual(s) may be directed and observed by a qualified individual when performing a single covered task.

The qualified individual must be able to effectively respond to errors or abnormal operating conditions that may occur during the performance of the task by the non-qualified individuals.

Tapping a pipeline, welding steel, and joining plastic pipe have a span of control of zero. Meaning, the Operator Qualified individual must perform the entire task. Certain other covered tasks also have a span of control of zero, and those are detailed in their applicable specifications and

the OQ Written Plan. All other covered tasks shall be completed by either Operator Qualified individuals or individuals under the direct observation of someone who is Operator Qualified. Direct observation means that the Operator Qualified individual remains in direct visual and verbal contact at all times with the individual performing the single covered task.

Both the nonqualified and qualified individuals should be identified on the applicable records being generated, for the work performed under span of control.

3.2 Installers who join PE plastic pipe/ tubing and fittings must be Operator Qualified **and** in compliance with the annual requalification requirements of Gas Specification G-8121 "Qualification of Joiners and Inspectors of Polyethylene (PE) Plastic Pipe/Tubing and Fittings for Gas Mains and Services."

A) All heat fusion joints must be fabricated in accordance with the fusion procedures outlined in this specification, the Northeast Gas Association (NGA) Plastic Pipe Joining Manual, and the manufacturers' operating manual for the approved heat fusion joining equipment. (See Sections 7.1 and 8.2)

B) All electrofusion joints must be fabricated in accordance with the fusion procedures outlined in IP-27, "Installation of Electrofusion Fittings on Polyethylene (PE) Plastic Pipe/ Tubing and Molded Fittings Using a Universal Electrofusion Processor."

C) All mechanical joints must be fabricated in accordance with the installation procedures outlined in Gas Specification IP-20, "Installation of Mechanical Fittings for Polyethylene (PE) Plastic Pipe and Tubing".

3.3 Second Inspectors of PE Plastic Joints

NOTE:	**Second Inspector is a third-party Company Qualified Contractor, or a non-crew based Qualified Company Management Employee.**

A) Second inspectors who inspect PE plastic pipe joints (heat fusion, electrofusion, or with mechanical fittings) shall be in compliance with the annual requalification stipulated in Gas Specification G-8121

4.0 REQUIREMENTS FOR INSTALLERS AND SECOND INSPECTORS

4.1 All installers (Company, Contractor, Per Diem) of heat fusion joints on PE plastic pipe, tubing, and molded fittings shall identify the installer by marking the plastic pipe, tubing, or fittings adjacent to the heat fusion joint at 12 o'clock (or as close to 12 o'clock as is possible) with a Company approved marker (e.g., PX-20 White Paint Marker (C/S # 024-7106) or Silver Sharpie).

A) Company installers shall clearly print "J" for joiner **AND** their five-digit employee number.

B) Contractor and Per Diem installers shall clearly print "J" for joiner **AND** their respective six digit Industrial Training Service (ITS) Operator Qualification identification number.

★ 4.2 After the heat fusion joints have cooled and solidified, the Operator Qualified installer **and** the Operator Qualified second inspector shall visually inspect all heat fusion joints around the entire circumference of the joint and compare against the visual inspection acceptance guideline given in the NGA Plastic Pipe Joining Manual.

A) Butt fusion joints should have uniform double fusion beads rolled over to the surface, be uniformly rounded, and consistent in size all around the joint. The PE plastic pipe, tubing, and fittings must be properly aligned (NOT angled or mitered).

NOTES:

When butt fusing to molded fittings, the fitting side bead may have an irregular appearance. This is acceptable provided the pipe side bead is correct.

This bead configuration DOES NOT apply to joints made with Dupont Aldyl A MDPE, Uponor Aldyl A MDPE or Phillips Driscopipe 7000 and 8000 HDPE.

B) Branch saddle fusion joints should have a characteristic three (3) bead shape and all beads should be uniformly sized all around the fitting base. The first bead (fitting base melt bead) and the third or center

bead (main pipe melt bead) should be about the same size all around the fitting base. The PE plastic pipe must be properly aligned.

4.3 All second inspectors (Company, Contractor) of heat fusion joints on PE plastic pipe, tubing, and molded fittings shall identify the second inspector by marking the plastic pipe, tubing, or fittings adjacent to the heat fusion joint at 12 o'clock (or as close to 12 o'clock as is possible) with a Company approved marker (e.g., PX-20 White Paint Marker (C/S # 024-7106) or Silver Sharpie).

A) Company second inspectors shall clearly print “P” for “Pass”, CE (for Con Edison), **AND** their five digit employee number.

B) Contractor second inspectors shall clearly print “P” for” Pass” **AND** their respective six digits ITS Operator Qualification identification number.

4.4 All PE plastic joints, joiners, and second inspectors shall be marked and documented as per DOJT GAS6006, “Documentation and Inspection of Polyethylene (PE) Plastic Joints on Gas Mains and Services.”

5.0 QUALIFICATION OF HEAT FUSION JOINING PROCEDURES

The heat fusion joining procedures outlined in this specification have been qualified in conjunction with:

★ • GTI Project No. 23372.1.18 Qualification of Pipe Joining Procedures per 49 CFR 192.283

• The NGA Plastic Pipe Joining Manual

• GT-14-048-1 Procedure for Qualifying Sidewall Plastic Pipe Joints

• GT-14-048-3A Procedure for Qualifying Manual Butt Fusion Plastic Pipe Joints

• GT-14-048-3B Procedure for Qualifying Hydraulic Butt Fusion Plastic Pipe Joints

6.0 GENERAL GUIDELINES

6.1 Prior to starting any task pursuant to this Specification, Con Edison employees should be familiar with Con Edison's Job Safety Analysis (JSA) library. Any Con Edison employee preparing a job briefing for any task to be accomplished pursuant to this Specification should review the JSA library to determine if there is a JSA applicable to the task. Any relevant JSA found in the library should be discussed during the job briefing for the task. This provision is applicable to Con Edison employees.

6.2 Where possible, heat fusion is preferred over electrofusion when joining pipe. (See Gas Specification IP-27)

When heat fusion or electrofusion is not practical or available, only approved restraining-type mechanical fittings shall be installed on PE plastic pipe and tubing per Gas Specification IP-20. All steel mechanical fittings shall be cathodically protected per Gas Specification G-8209, "Field Coating of Steel Pipe and Fittings Installed Underground and in Subsurface Structures."

6.3 All approved manual and hydraulic heat fusion joining equipment are for Dura-Line Polypipe GDB5, Performance Pipe 8300, JM Eagle UAC 3700, and ENDOT PE-100/PE-4710 high density PE pipe/tubing (PE 3408/4710).

See Operation of Fusion Equipment for approved heat fusion joining equipment.

See Gas Specification G-8104, "Polyethylene Pipe, Tubing, and Fittings for Gas Mains and Services" for approved PE plastic pipe, tubing, and fittings.

NOTES:

M8000 pipe was all black and replaced in 1997 with Performance Pipe 8100.

Performance Pipe 6800 is black with two thick yellow stripes at three different points on the pipe's surface.

Performance Pipe 8100 has a "yellow shell" around black pipe. This is the equivalent of Performance Pipe 8300 and JM Eagle (US Poly) UAC3700.

Performance Pipe 8300 is black with one thick yellow stripe at four different points on the pipe's surface and print line indicates PE 100. This is the equivalent of Performance Pipe 8100 and JM Eagle (US Poly) UAC 3700.

JM Eagle (US Poly) UAC3700 is black with one yellow stripe at three different points on the pipe's surface and the print line states PE100. This is the equivalent of Performance Pipe 8100 and 8300.

ENDOT EN PE 4710 (Gas) is black with one thin yellow stripe at three different points on the pipe's surface. This equivalent to Performance Pipe 8300 and JM Eagle (US Poly) UAC 3700.

Dura-Line Polypipe GDB50 is black with either one thin yellow stripe at three different points on the pipe's surface (similar to JM Eagle and ENDOT) or one yellow stripe at six different points on the pipe's surface.

6.4 Inspect PE plastic pipe, tubing, and fittings prior to installation to verify:

A) No cuts, gouges, deep scratches, or other defects.

B) PE plastic material is high density polyethylene (HDPE), PE3408/4710, and manufactured per ASTM D2513.

C) PE plastic material is NOT older than 10 years old.

(See Gas Specification G-8122, "Transportation, Handling, and Storage of Polyethylene Plastic Pipe/Tubing, and Fittings for Gas Mains and Services")

6.5 Quality fusion requires using all of the required tools and equipment and following all of the steps in the procedure in the correct sequence. Faulty fusion is caused by improper or defective equipment, or not following the procedure (omitting steps or performing steps out of sequence).

6.6 PE plastic molded fittings (without pup lengths) **can only** be joined to PE plastic pipe, tubing and other molded fittings by butt fusion, electrofusion, or MetFit fittings. (See Gas Specification G-8104 for approved fittings with pup lengths of PE plastic pipe or tubing). (See G-100,285 for approved MetFit fittings). With the exception of MetFit fittings, mechanical fittings **cannot** be installed directly onto a PE plastic molded fitting without pup lengths of pipe or tubing.

Install and inspect MetFit mechanical fittings as per manufacturer's procedures. Molded fittings shall **not** be altered in order to utilize MetFit fittings.

6.7 Heat fusion of PE plastic pipe, tubing, and fittings of different SDR wall thickness shall only be performed between **one change in SDR.**

SDR	7	⇔	9/ 9.3	⇔	11	⇔	13.5	⇔	15.5

Joining of PE plastic pipe, tubing, and fittings with SDR wall thickness **greater than one change in SDR** shall be electrofused. Approved restraining-type mechanical couplings may only be used for joining PE plastic pipe and tubing when an electrofusion coupling is unavailable. See Gas Specifications IP-20 and G-8209.

6.8 Table 1, Approved Joining Methods for PE Plastic Pipe/Tubing
(Note: this table does not apply to valves and other fittings)

PE Plastic Pipe Size	SDR	Vintage	Distribution Pressure[1]	Heat Fusion	Electrofusion	Mechanical Joint[2]
0.5" CTS	7	All	IP, MP, HP	YES	YES	YES stiffener = 0.090" WT
1"-1.25" CTS		All	LP, IP, MP, HP (1" ≤ 89 psi) HP (1.25" ≤ 71 psi)	YES	YES	YES stiffener = 0.090" WT
1" – 8", 12" IPS, 16" IPS	11	All	LP, IP, MP, HP	YES	YES	YES stiffener = black
1"-4" IPS	9.3	Pre-1990	LP, IP, MP, HP	YES	YES	YES stiffener = blue
Up to 4" IPS Aldyl-A	9.3	1970's	LP, IP, MP, HP (≤ 80 psi)	**NO**	YES	**NO**
All	26	2000's (Subcoil)[3]	LP	**NO**	NO	**NO**
6" IPS[4]	23.5	1970's	LP, IP, MP	**NO**	YES. IPEX-Friatec couplings only. No time reduction.	YES stiffener = orange
6" IPS[4]	26	1970's	LP, IP, MP	**NO**	YES. IPEX-Friatec couplings only. No time reduction.	**NO**
6" IPS[4]	26	>1970's Only as sleeve for Trenchless Technology	LP, IP, MP, HP	YES	YES. IPEX-Friatec couplings only. No time reduction.	**NO**
6" IPS[4]	32.5	1970's	LP, IP, MP	**NO**	YES. IPEX-Friatec couplings only. No time reduction.	**NO**
22.5" IPS Subline[3]	23.5	2000's	HP	**NO**	Contact the Gas Development Lab	**NO**

Notes:
1) LP = low pressure, IP = intermediate pressure, MP = medium pressure, HP = high pressure
2) MetFit coupling can be used to join any vintage of CTS tubing or SDR 11 pipe.
3) There are no methods to join to Subcoil/Subline pipe. Subline and Subcoil are liners that rely on partial structural properties of the host pipe.
4) SDR 23.5 / 26 / 32.5 is commonly known as thin-walled plastic pipe. Do not use electrofusion couplings other than IPEX-Friatec 6" PE with an SDR greater than 15.5. For electrofusion tee connection to thin-walled plastic pipe, contact Gas Development Lab
5) For other pipes not listed above, contact Gas Development Lab

6.9 It is important that the pipe is clean and dry before installing in the fusion machine to avoid contaminating fusion machine parts that contact the pipe, such as the heating iron or the facer. If the heating iron or facer becomes contaminated, the contamination may be transferred back to the pipe, possibly compromising fusion joint quality.

A) Clean the pipe outside diameter (OD), inside diameter (ID), and ends with a clean, dry, lint-free non-synthetic (e.g., cotton) cloth or paper towel (e.g., NS0209687)

If the contamination cannot be removed in this way, wash the pipe with water and a clean, lint-free, non-synthetic cloth/paper towel to remove the contamination. Then rinse the pipe with water and dry thoroughly with a clean, lint-free, non-synthetic cloth/paper towel. **Do NOT use soap water (leak detection solution) to clean the pipe.**

B) **Prior to installing the pipe in the fusion machine, the pipe shall be cleaned with 96% alcohol wipes** (Class/Stock # 689-3135 and 025-3724) **or 99.9% liquid isopropyl alcohol** (Class/Stock # 630-1246) **with a clean, lint-free, non-synthetic cloth/paper towel.** *Never use alcohol wipes after facing (for butt fusion) or after abrading with emery cloth (for branch saddle fusion).*

When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

C) If the pipe becomes contaminated after being placed in the fusion machine, remove the pipe and clean per Sections 6.9 (A) and (B). **Do NOT use the facer to remove contamination.**

6.10 All scrap PE plastic pipe, tubing, and/or fittings that cannot be reused, shall be brought back to the workout location for proper disposal/ recycling.

7.0 BUTT FUSION JOINING GUIDELINES

7.1 The Butt Fusion Joining Procedure in the NGA Plastic Pipe Joining Manual and the manufacturers' operating manual for the approved butt fusion joining equipment shall be followed.

★ 7.2 See the Operation of Fusion Equipment for approved manual and hydraulic butt fusion joining equipment.

7.3 PE plastic pipe shall not be joined by a field fabricated miter (angled) joint. Only use approved fabricated or molded fittings per Gas Specification G-8104.

★ 7.4 Whenever practical, no more than one length (40 feet) of PE plastic pipe (properly supported with rollers at 12' intervals) should be placed in the movable jaw of the fusion unit. If the first length (40') of PE plastic pipe is not properly supported **OR** if it becomes necessary to place more than one length of pipe in the movable jaw of the fusion unit, the hydraulic chart pressure must be increased by the **drag pressure** (force required to move the pipe once clamped in the machine) to compensate for the additional weight of the pipe material. A drag pressure of 30 psig was used to calculate the gauge pressures in the hydraulic chart pressures in Fusion Chart.

When fusing more than one length of PE plastic pipe in the moveable side of the carriage, the drag pressure above 30 psig must be added to the hydraulic chart pressure. **Use equations in the box below.**

The measured drag pressure is determined by clamping the pipe into the movable jaw, placing the travel control lever in the closed position, and slowly increasing the hydraulic pressure until the pipe **just** begins to move. This pressure on the hydraulic gauge is the measured drag pressure.

Drag Pressure = Measured drag pressure – 30 psig

Proper Fusion Pressure = Hydraulic Chart Pressure + Drag Pressure

NOTE:

To minimize drag pressure when placing more than one 40' length of PE plastic pipe in the movable jaw, properly support the pipe at 12’ intervals. If this is impractical (due to numerous lengths of plastic pipe extending from the movable jaw), then at approximately 60’ back from the movable jaw, "droop" the plastic pipe between the rollers.

The amount of "droop" is determined by the distance the movable jaw has to travel to bring the pipe ends together for fusion. Therefore, the movable jaw will only have to drag (or pull) the 60 feet plus the "droop" of the pipe between the rollers, thereby minimizing drag pressure.

7.5 When making the final tie-in to existing PE plastic pipe in the ground, use electrofusion coupling(s) to make the final tie-in, rather than trying to butt fuse in the excavation to make the final connection.

8.0 BRANCH SADDLE FUSION INSTALLATION GUIDELINES

8.1 Branch saddle fusion shall **only** be performed by the Development Lab.

8.2 The Saddle Fusion Joining Procedure in the NGA Plastic Pipe Joining Manual and the manufacturers’ operating manual for the approved branch saddle fusion joining equipment shall be followed.

★ 8.3 See the Operation of Fusion Equipment for approved branch saddle fusion joining equipment.

9.0 HEAT FUSION EQUIPMENT

9.1 All fusion equipment (i.e., butt and branch saddle fusion machines, heater irons/plates, electric facers, contact pyrometers,) shall be inspected by the Gas Development Lab prior to initial use and prior to the inspection due date (once every 12 months). Otherwise, the fusion equipment shall not be used.

9.2 Prior to performing heat fusion, the fusion equipment (i.e., fusion machines, heating tools, electric facers) shall be checked for damage and to verify they are in good working order. If any part of the fusion equipment is found to be damaged or defective, the equipment shall not be used.

9.3 Heating tool surfaces (i.e., heater iron/adapter plate) must be undamaged, clean, and at the correct surface temperature.

A) Prior to heating (when the heating tool is cold), the surfaces of the heater iron/adapter plates shall be **cleaned** to remove any plastic build-up or contaminants (e.g., dirt, grease).

1. To remove PE plastic pipe residue build-up on the heater iron/adapter plate surface, clean with a non-abrasive scotch pad (Class/Stock # 023-2181) and then wipe with a clean, dry, lint-free non-synthetic (e.g. cotton) cloth or paper towel (e.g. NS0209687).

2. To remove other contaminants on the iron/adapter, wipe the heater iron/adapter plate surface with a clean, dry, lint-free non-synthetic (e.g. cotton) cloth or paper towel (e.g. NS0209687).

B) When the thermometer on the heating tool reaches approximately 425° F, use a Company approved contact pyrometer (e.g. Cooper Atkins AquaTuff) to verify the heating iron surface temperature is within 400° - 450°F. See HOT GAS6027, “Use of Contact Pyrometers for Heat Fusion.”

1. To adjust the heater iron/adapter plate temperature, follow the manufacturers’ guidelines for adjusting heater temperature. Allow the heater iron/adapter plate to stabilize at the new temperature and recheck.

9.4 Heating irons and electric facers are **not** intrinsically safe and should not be used in a hazardous environment.

9.5 In order to prevent damage to the fusion equipment, it is important that the electrical power service and extension wires are properly sized for each unit.

10.0 HEAT FUSION DURING COLD AND/OR INCLEMENT WEATHER

10.1 Heat fusion during cold and/or inclement weather is permitted provided the following are observed:

A) Temperatures below 40°F

1. The specified heating tool surface temperature shall be maintained. **Do NOT increase heating tool surface temperature.**
2. Store heating iron in thermally insulated protective box or bag.
3. Pipe and fittings should be about the same temperature when they are fused together.

B) During inclement weather (rain or snow)

1. Store heater iron in protective box.
2. The pipe must clean and dry before, during, and after heat (butt or branch saddle) fusion or electrofusion.
3. Approved fire resistant tents (Class/Stock # 689-3929, 10’ x 8’ or Class/Stock # 659-3945, 6’ x 6’) shall only be used to protect the PE plastic pipe at the point of joining during inclement weather and shall **not** be used when there is escaping gas. **Gas must be allowed to rise and vent unobstructed.**

11.0 RECORDS

Any records generated in the course of performing work in accordance with this specification shall be maintained as required by Corporate Instruction CI-870-1 “Records Management”. Guidance on the retention of Company Gas Operations records can also be found on the Records Management intranet site.

12.0 REFERENCES

★ ASTM F2620-19 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

GAS6006 Documentation and Inspection of Polyethylene (PE) Plastic Joints on Gas Mains and Services

GAS6027 Use of Contact Pyrometers for Heat Fusion

G-8104 Polyethylene Pipe, Tubing and Fittings for Gas Mains and Services

G-8121 Qualification of Joiners and Inspectors of Polyethylene (PE) Plastic Pipe/Tubing and Fittings for Gas Mains and Services

G-8122 Inspection, Handling, Storage, and Transportation of Polyethylene (PE) Plastic Pipe, Tubing, and Fittings for Gas Mains and Services

G-8209 Field Coating of Steel Pipe and Fittings Installed Underground and in Subsurface Structures

IP-20 Installation of Mechanical Fittings for Polyethylene (PE) Plastic Pipe and Tubing

IP-27 Installation of Electrofusion Fittings on Polyethylene (PE) Plastic Pipe/Tubing and Molded Fittings Using a Universal Electrofusion Processor

Northeast Gas Association (NGA) Plastic Pipe Joining Manual

Con Edison Operation of Fusion Equipment

★ GTI Project No. 23372.1.18 Qualification of Pipe Joining Procedures per 49 CFR 192.283

GT-14-048-1 Procedure for Qualifying Sidewall Plastic Pipe Joints

GT-14-048-3A Procedure for Qualifying Manual Butt Fusion Plastic Pipe Joints

GT-14-048-3B Procedure for Qualifying Hydraulic Butt Fusion Plastic Pipe Joints