

FUSION QUALIFICATION REQUIREMENTS FOR POLYETHYLENE NATURAL GAS DISTRIBUTION PRESSURE PIPES AND FITTINGS

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FOREWORD

This technical note was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute (PPI). These members have shown their commitment to developing and improving quality products by assisting standards development organizations in the development of standards, and also by developing design aids and reports to help engineers, code officials, specifying groups, contractors and users.

The purpose of this document is to establish a standardized minimum testing protocol for demonstrating the fusion compatibility of a stress-rated PE compounds and is applicable to resin and pipe/fitting manufacturers. The protocol is based on the extensive work to demonstrate the fusion compatibility of stress-rated compounds detailed in PPI TR-33. This document establishes a common protocol to facilitate data acceptance by the gas distribution industry utilizing fused PE pipe.

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FUSION QUALIFICATION REQUIREMENTS FOR POLYETHYLENE NATURAL GAS DISTRIBUTION PRESSURE PIPES AND FITTINGS

1.0 Introduction, Purpose and Scope

This document provides PPI's protocol for testing to demonstrate the fusion capabilities of natural gas distribution pressure pipe and fittings made from stress-rated PE compounds (see Note 1) when using fusion procedures that conform to ASTM F2620ⁱ or F3565ⁱⁱ.

This protocol is limited to fusion procedures conforming to the Socket Fusion, Butt Fusion, or Saddle Fusion sections of ASTM F2620. For electrofusion fittings, this protocol is limited to fusion procedures conforming to ASTM F3565 and relies upon ASTM F1055ⁱⁱⁱ as the basis to verify their fusion compatibility. The testing requirements of the protocol are based on Code^{iv} requirements for fusion procedure qualification modified per best practices as determined by PPI members. References are made herein to natural gas distribution requirements (e.g., 49CFR192^{iv} and ASTM D2513^v). Code requirements are shown in Appendix A.

Note 1: Wherever reference is made to a PE compound in this document reference is being made to stress-rated PE compounds rated in accordance with PPI TR-3^{vi} and listed in PPI TR-4^{vii}.

Note 2: Appendix B provides a template that manufacturers may use to communicate compliance with the requirements of this protocol.

This protocol does not apply to other fusion procedures and does not address operator qualifications that may be required by federal code. This document does not provide guidance on the qualification of fusion procedures. Non-ASTM F2620 or non-F3565 procedures may require additional testing beyond the scope of this document.

PPI members representing PE compound, pipe, and fitting manufacturers worked together to form this document outlining the responsible party, the testing methodology, and the testing frequency to demonstrate the fusion compatibility of their products.

The focus of this document is pipe and fittings made to the following ASTM standards as incorporated by reference in the Code:

- ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings. ASTM D2513 references the following standards:
 - ASTM D2683^{viii} - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

- ASTM D3261^{ix} - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

1.1. Excluded Compounds

This document does not apply to products such as Aldyl® “A” MDPE pipe and Driscopipe® Series 7000 and 8000 HDPE pipe.

1.2. Fabricated Fittings

Fittings fabricated and tested in accordance with ASTM F2206^x using pipe qualified per the requirements of this document are not required to perform testing per this document.

2.0 Rationale for Test Program to Demonstrate Ability to Fuse

The ability to fuse PE components (i.e., pipe or fittings) is primarily a function of the PE compound and the fusion procedure used. Therefore, the PE compound manufacturer needs to confirm its compounds can be heat fused using a given fusion procedure. It is secondarily a function of the pipe and fitting manufacturing process. Therefore, pipe and fitting manufacturers need to confirm the products they produce with these PE compounds will heat fuse. Pipe and fitting manufacturers demonstrate this through destructive testing of their products.

Note 3: For the purposes of this document, the PE compound manufacturer is the party that formulates and qualifies the stress-rated compound and holds a PPI TR-4 independent listing. Manufacturers of pipe or fittings that conduct in-line compounding are not considered compound manufacturers (i.e., PPI TR-4 dependent listing owners).

Section 4.0 of this document details the protocol for testing based on the extensive work published in PPI TR-33^{xi}. TR-33 confirmed commercial PE compounds extruded into pipe can be fused to itself (self-fusions) and to other compounds (cross-fusions). Additional work completed in PPI TR-41^{xii} on saddle fusion fittings also established the ability to self-fuse and cross-fuse PE compounds. Fusions made in the development of TR-41 used methodology later incorporated into ASTM F2620 and demonstrated the successful cross-fusion of PE compounds. The PE compounds evaluated in TR-33 and TR-41 had ASTM D3350^{xiii} melt index cell classification values of:

- ‘3’ (<0.40 to 0.15 g/10 min.), or
- ‘4’ (<0.15 g/10 min., and a melt flow rate 190°C/21.6 kg of 4 – 20 g/10 min.)

The investigative work underpinning TR-33 and TR-41 demonstrated that PE compounds with melt index within the range of cell class ‘3’ and ‘4’ can be successfully fused. This conclusion, formed from the TR-33 and TR-41 testing, provides the basis for the recommendations in this document.

The evaluation protocol here-in is solely intended to evaluate the fusion compatibility between piping system components and is not a measure of the quality or design of the components. The quality of PE compounds and resulting components is presumed to meet the applicable quality requirements of industry standards and the manufacturer's quality control program.

3.0 Terminology

The following terminology is used in this document:

- Compound: a specific formulation of PE base material containing all necessary ingredients (e.g., pigment, additives) for the end-use application and which is stress-rated per PPI TR-3 and as listed in PPI TR-4 (public or private listing)
- Self-fusion: The fusion of the same compound to itself
- Cross-fusion: The fusion of a compound to a different compound

4.0 When Testing is Required

This section details when testing is required by the PE compound manufacturer, the pipe manufacturer, or the fitting manufacturer. Most of the testing is done by the PPI TR-4 independent listing holder (typically the resin company) as that entity formulated and approved the black or colored compound for extrusion. Note that these required tests are part of PPI's protocol and incorporate some of the Code requirements in Appendix A.

4.1. PE Compound Manufacturer

The PE compound manufacturer must demonstrate that the PPI TR-4 independent listed compound is fusible through testing of heat fused pipe joints made in accordance with Procedure 2 - *Butt Fusion* of ASTM F2620. This protocol does not apply to procedures other than ASTM F2620.

When a change to the PE compound requires the development of sustained pressure data (PPI TR-3, part F.6.2 *Other Modifications*), then a demonstration of fusion capability for the changed PE compound is required.

Demonstration of cross-compound fusion is not required (see Section 2.0) when the PE compound has an ASTM D3350 melt index cell classification value of '3' or '4'.

Note 4: A change in nomenclature (company name, grade name) does not require a re-demonstration of the ability to fuse. It is recommended that the nomenclature change be documented and attached to the original documentation demonstrating fusion compatibility for the compound.

The testing required for new and changed PE compounds is provided in Table 1.