



Designation: F 2145 – 01

An American National Standard

Standard Specification for Polyamide 11 (PA 11) Mechanical Fittings for Use on Outside Diameter Controlled Polyamide 11 Pipe and Tubing¹

This standard is issued under the fixed designation F 2145; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification describes requirements and test methods for the qualification of Polyamide 11 (PA 11) bodied mechanical fittings for use with outside diameter controlled Polyamide 11 (PA 11) pipe, nominal 2 pipe size (IPS), and smaller complying with Specification D 2513. In addition, it specifies general requirements of the material from which these fittings are made.

1.2 The test methods described in this specification are not intended to be used as routine quality tests.

1.3 This specification covers the types of mechanical fittings covered in 3.2.1.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

1.6 The text of this specification references notes and footnotes, which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this specification.

2. Referenced Documents

2.1 ASTM Standards:

- D 638 Test Method for Tensile Properties of Plastics²
- D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure³
- D 1600 Terminology for Abbreviated Terms Relating to Plastics²
- D 2513 Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings³

D 2837 Test Method for Obtaining Hydrostatic Design Basics for Thermoplastic Pipe Materials³

F 412 Terminology Relating to Plastic Piping Systems³

F 1588 Test Method for Constant Tensile Load Joint Test (CTLJT)³

2.2 ASME Standard:

ASME B31.8 Gas Transmission and Distribution Piping Systems⁴

2.3 Federal Standard:

CFR, Title 49, Part 192 Pipeline Safety Regulations⁵

2.4 Plastic Pipe Institute Standard:

PPI TR-4 PPI Listing of Hydrostatic Design Bases (HDB), Pressure Design Bases (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe⁶

3. Terminology

3.1 *Definitions*—Definitions of the terms used in this specification are in accordance with Terminology F 412 unless otherwise specified. Abbreviations are in accordance with Terminology D 1600 unless otherwise specified.

3.1.1 The Gas Industry Terminology is in accordance with ASME B31.8 or CFR, Title 49, Part 192 unless otherwise specified.

3.1.2 The term “pipe” refers to both “pipe” and “tubing”. The term “fitting” refers to a mechanical connecting device as described in 3.1.4 and 3.1.6.

3.1.3 *joint, n*—the location at which two pieces of pipe and a fitting are connected together. For example, an installed coupling has two joints.

3.1.4 *joint, mechanical, n*—a connection between piping components and employing physical force to develop a seal or produce alignment.

3.1.5 *long-term-strength (LTS), n*—the estimated tensile stress that when applied continuously will cause failure at

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.10 on Fittings. Current edition approved Oct. 10, 2001. Published December 2001.

² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 08.04.

⁴ Available from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

⁵ Available from Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402.

⁶ Available from Plastic Pipe Institute, 1825 Connecticut Ave., NW Suite 680, Washington D.C. 20009.

100 000 h. This is the intercept of the stress regression line with the 100 000 h coordinate.

3.1.6 *mechanical fitting, n*—fitting for making a mechanical joint to provide for pressure integrity, leak tightness, and resistance to end loads.

3.1.6.1 *category 1 mechanical fitting, n*—fitting for assembling pipes, which includes a compression zone to provide for pressure integrity, leak tightness, and resistance to end loads sufficient to cause no less than 25 % elongation of the PA11 piping as described in this specification.

3.1.7 *MAOP, n*—The Maximum Allowable Operating Pressure of the fuel gas piping system in psig as determined in accordance with CFR, Title 49, Part 192 and as represented in the following:

$$MAOP = P = 2 \times S / (DR - 1) \times f_D \quad (1)$$

where:

S = the PA 11 material's HDB as published in PPI TR-4,

DR = the pipe's dimension ratio determined by dividing the pipe's specified nominal outside diameter by the pipe's specified wall thickness; and,

f_D = the design factor for thermoplastic fuel gas piping as set by the authority having jurisdiction. In the United States, the design factor is cited in CFR, Title 49, Part 192.121.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 Types of Mechanical Fittings:

3.2.2 *in-line fitting, n*—mechanical fitting used to make a mechanical joint where the bore axis of compression and sealing zones of the fitting is essentially the same as the connected pipe, for example, couplings, ells, and tees.

3.2.3 *mechanical saddle fitting, n*—mechanical fitting used to make a mechanical joint that allows a lateral connection to an exiting main in which a portion of the fitting is contoured to match the O.D. of the pipe to which it is attached. Herein referred to as the *saddle fitting mating pipe* or *main pipe size*.

4. Materials and Manufacture Requirements

4.1 Polyamide 11 (PA 11) pressure containing materials subject to continuous stress, either hoop or axial, shall meet the requirements of Specification D 2513, Annex A5, have an ASTM material specification, and the materials long-term strength, such as the long-term hydrostatic strength, determined in accordance with Test Method D 2837, excepting that failure data can be obtained from specimens such as the following: tensile bars, plane strain, or actual fitting samples.

4.2 The physical properties of the PA 11 material used to produce the fitting shall be available from the fitting manufacturer upon request.

4.3 Specifications outlining all the physical properties and effects of environmental conditions for the PA 11 material used to produce the fitting shall be available from the fitting manufacturer upon request.

NOTE 1—Materials in long term contact with natural gas of line quality and LP gas vapor should be demonstrated not to adversely affect the performance of the fitting.

NOTE 2—Materials should have demonstrated resistance to environmental stress cracking when exposed, under stress to chemical compounds encountered in, or external gas piping systems, and a demonstrated

resistance to bacteriological decomposition. Such compounds include ice thawing chemicals, fertilizers, insecticides, herbicides, leak detection fluids, acids, bases, and, antifreeze solutions used to thaw frozen lines. The effects of liquid environments such as antifreeze agents, odorants, and hydrocarbons are known to be deleterious to some plastics, particularly under service conditions.

5. Dimensions

5.1 The dimensions and tolerance shall be determined by the manufacturer.

6. Qualification Requirements

6.1 *General*—Unless otherwise specified, each nominal size of fitting shall be tested. Testing of the thickest wall pipe that the fitting is designed to be used with qualifies it with use of lesser wall thickness.

6.1.1 Mechanical joint qualifications shall be performed on assembled joints using the fitting manufacturers joining procedure. All mechanical fitting offered by the manufacturer shall be capable of meeting the requirements of this standard when connecting Polyamide 11 gas piping complying with Specification D 2513. To verify the structural integrity of the fitting body, representative samples shall be subjected to the requirements of 6.2.1. It is not the intent of the specification to require testing of all fitting configurations, that is, tees, ells, etc., but each mechanical joint design in each size.

6.1.2 All mechanical fitting described in 3.2.1 shall have an internal pipe reinforcing tubular insert stiffener that extends at least under the seal and gripping device, where used. The saddle portion of saddle-type fittings do not require an internal tubular stiffener due to the nature of the connection.

6.2 Performance Requirements:

6.2.1 *Elevated Temperature Sustained Pressure*—The fitting joint or pipe in the area affected by the fitting shall not fail as defined in Test Method D 1598, when tested in accordance with 7.2. The fitting or joint meets this requirement when tested in accordance with any one of the two conditions (A or B) listed in 7.2.

6.2.2 *Tensile Strength*—The pipe joint shall accommodate the tensile loading when tested in accordance with 7.3.

6.2.2.1 *In-Line Fitting, Category 1*—The joint shall provide resistance to a force on the pipe equal to or greater than that which will cause no less than 25 % elongation of pipe, or the pipe fails outside the joint area when tested in accordance with 7.3.

6.2.2.2 *Mechanical Saddle Fittings*—The joint between the saddle and mating pipe shall not fail by rotation or leakage when tested in accordance with 7.5.

6.2.2.3 Joint restrain capabilities less than as defined above shall constitute failure of the test.

6.2.3 *Temperature Cycling Test*—The mechanical joint shall provide a pressure seal after 10 cycles of the temperature cycling test when tested in accordance with 7.4.

6.2.4 *Constant Tensile Load Joint Test*—The joint shall not fail leakage or pullout when loaded to an axial tensile stress of 1320 psi (9.1 Mpa) and tested in accordance with 7.5.

7. Test Methods

7.1 *General*—The test methods of the specification covers the mechanical joint designs. Test methods that are applicable