Designation: F1973 – 13ε1

Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems[1]

This standard is issued under the fixed designation F1973; 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.

ε[1] NOTE—7.4.3 was editorially revised in October 2013.

1. Scope*

1.1 This specification covers requirements and test methods for the qualification of factory assembled anodeless risers and transition fittings, for use in polyethylene (PE), in sizes through NPS 8, and Polyamide 11 (PA11) and Polyamide 12 (PA12), in sizes through NPS 6, gas distribution systems.

1.2 The test methods described are not intended to be routine quality control tests.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 Throughout this specification footnotes are provided for informational purposes and shall not be considered as requirements of this specification.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

NOTE 1—For over 40 years D2513 was the singular US CFR Title 49 Part 192 referenced Standard Specification codifying the installation and use of thermoplastic gas piping in jurisdictional installations. Initially all materials (PE, PVC, ABS, CAB) were contained within the body of the standard D2513. In later years D2513 was completely reformatted to make it more user friendly by moving material-specific requirements from the standard's body to mandatory annexes. The next major change occurred late in 2009 at which time all thermoplastic materials, except polyethylene, were removed from D2513 changing its Title and Scope from a thermoplastic gas piping standard to a polyethylene-only gas piping standard. This recent change required that new standards be developed for those materials that were removed from D2513 including PA11. This causes problems for PA11 piping because it has been referenced and permitted for jurisdictional use and installation under US CFR Title 49 Part 192 as complying with D2513 and D2513 no longer has the A5 polyamide annex and Part 192 still references D2513-99 which makes for potential confusion. This puts PA11 gas piping standards into somewhat of a limbo since D2513 is now a PE-only specification is referenced in all of these standards. Therefore until Part 192 is revised to reference the new PA11 specification, F2945, PA11 has to fall back to citing the US Code referenced 1999 edition of D2513 in related standard such as this one. Until CFR Title 49 Part 192 references the newly developed thermoplastic gas piping standards for those materials removed from D2513, there will be dual references, both D2513–99 and F2945 for PA11, as seen in this standard. At which time Part 192 references F2945, the PA11 gas piping standard, all references to D2513 and this note will be removed from these standards.

A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A513 Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

D638 Test Method for Tensile Properties of Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2513 Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

E515 Practice for Leaks Using Bubble Emission Techniques

F412 Terminology Relating to Plastic Piping Systems

F1588 Test Method for Constant Tensile Load Joint Test (CTLJT)

F2785 Specification for Polyamide 12 Gas Pressure Pipe, Tubing, and Fittings

F2897 Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components (Pipe, Tubing, Fittings, Valves, and Appurtenances)

F2945 Specification for Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings

2.2 *Federal Standard:*[3]

CFR Title 49 Part 192 Transportation of Natural and Other Gas By Pipeline: Minimum Federal Safety Standards

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.60 on Gas.

Current edition approved May 1, 2013. Published May 2013. Originally approved in 1999. Last previous edition approved in 2012 as F1973–12. DOI: 10.1520/F1973-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

***A Summary of Changes section appears at the end of this standard**

2.3 *ANSI Standards:*
ANSI B 31.8 Gas Transmission and Distribution Piping Systems[4]
ANSI/ASME B1.20.1 Pipe Threads, General Purpose (inch)[4]
ANSI B 16.5 Steel Pipe Flanges, Flanged Fittings[4]
2.4 *ASME Standard:*[5]
ASME Boiler and Pressure Vessel Code
2.5 *API Standard:*[6]
API 1104 Standard for Welding Pipelines and Related Facilities
2.6 *UL Standard:*[7]
UL 360 Flexible Metal Hose
2.7 *PPI Standard:*[8]
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 Pipe

3. Terminology

3.1 The gas industry terminology used in this specification is in accordance with ANSI B31.8 or the United States CFR 49 Part 192, unless otherwise indicated.

3.1.1 The term "pipe" used herein refers to both "pipe" and "tubing" unless specifically stated otherwise.

3.1.2 The term "gas" used herein refers to any fuel gas unless specifically stated otherwise.

3.2 *Definitions*—Definitions are in accordance with Definitions F412 unless otherwise specified. Abbreviations are in accordance with Abbreviations D1600 unless otherwise specified.

3.3 *Definitions:*

3.3.1 *anodeless flex riser casing*—a flexible, plastic coated, metallic, non-gas carrying, protective outer sleeve portion of an anodeless riser which is sometimes selected as an alternate to rigid riser casings.

3.3.2 *anodeless riser*—a type of transition fitting which is designed to transport gas from an underground polyethylene or polyamide 11 or polyamide 12 service line to above-ground steel piping. In an anodeless riser, the polyethylene or polyamide 11 or polyamide 12 pipe is always the gas carrier, at least, in the below ground section.

3.3.3 *anodeless riser, flex design*—an anodeless riser where the rise leg is a transition fitting which is fabricated to an anodeless flex riser casing which is field bent to form the base leg.

3.3.3.1 *Discussion*—Anodeless flex risers usually require a riser bracket attached to a rigid supporting member to avoid meter set loads from being transmitted to the thermoplastic service line.

3.3.4 *anodeless riser nipple*—the metallic, aboveground, gas carrying pipe or fitting portion of an anodeless riser.

3.3.5 *anodeless riser rigid riser casing*—the metallic, non-gas carrying protective outer sleeve portion of an anodeless riser.

3.3.6 *anodeless riser, rigid, straight and prebent*—an anodeless riser which is produced straight or factory prebent, usually 90°, thus defining rise leg and base leg dimensions.

3.3.7 *base leg*—the steel horizontal portion of an anodeless riser measured from the centerline of vertical.

3.3.8 *Category 1*—a transition joint which provides for pressure tightness and resistance to end loads sufficient to cause no less than 25 % elongation of the PE, PA11 or PA12 piping as described in this standard.

3.3.9 *Category 3*—a transition joint which provides for pressure tightness and resistance to end loads greater than the maximum thermal stress that would be produced by a temperature change of 100°F (55°C).

3.3.10 *grade level marking*—a marking, tape or label applied to the riser to identify the point at which the transition from PE, PA11 or PA12 gas carrier to metallic gas carrier occurs. This marking assists the installer in determining the grade level of the installation.

3.3.11 *insert stiffener*—a rigid, non-split, solid wall tube which is inserted into PE, PA11 or PA12 piping to support compression loads in the area of the transition joint.

3.3.12 *joint*—the location at which two or more pieces of pipe or a pipe and a fitting are connected.

3.3.13 *MAOP*—the maximum allowable operating pressure of the fuel gas piping system, in psig, as determined in accordance with US DOT CFR, Title 49, Part 192.121 and as represented in the following:

$$\text{MAOP} = P = 2 \times S/(R - 1) \times f_D \quad (1)$$

where:

S = The Thermoplastic materials' HDB as published in the Plastics Pipe Institute PPI TR 4 publication,
R = The pipe's dimension ratio determined by dividing the pipe's specified nominal outside diameter by the pipes specified nominal wall thickness, and
f_D = the design (derating) 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.

3.3.14 *rise leg*—the vertical portion of an anodeless riser measured from the centerline of horizontal.

3.3.15 *service line*—a fuel gas distribution line which transports gas from a common source of supply (gas main) to the customer piping.

3.3.16 *spigot*—a rigid profiled solid wall metallic tube, inserted into the PE, PA11 or PA12 piping serving as the stiffener in the area of transition.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.
[6] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://www.api.org.
[7] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.
[8] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

3.3.17 *transition fitting*—a fitting that makes a transition joint between two different types of piping materials. As used in this Standard, it is the transition between the PE, PA11 or PA12 and the metallic pipes.

3.3.18 *transition joint*—the joint at which two different piping materials (the PE, PA11 or PA12 and metal piping) are connected.

4. Materials and Manufacture

NOTE 2—Materials used in components of the fitting that will be in long term contact with gas should be demonstrated by testing or history of successful usage not to be adversely affected.

4.1 *General:*

4.1.1 All materials of the fitting shall meet the performance requirements of this specification. Specific materials referenced in this section are common materials used in these types of products. Alternate materials proven to provide equal or better performance are acceptable.

4.1.2 As per the recommendations of the respective resin manufacturers, no cross fusion between PA11 pipe and fittings and PA12 pipe and fittings is permitted. Alternatively, no cross fusion between PE pipe and fittings and either PA11 or PA12 pipe and fittings is permitted.

4.2 *Casings and Nipples:*

4.2.1 Rigid riser casings shall be constructed of Specification A53/A53M, Specification A513 or equivalent metallic materials with a minimum nominal 0.065 in. (1.65 mm) wall thickness within the allowable tolerance ranges of the applicable metallic piping specification.

4.2.2 Flex riser casings shall be constructed of plastic coated flexible metallic tubing providing a crush strength of not less than 1000 lbs. When tested in accordance with UL 360, section 9.1. The flex shall also be capable of withstanding a tensile pull of 300 lbs force without breaking or unwinding.

4.2.3 Riser nipples shall be constructed of Specification A53/A53M, or equivalent, steel pipe with a minimum of schedule 40 wall thickness.

4.2.4 All burrs on metal components, which could damage the PE, PA11 or PA12 piping, shall be removed prior to insertion of the PE, PA11 or PA12 piping so as to prevent any damage to the PE, PA11 or PA12 gas piping. Alternately, all such burrs shall be suitably covered with a protective device such as an ID plastic sleeve, to preclude any damage to the PE, PA11 or PA12 gas piping.

4.3 *Polyethylene Pipe (PE), Polyamide 11 (PA11) and Polyamide 12 (PA12) Pipe:*

4.3.1 Polyethylene and pipe shall comply with the requirements of Specification D2513.

4.3.2 Polyamide 11 pipe shall comply with the requirements of Specifications D2513-99 and F2945.

4.3.3 Polyamide 12 pipe shall comply with the requirements of Specification F2785.

4.4 *Elastomers:*

4.4.1 Gas sealing elastomeric components shall be of materials compatible with all components of the fitting and the materials of the pipes being joined, and shall be resistant to fuel gases.

4.5 Specifications outlining the physical and chemical properties of all fitting materials shall be available from the fitting manufacturer upon request.

5. Dimensions, Mass, and Permissible Variations

5.1 Because of the varying designs, the actual spread of dimensions is quite different from manufacturer to manufacturer. A table of dimensions and tolerances encompassing these differences would be meaningless and without value and, therefore, are omitted from this specification.

6. Design Qualification Requirements

6.1 *General:*

6.1.1 After initial testing, any revision to design adversely affecting performance requires retesting.

6.2 *Bend Radius Requirements:*

6.2.1 The bend radius of anodeless risers shall not be less than 8× the diameter of the PE, PA11 or PA12 piping.

NOTE 3—If a bend radius of less than 8× the nominal PE, PA11 or PA12 pipe diameter is used the PE, PA11 or PA12 pipe manufacturer should be contacted to assure that their piping can accept a bend radius less than 8×.

6.3 *Thread Requirements:*

6.3.1 All gas carrying steel pipe threads shall comply with ANSI/ASME B1.20.1

6.3.2 The polyethylene or polyamide 11 or polyamide 12 piping shall not be threaded.

6.4 *Flange Requirements:*

6.4.1 All steel flanges shall comply with ANSI B 16.5.

6.5 *Welding Requirements:*

6.5.1 All gas pressure containing factory welding shall comply with the requirements of the United States Code of Federal Regulations, Title 49, Part 192, Subpart D or in accordance with ASME Boiler and Pressure Vessel Code, Section IX or API 1104.

6.6 *Temperature Cycling:*

6.6.1 The joint shall be leak-free after ten temperature cycle tests as tested at a minimum of 1.5 × MAOP and 7 ± 3 psig in accordance with 7.4.

6.7 *Tensile Pull Test Requirements :*

6.7.1 Transition joints in transition fittings and anodeless risers in PE, PA11 or PA12 sizes below NPS 4 shall be proven to be of full restraint/full seal Category 1 design. The joint qualifies under this requirement if the pipe is pulled to a minimum of 25 % elongation, as indicated by when the length of the unrestrained PE, PA11 or PA12 piping has been elongated to 125 % of its original length, when tested in accordance with 7.3, and is bubble tight in accordance with 6.7.3. No leakage or pullout is permitted.

6.7.2 In PE, PA11 or PA12 sizes NPS 4 and larger the joint shall be qualified to be of either Category 1 design as in 6.7.1, or of Category 3 design by pull testing to tensile stress equal to or greater than the maximum tensile stress that would be produced by a temperature change of 100°F (38°C) when tested in accordance with 7.3. No leakage or pullout is permitted in accordance with 6.7.3. Failure of one sample constitutes failure of this test.

NOTE 4—Sample calculations are shown in Specifications D2513 or F2785section X2.4, Thermal Stress.

6.7.3 The samples shall be leak tested at 7 ± 3 psig and a minimum of 1.5 × MAOP, prior to, and at the end of the test while still under tensile load and immediately following the tensile test. No leakage shall be permitted when tested in accordance with 7.2.

6.7.4 Each nominal size transition design, in medium density PE, PA11 or PA12 shall be tested, except testing of the heaviest wall (lowest SDR) polyethylene or polyamide 11 and polyamide 12 piping shall qualify all thinner wall polyethylene or polyamide 11 or polyamide 12 pipe joints of the same outside diameter.

6.7.5 The polyethylene, polyamide 11 or polyamide 12 pipe, in the transition compression zone(s), shall be fully supported by an inserted stiffener or spigot which, by design, has no sharp O.D. burrs capable of damaging the polyethylene, polyamide 11 and polyamide 12 pipe during assembly.

6.8 *Leak Test:*

6.8.1 The transition joint shall be leak free when leak tested at 7 ± 3 psig and at a minimum of 1.5× the MAOP at both 73.4 ± 3.6°F (23 ± 2°C) and –20 ± 3.6°F (–29 ± 2°C) in accordance with 7.2.

6.9 *Constant Tensile Load Joint Test—CTLJT:*

6.9.1 Test one specimen in accordance with Test Method F1588 unless excepted below.

6.9.2 The fiber stress shall be as follows:

6.9.2.1 1,320 psi for PE piping.

6.9.2.2 2060 psi for polyamide 11 (PA11) piping.

6.9.2.3 2600 psi for polyamide 12 (PA12) piping.

6.9.3 The duration of the test shall be 1000 h.

6.9.4 The samples shall be leak tested at 7 ± 3 psig and a minimum of 1.5 × MAOP, prior to, at the end of the test (while still under tensile load and immediately following the CTLJT. No leakage shall be permitted when tested in accordance with 7.2.

6.10 *Coatings:*

6.10.1 Riser and transition fitting coatings, if any, shall be as agreed upon between the buyer and seller.

6.11 *Riser Flex Connection:*

6.11.1 The connection between the riser flex and the anodeless riser shall be demonstrated to withstand a pull force greater than 300 lb when tested in accordance with 7.3 except no leak tests shall be conducted. Separation of the flex or the separation of the flex from the riser or adapter shall constitute failure of this test. Test one representative specimen.

6.12 *Transition Zone Identification :*

6.12.1 Each anodeless riser shall be clearly marked to show the installer at what point the transition from plastic to metal gas carrier is made. This marking shall have verbiage such as "grade level", "transition zone" or be described in the manufacturer's literature as the indication of grade level.

NOTE 5—The marking described is used by the installer to determine the maximum grade level of the riser at installation.

7. Test Methods

7.1 *General:*

TABLE 1 Number of Test Samples

Nominal Outlet Pipe Size	Number of Samples
½ through NPS 2	6 (3-MDPE, 3-HDPE, 6-PA11 6-PA12)
> NPS 2	2 (1-MDPE, 1-HDPE, 6-PA11 6-PA12)

7.1.1 Unless otherwise specified, prior to testing, condition all samples at an ambient temperature of 73.4 ± 3.6°F (23 ± 2°C) for not less than 4 h.

7.1.2 Unless otherwise specified the test conditions shall be 73.4 ± 3.6°F (23 ± 2°C).

7.1.3 Unless otherwise specified, the number of specimens shall be as in Table 1.

7.2 *Leak Testing:*

7.2.1 Pressurize the sample using air or other inert gas.

NOTE 6—SAFETY – In large diameter samples it is prudent to first fill the specimen with a coarse granular solid to reduce the pressurized volume of the sample. Plastic granules are frequently used for this purpose.

7.2.2 Ensure that all end caps and test fittings are bubble tight.

7.2.3 Detect leakage of the transition joint in accordance with Test Method E515, 8.2.1 and 8.4.1.1 on Immersion Technique or 9.1, 9.2, and 9.3 Liquid Application Technique. Conduct leak testing for 2 min.

7.3 *Tensile Pull Testing:*

7.3.1 Affix the transition joint area of the transition fitting or anodeless riser in a tensile apparatus in accordance with Test Method D638 capable of subjecting the joint to a constant pull rate of 0.2 ± 25 % in./min (5 ± 25 % mm/min).

7.3.2 The minimum lengths of unreinforced PE, PA11 or PA12 piping in test specimens shall be as in Table 2.

7.3.3 Tensile pull test the transition joint at a constant pull rate of 0.2 ± 25 % in./min. (5 ± 25 % mm/min).

7.3.4 Return the tensile machine crosshead to the original position, remove the transition.

7.4 *Temperature Cycling Test:*

7.4.1 Conduct tests on six of the smallest and six of the largest nominal outlet pipe size of each transition design used in transition fittings or anodeless risers.

7.4.2 Leak test specimens at ambient at 7 ± 3 psig and a minimum of 1.5 × MAOP in accordance with 7.2.

7.4.3 Condition specimens to a temperature of –20 ± 3.6°F (–29 ± 2°C) and maintain for a minimum of 2.5 h.

7.4.4 Condition specimens to a temperature of 140 ± 3.6°F (60 ± 2°C) and maintain for a minimum of 2.5 h.

7.4.5 Repeat 7.4.3 and 7.4.4 for a total of ten cycles.

7.4.6 After the 10th cycle is completed, pressurize 50 % of the specimens of each size at 7 ± 3 psig and the remaining 50 % of each size at 1.5 × MAOP of the piping material and SDR for which the fittings are designed to be used. Leak test first at 140 ± 3.6°F (60 ± 2°C) and then at –20± 3.6°F (–29 ± 2°C). Condition sample at leak test temperature for at least 4 h prior to testing.

8. Marking

8.1 Transition fittings and anodeless risers shall be marked as follows:

TABLE 2 Minimum Lengths of Unreinforced PE or PA11 Piping

PE Pipe Size	Minimum PE Length
< NPS 4	5 times O.D.
≥ NPS 4	3 times O.D.

8.1.1 The manufacturer's name or trademark,

8.1.2 The PE piping's designation in accordance with Specification D2513 in the following example format – PE 3408 CDC,

8.1.3 The PA 11 piping's designation with Specification D2513–99 and its Annex 5 in the following format example- PA32312 EF.

8.1.4 The PA 12 piping's designation with Specification F2785 in the following format example- PA42316 EG.

8.1.5 A traceable lot number or date code indicating date, or date range of manufacture,

8.1.6 The nominal pipe size of the metal end connection,

8.1.7 The nominal pipe size, wall thickness or SDR, of the polyethylene or polyamide 11 or polyamide 12 piping,

8.1.8 This designation: F1973, and

8.1.9 On anodeless risers, a grade level marking, tape or label in accordance with 6.11.

8.2 *Special Marking:*

8.2.1 Product in sizes NPS 4 and larger must be marked as shown below, in addition to the above marking requirements.

8.2.1.1 The fitting shall be marked Category 1 or CAT 1 if the fitting design passes a pull test to 25 % elongation as required in 6.7.1,

8.2.1.2 The fitting shall be marked Category 3 or CAT 3 if the fitting design passes the 100°F (38°C) delta-T tensile pull test requirements of 6.7.2,

8.2.1.3 Fittings with PE, PA11 or PA12 sizes smaller than NPS 4 do not require special marking as they are all tested to Category 1, full seal, full restraint requirements in accordance with 6.7.1.

8.3 Transition fittings and factory assembled risers intended for transport of natural gas shall be marked with the 16-character gas distribution component traceability identifier in accordance with Specification F2897. The 16-character code shall be expressed in alpha-numeric format and Code 128 bar code format with a minimum bar thickness value of 0.005 in. or an alternative 1D or 2D bar code symbology as agreed upon between manufacturer and end user. All fittings shall have the 16- character codes marked or affixed to the product, product packaging, or any manner agreed upon between manufacturer and end user.

8.4 The manufacturer shall either ensure that the 16-character gas distribution component tracking and traceability identifier in accordance with Specification F2897 for the PE, PA11, or PA12 material is visible on the final product, or shall maintain records for the 16-character code for the PE, PA11, or PA12 materials as necessary to confirm the identification of these materials upon request by the end user.

9. Manufacturer's Caveat

9.1 When the product is marked with this ASTM designation (F1973), the manufacturer affirms that the product was qualified in accordance with this specification and has been found to meet the requirements of this specification.

10. Keywords

10.1 anodeless risers; fuel gas piping; plastic gas piping; plastic pipe; polyamide 11; polyamide 12; pressure pipe; risers; transitions

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1973–12) that may impact the use of this standard.

(1) Changes were made to 2.1, 4.3.1.
(2) Added 4.3.2 and 4.3.3.
(3) Changes were made to 8.1.3 and 8.1.4.
(4) New Note 1 was added.
(5) Note 4 was revised.

Committee F17 has identified the location of selected changes to this standard since the last issue (F1973–08) that may impact the use of this standard.

(1) Requirements to include 16-digit traceability identifier added under 8.3 and 8.4.