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An American National Standard

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

This standard is issued under the fixed designation F 1973; 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 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), 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 given in parentheses are for informational purposes only.

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:*

A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless[2]

A 513 Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing[2]

D 638 Test Method for Tensile Property of Plastics[3]

D 1600 Abbreviations of Terms Relating to Plastics[3]

D 2513 Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings[4]

E 515 Test Method for Leaks Using Bubble Emission Techniques[5]

F 412 Terminology Relating to Plastic Piping Systems[4]

F 1588 Test Method for Constant Tensile Load Joint Test (CTLJT)[4]

2.2 *US Government Document:*

United States Code of Federal Regulations Title 49 Part 192[6]

2.3 *ANSI Standards:*

ANSI B 31.8 Gas Transmission and Distribution Piping Systems[7]

ANSI/ASME B1.20.1 Pipe Threads, General Purpose (inch)[7]

ANSI B 16.5 Steel Pipe Flanges, Flanged Fittings[7]

2.4 *ASME Standard:*

ASME Boiler and Pressure Vessel Code[8]

2.5 *API Standard:*

API 1104 Standard for Welding Pipelines and Related Facilities[9]

2.6 *UL Standard:*

UL 360 Flexible Metal Hose[10]

2.7 *PPI 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 Pipe[11]

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 F 412 unless otherwise specified. Abbreviations are in accordance with Abbreviations D 1600 unless otherwise specified.

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[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.

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[2] *Annual Book of ASTM Standards*, Vol 01.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 08.04.

[5] *Annual Book of ASTM Standards*, Vol 03.03.

[6] Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

[7] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[8] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

[9] Available from American Petroleum Institute, 1220 L St., NW, Washington, DC 20005.

[10] Available from Underwriters Laboratories, 333 Pfingsten Rd., Northbrook, IL 60062.

[11] Available from Plastics Pipe Institute, Inc., 1825 Connecticut Ave., NW, Suite 680, Washington, DC 20009.

3.2.1 *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.

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

3.2.3 *anodeless riser, flex design*[12]—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.

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

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

3.2.6 *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.

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

3.2.8 *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 or PA11 piping as described in this standard.

3.2.9 *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).

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

3.2.11 *insert stiffener*—a rigid, non-split, solid wall tube which is inserted into the polyethylene or polymide 11 piping to support compression loads in the area of the transition joint.

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

3.2.13 *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.

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

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

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

3.2.17 *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 or PA11 and the metallic pipes.

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

4. Materials and Manufacture [13]

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.

4.2 *Casings and Nipples*:

4.2.1 Rigid riser casings shall be constructed of Specification A 53, Specification A 513 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 A 53, 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 or PA11 piping, shall be removed prior to insertion of the PE or PA11 piping so as to prevent any damage to the PE or PA11 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 or PA11 gas piping.

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

4.3.1 Polyethylene and Polyamide 11 pipe shall comply with the requirements of Specification D 2513.

4.4 *Elastomers*:

[12] Anodeless flex risers usually require a riser bracket attached to a rigid supporting member to avoid meter set loads from being transmitted to the polyethylene service line.

[13] 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.

4.4.1 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 or PA11 piping.[14]

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 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 or PA11 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 or PA11 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 or PA11 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.[15] No leakage or pullout is permitted in accordance with 6.7.3. Failure of one sample constitutes failure of this test.

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, high density PE, and polyamide 11 (or PA11) shall be tested, except testing of the heaviest wall (lowest SDR) polyethylene or ploymide 11 piping shall qualify all thinner wall polyethylene or polyamide 11 pipe joints of the same outside diameter.

6.7.5 The polyethylene or ploymide 11 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 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 F 1588 unless excepted below.

6.9.2 A fiber stress of 1320 shall be used.

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.[16]

7. Test Methods

7.1 *General*:

[14] If a bend radius of less than 8× the nominal PE or PA11 pipe diameter is used the PE or PA11 pipe manufacturer should be contacted to assure that their piping can accept a bend radius less than 8×.

[15] Sample calculations are shown in Specification D 2513 section X2.4 Thermal Stress.

[16] The marking described is used by the installer to determine the maximum grade level of the riser at installation.

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.[17]

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 E 515, 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 D 638 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 or PA11 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.

[17] 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.

TABLE 1 Number of Test Samples

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

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

8. Marking

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

8.1.1 The manufacturer's name or trademark,

8.1.2 The PE piping's designation in accordance with Specification D 2513 in the following example format – PE 3408 CDC,

8.1.3 The PA 11 piping's designation in accordance with Specification D 2513 and Annex A5 in the following example format- PA32312 EF.

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

8.1.5 The nominal pipe size of the metal end connection,

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

8.1.7 This designation: F 1973, and

8.1.8 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 or polyamide 11 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.

9. Manufacturer's Caveat

9.1 When the product is marked with this ASTM designation (F 1973), 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; pressure pipe; risers; transitions