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An American National Standard

Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe[1]

This standard is issued under the fixed designation F477; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers elastomeric seals (gaskets) used to seal the joints of plastic pipe used for gravity, low-pressure, and high-pressure applications. This refers to push-on joints which require no internal or external pressure to effect the initial seal.

1.2 Requirements are given for natural or synthetic rubber gaskets, or a combination of both. ~~Note1—Oil-resistant gaskets are available for those applications where exposure to solvents or oil may occur. The user should contact the gasket manufacturer for recommendations.~~

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

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1.4 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.

1.5 The following precautionary caveat pertains only to the test method 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 consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D395 Test Methods for Rubber PropertyCompression Set
D412 Test Methods for Vulcanized Rubber and Thermoplastic ElastomersTension
D471 Test Method for Rubber PropertyEffect of Liquids
D518 Test Method for Rubber DeteriorationSurface Cracking
D573 Test Method for RubberDeterioration in an Air Oven
D883 Terminology Relating to Plastics
D1149 Test Methods for Rubber DeteriorationCracking in an Ozone Controlled Environment
D1229 Test Method for Rubber PropertyCompression Set at Low Temperatures
D1349 Practice for RubberStandard Temperatures for Testing
D1414 Test Methods for Rubber O-Rings
D1415 Test Method for Rubber PropertyInternational Hardness
D1566 Terminology Relating to Rubber
D2240 Test Method for Rubber PropertyDurometer Hardness
F913 Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe

2.2 *NSF Standards:*

Standard No. 14 for Plastic Piping Components and Related Materials[3]
Standard No. 61 for Drinking Water Systems Components-Health Effects[3]

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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 F17.20 on Joining.

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[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 NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.

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

3. Terminology

3.1 *Definitions*—Terms relating to rubber or elastomer shall be as defined in Terminology D1566. Terms relating to plastics shall be as defined in Terminology D883.

4. Composition and Manufacture

~~4.1All~~4.1 All gaskets shall be extruded or molded in such a manner that any cross section will be dense, homogeneous, and free of porosity, blisters, pitting, or other defects that make them unfit for the use intended. The gasket shall be fabricated from a high-grade elastomer material. The basic polymer shall be natural rubber, synthetic rubber, a blend of both, or a thermoplastic elastomer, meeting the requirements prescribed in Sections 5 and 6.

4.2 Where a splice is used in the manufacture of the gasket, the strength shall be such that the gasket shall withstand 100 % elongation over the part of the gasket which includes the splice with no visible separation of the splice. While in a stretched position the gasket shall be rotated in the spliced area a minimum of 180° in each direction in order to inspect for separation. In addition, any portion of the splice shall be capable of passing a bend test without visible separation. The bend test for circular gaskets is defined as wrapping the portion of the unstretched gasket containing the splice a minimum of 180° and a maximum of 270° around a rod of a diameter equal to the cross section diameter of the gasket.

5. Dimensions and Tolerances

5.1 When in its final assembled position, the gasket shall not be stretched more than 30 % of its original circumference.

NOTE ~~2~~1—Excessive stretch may have deleterious effect on rubber gaskets, the minimum stretch compatible with the proper performance of the gasket should be used at all times.

5.2 The gaskets shall conform to the dimensions specified by the manufacturer of the pipe or fittings, with which the gaskets are to be used, with a Rubber Manufacturers' Association Class 3 tolerance on all cross section dimensions, and ±1 % on all diametrical dimensions, unless otherwise agreed upon by the pipe or fitting manufacturer and the purchaser.

5.3 For molded gaskets or gasket material, the permissible flash shall be a maximum of ~~+0.80 mm (0.032 in.).~~+0.032 in. (0.80 mm). Maximum mold mismatch shall not exceed ~~0.25 mm (0.010 in.).~~ 0.010 in. (0.25 mm).

6. Physical Requirements

6.1 *Standard Gasket requirements*—The sealing portion of the gaskets shall comply with the physical requirements listed in Table 1 for thermoset elastomers or Table 2 for thermoplastic elastomers, when tested in accordance with the methods in Section 7.

6.1.1 *Oil resistant gaskets requirements*—The sealing portion of the gaskets shall not contain less than 50% by volume oil resistant polymer and shall meet the physical requirements listed in Table 3, when tested in accordance with the methods in Section 7.

NOTE ~~3—Some~~ 2—Some gaskets incorporate a high durometer elastomeric or nonelastomeric, that is, metal or plastic material, as a reinforcement or retaining feature, or both. These materials do not alter the physical properties of the sealing portion of the gasket and should not be tested as such, or expected to meet the material requirements listed in Table 1.

NOTE ~~4—The~~ 3—The gasket manufacturer should be assured that materials used for retaining or reinforcement, or both, do not encroach upon the sealing surfaces of the gasket, and have physical properties which ensure adequate longevity for the anticipated usage.

~~6.1.1~~6.1.2 *Hardness*—The Type A durometer average hardness specified by the manufacturer shall be within the range given in Table 1 and Table 3 for thermoset elastomers or Table 2 for thermoplastic elastomers. Gaskets are required to have the Type A durometer hardness specified, ± 5 points.

6.2 Elastomer compounds must be non-crazing to pipe. The gasket in the cured state shall not cause craze marks, pits, or blisters when in contact with the plastic pipe. Staining of the plastic pipe in the area of gasket contact is acceptable. Test in accordance with 7.9 to qualify elastomer compound for pipe made from the plastic polymer in question.

6.3 Where the particular joint design utilizing a rubber gasket dictates the use of a lubricant to facilitate assembly, the lubricant shall be of such composition which will in no way damage the gasket or pipe due to prolonged exposure.

7. Test Methods

7.1 Perform laboratory tests to determine the physical properties of the gaskets to be furnished under this specification on: (*1*) the finished product as supplied, (*2*) test specimens taken from the finished product, or (*3*) from specimens of fabrication of the same elastomeric compound, and in accordance with the appropriate ASTM standard. (See Practice D1349.)

7.2 *Tensile Strength and Elongation*—Determine tensile strength, 100 % modulus, and elongation in accordance with Test Methods D412 or D1414 for O-rings.

7.3 *Hardness*—Determine the durometer, Type A, of the gasket in accordance with Test Method D2240 or Test Methods D1414 for O-rings. (See Test Method D1415.)

7.4 *Low-Temperature Hardness*—Measure the durometer, Type A, of the gasket in accordance with Test Method D2240 or Test Methods D1414 for O-rings after conditioning for 22 h at ~~−10~~+14 ± ~~2°C (+14~~4°F (−10 ± ~~4°F)~~2°C) to determine the change in hardness.

TABLE 1 Physical Requirements for Elastomeric Seals for Plastic Pipe

Tests	Low-Head Application (Below 150 kPa or 50-ft Head)	High-Head Application (150 kPa or 50-ft Head and Above)
Original Properties:		
~~Tensile strength, min, MPa (psi)~~	~~8.3 (1200)~~	~~13.8 (2000)[A]~~
Tensile strength, min, psi (MPa)	1200 (8.3)	2000 (13.8)[A]
~~Elongation, min, %~~	~~325~~	~~400~~
Elongation, min, %	325	400
~~Hardness, Type A durometer~~	~~40 to 60~~	~~40 to 60~~
Hardness, Type A durometer	40 to 60	40 to 60
~~Low-temperature hardness, Type A durometer, max increase, points~~	~~15~~	~~15~~
Low-temperature hardness, Type A durometer, max increase, points	15	15
~~Compression set, max %~~	~~25~~	~~20~~
Compression set, max %	25	20
~~Ozone resistance~~	~~no cracks~~	~~no cracks~~
Ozone resistance	no cracks	no cracks
Accelerated Aging (Air Oven Test):		
~~Decrease in tensile strength, max % of orignal~~	~~15~~	~~15~~
Decrease in tensile strength, max % of orignal	15	15
~~Decrease in elongation, max % of original~~	~~20~~	~~20~~
Decrease in elongation, max % of original	20	20
~~Hardness, Type A durometer, max increase, points~~	~~8~~	~~8~~
Hardness, Type A durometer, max increase, points	8	8
After Water Immersion:		
~~Change in volume max %~~	~~5~~	~~5~~
Change in volume max %	5	5

[A] For EPDM and nitrile seals, tensile strength min. ~~MPa (~~ psi (MPa) is 150~~.30~~ (150~~.3~~).

7.5 *Compression Set*—Determine the compression set in accordance with Method B of Test Methods D395 or D1414 for O-rings. Test temperature and time shall be 22 h at ~~70~~158 ± ~~2°C (158~~ 4°F(70 ± ~~4°F),~~2°C), with a 25 % deflection of the test specimens. (See Test Method D1229.)

7.6 *Accelerated Aging*—Age specimens for physical test in accordance with Test Method D573. (See Test Method D518.)

7.6.1 Age physical test specimens for 96 h at ~~70~~158 ± ~~2°C (158~~4°F (70 ± ~~4°F).~~ 2°C).

7.7 *Water Immersion*—Determine the change in volume in accordance with Test Method D471 or Test Methods D1414 for O-rings.

7.7.1 The temperature shall be ~~70 ± 2°C (158 ± 4°F),~~158 ± 4°F (70 ± 2°C), and the immersion period shall be 48 h.

7.7.2 Immediately after removal from the water, blot the specimens, weigh, and calculate the volume increase in accordance with Test Method D471.

7.8 *Oil Immersion*—Determine resistance to oil by calculating % volume change after immersing product specimen in ASTM IRM 903 oil for 212 ± 4° F (70 h at 100 ± 2° C) in accordance with Test Method D471.

7.9 *Ozone Resistance*—Determine the gasket's resistance to ozone in accordance with Test Method D1149.

7.89.1 Conduct test for 70 h in 50 pphm concentration at ~~40~~104 ± ~~2°C (104~~4°F (40 ± ~~4°F)~~2°C) with specimens stressed to 20 % extension.

7.910 Determine elastomer compound effect on pipe (6.2) by the following procedure:

~~7.9.1The~~7.10.1 The specimen shall be a gasket or a part of a gasket that will fit within the test fixture shown in Fig. 1.

~~7.9.2The~~7.10.2 The fixture for the test shall be as described for the compression set test in Method B of Test Methods D395 with a plate of plastic adjoining the interior surfaces of the compression plates (see Fig. 1).

7.910.3 Make liner bearing plates of plastic with a minimum wall thickness of ~~3.0 mm (0.120 in.)~~0.120 in. (3.0 mm) to fit the interior surfaces of the fixture's compression plates.

7.910.3.1 Form the plastic bearing plate from like plastic material by cutting and pressing pipe at a workable stressrelieving temperature not to exceed that required to form a gasket race.

~~7.9.4Set~~7.10.4 Set the test apparatus up as in the compression set test in accordance with Method B of Test Methods D395 with the plastic bearing plate in place.

~~7.9.5Age~~7.10.5 Age the specimens under load for 96 h at ~~70~~158 ± ~~2°C (158~~4°F (70 ± ~~4°F).~~2°C).

~~7.9.6Let~~7.10.6 Let the specimens cool in the fixture for 24 h at ~~21~~70 to ~~25°C (70~~77°F (21 to ~~77°F).~~25°C).