



Standard Specification for Rubber Seals Contacting Liquids in Solar Energy Systems¹

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1. Scope

1.1 This specification covers the general requirements for materials used in preformed rubber seals that contact the circulating liquid in solar energy systems. Particular applications may necessitate other requirements that would take precedence over these requirements when specified.

1.2 This specification does not include requirements pertaining to the design, fabrication, or installation of the seals.

2. Referenced Documents

2.1 ASTM Standards:

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension²

D 471 Test Method for Rubber Property—Effect of Liquids²

D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber²

D 1229 Test Method for Rubber Property—Compression Set at Low Temperatures²

D 1349 Practice for Rubber—Standard Temperatures for Testing²

D 1415 Test Method for Rubber Property—International Hardness²

D 1566 Terminology Relating to Rubber²

D 2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics²

D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets²

D 3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products²

2.2 Other Standards:

RMA Handbook—Rubber Products: Molded, Extruded, Lathe Cut, and Cellular³

3. Terminology

3.1 Refer to the definitions of terms in Terminology D 1566.

¹ This specification is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.36 on Seals.

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² Annual Book of ASTM Standards, Vol 09.01.

³ Available from the Rubber Manufacturers Association (RMA), 444 Madison Ave., New York, NY 10022.

4. Classification

4.1 Types:

4.1.1 *Type C*, intended for use in cold climates (below -10°C in winter).

4.1.2 *Type W*, intended for use in warm climates (above -10°C in winter).

4.2 Grades:

4.2.1 Grade designations represent differing degrees of hardness in accordance with Test Method D 1415 as follows:

4.2.1.1 *Grade 3*, hardness of 30 ± 5 .

4.2.1.2 *Grade 4*, hardness of 40 ± 5 .

4.2.1.3 *Grade 5*, hardness of 50 ± 5 .

4.2.1.4 *Grade 6*, hardness of 60 ± 5 .

4.2.1.5 *Grade 7*, hardness of 70 ± 5 .

4.2.1.6 *Grade 8*, hardness of 80 ± 5 .

NOTE 1—The grade to be used in a particular application depends on the design of the seal and must be specified by the designer.

4.3 Classes:

4.3.1 Seals shall be classified as follows:

4.3.1.1 *Class A*, seals for use with aqueous liquids at a maximum service temperature of 100°C .

4.3.1.2 *Class AT*, seals for use with aqueous liquids at a maximum service temperature above 100°C .

4.3.1.3 *Class N*, seals for use with nonaqueous liquids.

NOTE 2—Aqueous liquids include water and antifreeze solutions.

5. Ordering Information

5.1 Orders for seals under this specification shall include the following information:

5.1.1 ASTM designation and year of issue,

5.1.2 Type, grade, and class,

TABLE 1 Elongation Requirements for Rubber Seals in Liquid Heat-Transport Systems

Grade	Ultimate Elongation, min, %
3	350
4	300
5	250
6	200
7	150
8	100

- 5.1.3 Design and dimensions of seal,
- 5.1.4 Contacting liquid,
- 5.1.5 Maximum service temperature, and
- 5.1.6 Quantity.

6. Dimensions

6.1 The tolerances in dimensions shall conform to the following designations in the RMA Handbook.

6.1.1 Molded Seals:

6.1.1.1 *Commercial Dimensions*—RMA A3-F3-T.032.

6.1.1.2 *Critical Dimensions*—RMA A2-F3-T.032.

6.1.2 Extruded Seals:

6.1.2.1 *Commercial Dimensions*—RMA A2-F3.

7. Workmanship, Finish, and Appearance

7.1 Seals shall be free of blisters, checks, cracks, and other imperfections that can affect their ability to make or maintain a liquid-tight seal.

8. Test Methods

8.1 Prepare the specimens in accordance with Practice D 3183 and test the specimens in accordance with the test methods given in 8.2. For control of production, specimens may be taken from standard test sheets prepared in accordance with Practice D 3182, using the same unvulcanized material used to prepare the seals and vulcanizing the material at the same temperature used for the seals to an equivalent state of vulcanization.

8.2 Determine ultimate elongation in accordance with Test Methods D 412. Determine other requirements in accordance with the methods specified in Table 2.

8.3 Test Class A seals for heat resistance and compression set at a temperature of 125°C and for resistance to liquids at a temperature of 100°C.

8.4 Test Class AT and Class N seals for heat resistance and compression set at the standard test temperature in accordance with Practice D 1349, that is, between 25 and 49°C above the maximum service temperature, and for resistance to liquids at the standard test temperature, that is, between 1 and 25°C above the maximum service temperature. The standard test

temperatures shall not be less than those for Class A seals. Above 125°C, the standard test temperatures are 150, 175, 200, 225, and 250°C.

8.5 Using the liquid in service for the particular heat-transport system, test in accordance with Test Method D 471.

9. Requirements

9.1 Seals shall be vulcanized from suitable rubber compounds and conform to the requirements given in Table 1 and Table 2.

10. Precision and Bias

10.1 A precision and bias statement is not necessary for this specification as it is a listing of material requirements.

11. Inspection and Rejection

11.1 Manufacturers of seals may use their quality-control systems for production inspection to assure the seals conform with this specification, provided appropriate records are kept. In case of dispute regarding the quality of a delivered product, a sample of five seals shall be taken from the lot and tested for compliance with this specification. If one of the five seals does not conform, a second sample of five seals may be taken and tested. If two or more of the ten seals do not conform, the lot may be rejected.

12. Product Marking

12.1 The following information may be marked on either the seal, packaging, label or tag:

12.1.1 Name, brand, or trademark of the manufacturer,

12.1.2 Type and grade,

12.1.3 Compliance with this specification, ASTM Specification D 3832, and

12.1.4 Any other information required by the manufacturer or the purchaser.

13. Packaging

13.1 Material shall be protected by suitable packaging to prevent damage during shipment or storage prior to installation in solar collector.

TABLE 2 Other Requirements for Rubber Seals in Liquid Heat-Transport Systems

Property	Unit	Requirement	ASTM Test Method
Compression set:			
High temperature ^A	%	30 max	D 395, Method B
Low temperature ^B	%	60 max	D 1229
Resistance to Heating: ^C			
Hardness change	IRHD	10 max	D 1415
Ultimate elongation change	% of original	30 max	D 412
Resistance to ozone, ^D 100 mPa, for 166 h at 40°C	—	no cracking	D 1149
Resistance to low temperature ^E	°C	−40 max	D 2137
Resistance to Liquid: ^F			
Volume change	%	+ 40 to − 10	D 471
Hardness change	IRHD	±10	D 1415

^AAfter compression for 70 h at the temperature specified in 8.3 or 8.4.

^BAfter compression for 166 h at − 10°C. Set shall be measured at 10 s after force is released. Lubricated plates or polytetrafluoroethylene film is recommended if the rubber adheres to the metal plates during the test.

^CCondition for 166 h at the temperature specified in 8.3 or 8.4.

^DThis requirement applies only to seals that are exposed to outside atmospheres.

^EThis requirement applies to Type C seals only.

^FRubber shall be immersed in liquid used in service for 166 h at the temperature specified in 8.3 or 8.4.

14. Keywords

14.1 liquids; rubber seals; solar energy systems

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