



Classification Standard for Radial Lip Seal Materials

1 Scope

1.1 Material Description. The radial lip seal materials described in Table 1 are defined using the material symbol representing the production intent seal construction for single or dual materials. Table 2 through Table 5 provide further characterization of the seal element properties using various combinations of symbols to build a line callout. See Section 8.

1.1.1 Material Identification. The seal material shall be of the type described in Table 1. The material type shall be specified in the line callout using a symbol of Table 1.

Table 1: Material Classification

Material Symbol	Description	Seal Application Use
EA	Ethylene Acrylic (AEM) ^{Note 1}	Secondary or Dust Lip
PA	Polyacrylate (ACM) ^{Note 1, Note 2}	Secondary or Dust Lip
T	Polytetrafluoroethylene (PTFE)	Primary and Secondary Lip
V	Fluorocarbon (FKM/FPM) – Bisphenol Cure	Primary and Secondary Lip (lower cost)
VP	Fluorocarbon (FKM/FPM) – Peroxide Cure	Primary and Secondary Lip

Note 1: Per ASTM D1418 or ISO 1629.

Note 2: Sulfur cure is not permitted.

1.2 Symbols. Materials shall be identified according to SAE J2232 or VDA 260, except in the case of polytetrafluoroethylene (PTFE), which will be identified using SAE J1344, ISO 1043, or VDA 260.

1.3 Applicability. This standard provides an alpha numeric system for specifying significant properties of seal materials used in radial lip seal production drawings and in Vehicle Technical Specifications, Component Technical Specifications, Statement of Requirements, etc., in line callout form, as shown in Section 8. It is intended for crankshaft and camshaft seals used passenger car and light duty truck applications.

1.3.1 Specific codes are used for each print specified material (both primary and secondary lip). This applies to garter spring and springless, low friction lay-down lip seal construction. See Figure 1 and Figure 2.

1.4 Remarks.

1.4.1 Cure Systems. For economic and/or performance reasons, the preferred lip seal cure system is defined in Table 1. The table represents the current Bill of Material for radial lip seals.

1.4.2 Seal compounds are characterized by their measured property changes after exposure to the conditions of this standard. Test fluid immersion time (168 h) is sufficient for compound property changes to reach equilibrium (see 3.5) for prolonged test times (e.g., 1008 h) yield similar results.

1.4.3 Qualifying Candidate Testing. Tests for primary lips (contacting the shaft) shall include properties from Table 2 through Table 7. If the secondary or dust lip is a different compound, use Table 3 through Table 7 (typically the front seal only). Fluid resistance (Table 6) for engines, shall include O1 and O2 as this is a global standard. Additional test fluids are at the direction of the part responsible design release engineer as designated in the Statement of Requirements (SOR) or Component Technical Specification (VTS) documents.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ARPM OS-3	ASTM D1418	ISO 1043	SAE J1344
ASTM D412	ASTM D4745	ISO 1629	VDA 260
ASTM D471	ISO 37	ISO 1817	
ASTM D1415	ISO 48	SAE J2232	

2.2 GM Standards/Specifications.

GMW3059	GMW16444	GMW16955	GMW17409
GMW15827	GMW16612	GMW17205	

2.3 Additional References.

- Association for Rubber Product Manufacturers (ARPM) Indianapolis, Indiana (www.arpminc.com)
- Component Technical Specifications (CTS)
- Statement of Requirements (SOR)
- Vehicle Technical Specifications (VTS)

3 Requirements

3.1 Corrosion Characteristics. The corrosive characteristics of the seal material shall be determined by GMW17409 on specimens cut from seals. The corrosion rating shall be specified in the line callout using the symbols of Table 2.

Table 2: Corrosivity Symbol

Corrosivity Symbol	Corrosion Rating
C0	0
C1	1
C2	2
C3	3

3.2 Microhardness. Microhardness for the compounds other than Teflon, shall be determined by ARPM OS-3 on specimens cut from seals using equipment described in ASTM D1415 or ISO 48, Method M. Microhardness shall not be determined for Teflon. The hardness shall be specified in the line callout using the symbols of Table 3 and the explanations of Note 1 from Table 3.

Table 3: Microhardness Symbol ^{Note 1}

Hardness Symbol	Microhardness Range ^{Note 2}
H60	55 to 65
H65	60 to 70
H70	65 to 75 ^{Note 3}
H75	70 to 80

Note 1: This table does not include all possible values. Its function is solely to illustrate how the coding system works. The microhardness range shall be X to Y with the range (Y to X) being 10 and with X and Y being multiples of five (5). The microhardness symbol shall be the letter H followed by the average of X and Y.

Note 2: Microhardness is defined in International Rubber Hardness Degrees (IRHD), per ASTM D1415 or ISO 48.

Note 3: The hardness for most seals is in the range of 65 to 75.

3.3 Tensile Strength. Tensile strength for the compounds other than Teflon shall be determined by ASTM D412 or ISO 37. The tensile specimens shall be compounded and molded in a manner similar to the seal under consideration. Tensile strength for Teflon shall be determined using the procedure of ASTM D4745. The tensile strength shall be specified in the line callout using the symbols of Table 4 and the explanations of Note 1 from Table 4.

Table 4: Tensile Strength Symbol ^{Note 1}

Tensile Strength Symbol	Minimum Tensile Strength, MPa ^{Note 2}
S050	5.0 ^{Note 3}
S055	5.5
S060	6.0
S065	6.5

Note 1: This table does not include all possible values. Its function is solely to illustrate how the coding system works. The minimum tensile strength shall be XY.Z MPa with Z being 0 or 5. The tensile strength symbol shall be SXYZ.

Note 2: Although suitable tests are not available to determine tensile strength of seal materials in the product, it is included herein to aid in the selection of appropriate compounds. It is not intended that tensile strength be a part of quality control procedure.

Note 3: In no case should a tensile strength below 5.0 MPa be specified.

3.4 Tensile Elongation at Break. Tensile elongation at break for the compounds other than Teflon shall be determined by ASTM D412. The tensile specimens shall be compounded and molded in a manner similar to the seal under consideration. Elongation at break for Teflon shall be determined using the procedure of ASTM D4745. The elongation at break shall be specified in the line callout using the symbols of Table 5 and the explanation of Note 1 from Table 5.

Table 5: Tensile Elongation at Break Symbol ^{Note 1}

Tensile Elongation at Break Symbol	Minimum Tensile Elongation at Break, Percent (%)
E05	50
E10	100
E15	150
E20	200

Note 1: This table does not include all possible values. Its function is solely to illustrate how the coding system works. The minimum tensile elongation at break shall be XY0 percent (%), with XY0 being a multiple of 50. The elongation at break symbol shall be EXY.

3.5 Fluid Resistance. The fluid resistance of the seal material shall be evaluated by immersing the compounds in the fluids listed in Table 6 for 168 h +2/-0 h at 150 °C ± 2 °C, and measuring the change in hardness, volume, tensile strength, and elongation at break. The fluid of immersion shall be specified in the line callout using the symbols of Table 6. Document revisions may not keep pace with test fluid changes. Consult with GM Powertrain Materials Engineering regarding potential changes before proceeding with fluid testing. Unless otherwise specified, the seal material shall be evaluated in fluids O1, and O2 for typical engine application, in fluid T1 for automatic transmission application, and in fluid T2 for manual transmission application.

3.5.1 Optional Fluids may be designated other than those in Table 6. Use ZN where N is a number representing each fluid chosen. If only one (1) optional fluid is specified, use the number one (1) following the Z. For example, Z1: GMW15827 Dexos[®] 1, 5W30. If multiple optional fluids are specified for test, there will be multiple references to ZN, where, for each fluid, the value of N will be a number increasing sequentially (i.e., 1, 2, 3, etc.) At the end or below the alpha-numeric suffixes for GMW17437, each ZN test fluid is identified. Symbols for Change of Property in that ZN fluid are listed in the total line callout. See Section 8, Coding System.