



Ethylene Propylene Diene Terpolymer for Sealings in Coolant

1 Scope

This specification covers the materials and performance of Ethylene Propylene Diene Monomer (EPDM) sealings in the cooling circuit. EPDM rubber is a terpolymer of Ethylene, Propylene and Diene monomers.

Note: The words **must**, **shall** or **will** as used in this document mean a mandatory requirement.

1.1 Material Description. Materials covered by this specification are divided into seven (7) EPDM "Types":

Note: Continuous and Excursion temperature limits are as defined by the Vehicle Technical Specifications (VTS).

- **Type A:** EPDM for sealing radiator, sulfur cured; -35 °C to +125 °C continuous, +150 °C excursion.
- **Type B:** EPDM for sealing radiator, peroxide cured; -35 °C to +150 °C continuous, +175 °C excursion.
- **Type C:** EPDM for sealing in engine applications, peroxide cured, better compression set; -35 °C to +150 °C continuous, +175 °C excursion.
- **Type D:** EPDM O-rings in water circuit, sulfur cured; -35 °C to +125 °C continuous, +150 °C excursion.
- **Type E:** EPDM for gasket, peroxide cured, with a functional temperature range of -35 °C to +135 °C. The limits are defined by ASTM D1329 TR₁₀ and the continuous upper limit by SAE J2236.
- **Type F:** EPDM for gasket, peroxide cured, with a functional temperature range of -35 °C to +150 °C. The limits are defined by ASTM D1329 TR₁₀ and the continuous upper limit by SAE J2236.
- **Type G:** EPDM for gasket, peroxide cured, with a functional temperature range of -35 °C to +125 °C. The limits are defined by ASTM D1329 TR₁₀ and the continuous upper limit by SAE J2236.

1.2 Symbols. Identify the elastomer nomenclature using ASTM D1418 or ISO 1629.

1.3 Applicability. This standard covers the use of EPDM on coolant system joints not exposed to engine oil either during assembly or service.

1.4 Remarks.

1.4.1 Some prints/drawings identify "D" or race track shapes as O-rings. To avoid confusion, testing and table data only apply to the ASTM D1414 definition of an O-ring.

1.4.1.1 Tensile and elongation properties of O-rings are measured by spool separation, however, during this step, the elongation across the specimen width is not uniform. To minimize data variation, the recommended ratio of O-ring Inside Diameter (ID) to cross section width should be 9 to 1 or greater.

Note: The ratio for SAE AS568D size is 7 to 1.

Of greater interest is tensile stress at 20% to 50% elongation because it is closer to the performance range of the O-ring.

1.4.2 Rubber Adhesion to Carrier (Edge Molded Design). Rubber must be secure to the carrier over the entire contact length. On a fully cured part, attempts to remove the rubber using pliers or other gripping tools in a 90 degree or 180 degree pull (to the carrier) shall result in tearing of the rubber. A cut (up to 12 mm) between the rubber and carrier is permitted to facilitate gripping of the rubber. A clean adhesive failure (rubber to carrier) is not acceptable. Nondestructive test alternative using an interference fit, post die for small openings or a straight segment rule die that deflects or bends the edge bonded rubber is permitted. For open segment tests, the carrier must be securely clamped to prevent movement during deflection of the edge bonded elastomer. The interference of the die edge to the elastomer profile must make contact at the mid-point of the flexible extension from the bonded edge. One (1) pass (downward and upward) is sufficient. There must be no loss of elastomer to metal adhesion or elastomer cracking under 2x magnification.

2 References

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

2.1 External Standards/Specifications.

ASTM D297	ASTM D1415	ISO 48-2	ISO 3601-1
ASTM D395	ASTM D1418	ISO 188	ISO 23529
ASTM D412	ASTM D1505	ISO 815	ISO/IEC 17025
ASTM D471	ASTM D4968	ISO 1629	SAE AS568D
ASTM D573	ASTM D2240-15e1	ISO 1817	SAE J2236
ASTM D624	IATF 16949	ISO 2393	
ASTM D1329	ISO 34-1	ISO 2781	
ASTM D1414	ISO 37	ISO 2921	

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW17113	GMW17821
GMW3155	GMW16955	GMW17205	GMW17918

2.3 Additional References.

- Association for Rubber Product Manufacturers (ARPM), Indianapolis, Indiana (www.arpminc.com) O-Ring Inspection Guide, Surface Imperfections Control (OR-1) and the Handbook for Molded, Extruded, Lathe Cut and Cellular Products
- Automotive Industry Action Group (AIAG) D22: Best Practice Unified Procedure for Approval of Rubber, Southfield, Michigan (www.aiag.org)
- Axel Products, Incorporated, Ann Arbor, Michigan (www.axelproducts.com)
- Component Technical Specifications (CTS)
- Tirreno Ind.Com. de Produtos Quimicos LTDAR., Bandeirantes, 610 - Conceição, Diadema - SP, 09912-230, Brazil phone: +55 11 4053-3339. **Fax:** (11) 4056-5061 **E-mail:** tirreno@tirreno.com.br
- Vehicle Technical Specifications (VTS) (ID)

(ID) = This document is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

3 Requirements

3.1 Requirements on Test Specimens.

3.1.1 Compound Characterization for Finite Element Modeling. Elastomer compounds qualifying to this standard must also be entered into the hyperelastic GM Material Property Database for finite element modeling unless otherwise specified as not required by the Component Statement of Requirements (SOR) or Component Technical Specification (CTS). If no SOR or CTS exists for elastomer part/component or a Finite Element Analysis (FEA) requirement is not listed, the default is to require FEA data collection.

Axel Products, Incorporated is GM's sole global contract test facility as the equipment and test methods used are unique and confidential. Data developed for FEA purposes by another test facility is not recognized. A finite element development form is submitted with each elastomeric compound. The form is available from Axel Products, Incorporated or GM Powertrain Engine Materials Engineering. Follow the form instructions. Every four (4) ASTM D3182 slabs represent one (1) production batch. Compound approval cannot proceed without a submission for FEA characterization.

3.1.1.1 Test Samples. Unless otherwise specified, the shape and size of test pieces shall be in accordance with the relevant test procedure. If not otherwise stated, mechanical properties in delivery state and after heat or fluid immersion are to be tested at +23 °C and with the same test methods.

3.1.1.2 Micro-hardness (Surface). Part micro-hardness measurements, per ASTM D1415, Type M or ISO 48-2, Method M. Surface measurements shall follow GMW17821.

3.1.2 Conditioning. Conditioning shall be as specified in the relevant test procedure.

3.1.2.1 Elastomer Test Specimens Preparation. Specimens used to develop all table properties are die cut specimens from ASTM D3182 or ISO 2393 sheet stock molded to the same conditions as for actual products, with post cure if applicable. Precondition slabs at 50% Relative Humidity (RH) and 23 °C for at least 16 h before testing. As an option, specimens from non-post cure compounds, may be used from production molds. Report cure time and temperature conditions for all molded specimens.

3.1.3 Equipment. Conforming to the relevant test procedure.

3.1.4 Calibration. The test facilities equipment shall be in good working order and shall have a valid calibration label.

3.1.5 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this document shall be determined correctly with respect to its physical definition.

3.1.5.1 Test Standards Equivalency. For reasons of cost and convenience, this document lists equivalent industry standards. Equivalency as it applies to this document, is stated in ASTM D4968, Appendix A2. Documents may have some minor form differences, but otherwise will give identical results to those actions performed as a result of following the ASTM International standard and vice versa. Only use the equivalent standards listed in Table 1 and Table 2.

3.1.6 Facilities. Conform to the relevant test procedures.

3.1.6.1 GM Powertrain Only. All data must be generated by an ISO /IEC 17025, IATF 16949, or a GM accredited laboratory.

3.1.7 Deviations. Only improvements (e.g., increase in test time, harsher test media, etc.) or corrections (e.g., publication error, missing information, etc.,) from the requirements of this standard are permitted, provided these changes have been agreed upon between tester and requester. Use of test procedure/condition deviations are considered temporary (up to six (6) months) until a consensus is reached and revisions made to this document by the sponsor. No specification limit deviation or test exemption(s) to accommodate material compliance to this standard is permitted on the production print or any relevant documentation by source or end user. All issues must be worked out through revision of this standard.

3.1.7.1 Exceptions to these requirements are not permitted on GM purchased part drawings. An example of an illegal deviation is:

- **Material:** GMW14747 except age resistance to SAE J2236 change in elongation is -60% maximum.

In this example, SAE J2236 is a definition and cannot be modified.

3.2 Material and Performance Requirements.

3.2.1 Minimum Lot Testing. Material properties are summarized in Table 1. For full approval of a sealing, compliance to the requirements of Table 1 is needed. A minimum of three (3) production lots of compound from each mix site shall be tested to each of the requirements for Design or Product Validation Testing. Microsoft Excel data reporting sheets are provided for this standard and are supplied by the Elastomer Global Subsystem Leadership Team (GSSLT) chairperson (eventually a CG number will be assigned and the data sheet will accompany this standard).

3.2.2 Audit/Inspection Testing. If not defined otherwise, the following testing should be done for production audit testing beyond the approved supplier process plan. Three (3) samples of material shall be tested to each of the requirements for Audit/Inspection Testing. All tests per Table 2, except those at or more than 336 h and Joint Sealing Function.

3.2.3 Product Validation Testing/Audit/Inspection Testing. If not defined otherwise, the following testing should be done for production audit testing:

- Material properties to Table 2.

3.2.4 To qualify a compound to Table 2, Type D, use ISO 3601-1 or SAE AS568D size O-rings (25 mm ± 0.25 mm × 3.5 mm ± 0.1 mm) prepared under the same conditions as production parts.

3.2.4.1 O-ring Test Conditions. Only compounds used for O-rings require testing to O-ring conditions.

- Test Spool Diameter: 12.7 mm
- Test Pull Rate: 254.0 mm/minute

3.2.5 Sealability. Test production intent gasket and seal engine parts on required joint hardware to GMW3155.

3.2.6 Managing Change. Any change in cost, design, function, properties, manufacturing process, and/or location of manufacture to the component or material, requires a new release of the product. It is the sole responsibility of the supplier to immediately provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier before start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.2.6.1 GM Powertrain Only. Elastomer polymer or ingredient changes to the approved production compounds are made by submitting the Automotive Industry Action Group (AIAG) D22 Template, titled "**Best Practice Unified Procedure for Approval of Rubber**", assigning a number(s) to the appropriate listed changes, and a Supplier Production Change Request (SPCR). GM report forms are available from GM Powertrain Engine Materials Engineering. Submit a completed D22 form to GM Powertrain Materials Engineering before submitting a SPCR.

3.3 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

Table 1: Material Properties

Property	Test Method	Unit	Value
Hardness			
Type A, B, C, E, F, and G	ISO 48-2 Method M	IRHD	As specified on drawing
Type D	ISO 48-2 Method M (measured on cross section)	IRHD	As specified on drawing
Hardness			
All Types	ASTM D2240-15e1	Shore A	To be reported
Density			
All Types	ASTM D297, ASTM D1505 or ISO 2781	g/cm ³	Must conform to released compound
Elongation at Break			
Type A and B	ASTM D412, Die C or ISO 37, Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	300 minimum
Type C	ASTM D412, Die C or ISO 37, Type 4 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	150 minimum
Type D	ASTM D1414 or ISO 37, on complete O-ring 254 mm/minute $\pm$ 20 mm/minute	%	150 minimum
Type E and G	ASTM D412, Die C or ISO 37, Type 2 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	240 minimum
Type F	ASTM D412, Die C or ISO 37, Type 2 dumbbell, 200 mm/minute $\pm$ 20 mm/minute	%	220 minimum