



Hydrogenated Nitrile Rubber for Engine Coolant Sealing

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose/Material Description. This specification covers hydrogenated nitrile rubber (HNBR) used in static sealing against extended life coolant for gas and diesel engines.

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

Commercial compounds are divided into the following types:

1.1.1 Type A. All 25% to 36% acrylonitrile (ACN) HNBR gasket or O-ring compound(s) in contact with engine coolant for application temperatures with a functional temperature range of -29 °C to 125 °C (continuous) as defined by ASTM D1329 TR10 and SAE J2236 respectively.

1.1.2 Type B. All 36% to 44% acrylonitrile (ACN) HNBR gasket or O-ring compound(s) with a functional temperature range of -18 °C to 135 °C (continuous) as defined by ASTM D1329 TR10 and SAE J2236 respectively.

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

1.3 Applicability. This standard covers the use of hydrogenated nitrile elastomer whose function is to seal cooling system components (e.g., water pump, oil cooler or front engine cover, etc.) Type A is used for general use. Type B covers higher coolant operating temperatures (e.g., turbo).

1.3.1 Other Coolant Standards. Use GMW14747 for coolant joints not exposed to hydraulic fluids during initial assembly or service. Use GMW14751 for joints sealing oil and coolant simultaneously. Use GMW17470 as a lower cost alternative to GMW14751 for coolant joints with incidental exposure to hydraulic fluids during assembly or service.

1.4 Remarks.

1.4.1 The acrylonitrile (ACN) content of HNBR influences the low temperature of the compound. High ACN (35% to 43%) sacrifices low temperature flexibility. Low ACN content (18% to 23%) of HNBR improves low temperature flexibility.

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

1.4.2.1 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 ring inside diameter (ID) to cross section width should be 9 to 1 or greater. Of greater interest is tensile stress at 20% to 50% elongation because it is closer to the performance range of the O-ring.

Note: The ratio for SAE AS568-214 size is 7 to 1.

1.4.2.2 Compression Set. Testing a whole O-ring for compression set is not permitted. Air trapped in the O-ring inside diameter results in a different thermal condition between the inside and outside surface of the specimen.

1.4.3 Elastomers used in part of assembly (POA) are usually selected by supplier-specific criteria and often remain unspecified or unidentified on end user prints and drawings. As the original equipment manufacturer (OEM) end user, GM reserves the right (through directed buy) to define common rather than source-specific requirements. Use this document in the appropriate Statement of Requirements, Appendix C, and corporate prints and drawings using Section 8 Coding.

1.4.4 Compression Stress Relaxation. Per GMW17113, deflection is 15% for manual and continuous. Note that only one method, manual or continuous, must be run. Only one method is required not both methods. For manual, there is the option of running 35% deflection in addition to the required 15%. 15% deflection replicates least material conditions (LMC) and 35% replicates most material conditions (MMC).

2 References

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

2.1 External Standards/Specifications.

ASTM D297	ASTM D1415	ISO 37	JIS K 6251
ASTM D395	ASTM D1418	ISO 48-2	JIS K 6252-1
ASTM D412	ASTM D1505	ISO 815-1	JIS K 6253-5
ASTM D471	ASTM D3182	ISO 1629	JIS K 6258
ASTM D624	ASTM D4968	ISO 1817	JIS K 6261-1
ASTM D1329	IATF 16949	ISO 2781	SAE AS568-214
ASTM D1414	ISO 34-1	ISO 17025	SAE J2236

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW14751	GMW17113
GMW3155	GMW14747	GMW16955	GMW17205

2.3 Additional References.

- Association for Rubber Products Manufacturers, Inc. (ARPM), Indianapolis, Indiana (www.arpminc.com) O-Ring Inspection Guide, Surface Imperfections Control (OR-1) and the Handbook for Molded, Extruded, Lathe Cut & Cellular Products.
- Automotive Industry Action Group (AIAG) D22, Best Practice Unified Procedure for Approval of Rubber and Plastic Formulation Ingredient Changes, 26200 Lahser Road, Suite 200, Southfield, MI 48033-7100.
- Axel Products, Incorporated, 2255 S. Industrial Hwy., Ann Arbor, Michigan 48104 (www.axelproducts.com).
- Component Statement of Requirements (SOR).
- Component Technical Specification (CTS).
- Corporate prints and drawings.
- Elastomer Finite Element Data Request Form (CG5335).
- Statement of Requirements, Appendix C.

3 Requirements

3.1 Compound Characterization for Finite Element Modeling. All elastomeric compounds qualifying to this standard must also be entered into the hyperelastic GM Material Property Database for finite element modeling unless otherwise specified by the Component Statement of Requirements (SOR) or Component Technical Specification (CTS). Axel Products, Incorporated is GM's sole global contract test facility as the equipment and test methods used are unique and confidential. A finite element development form (CG5335) is submitted with each elastomeric compound. The CG5335 form is available from Axel Products, Incorporated or Information Handling Systems. Follow the form instructions. Table 1 shows where in the part and compound development process the data is characterized for hyperelastic modeling.

Table 1: Candidate Compound Requirements for Finite Element Analysis (FEA) Modeling Data

Part or Component Design Level	Compound Readiness at Submission Time	Intent	Requirements at Time of Characterization ^{Note 1}
Design Development, Production or Production Intent	Available from production batch process only	Represent properties from all mixing location(s)	One or more of the following: • Production drawing content met. • Production Part Approval Process (PPAP) started or successfully completed. • Design development before tooling and parts tested. • Satisfies all relevant GM documents. • Compound selected for production intent process and design.

Note 1: All validation testing including GMW3155 may not be completed at the time of compound characterization. Maintaining entries in the database will be reevaluated if the compound was the reason for a non-compliance to test requirements.

3.1.1 Test Samples. Unless otherwise specified, the shape and size of test pieces shall be in accordance with the relevant test procedure and comply with 3.1.5.1 Test Standards Equivalency.

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.

3.1.1.1 Print Designations for Micro-hardness Method. The part print shall indicate which hardness method using the word surface or cross section in parentheses after the numerical range. Slab measurements require no designation after the numerical range.

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 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 their 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 ISO standard and “vice versa.” Only use the equivalent standards listed in Table 2. This also means the approved compounds are equivalent.

3.1.6 Facilities. Conform to the relevant Test Procedures.

3.1.6.1 GM North America Powertrain Only. All data must be generated by an ISO 17025, IATF 16949 or 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 they 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.