



FKM/FPM for Crankcase Ventilation Applications

1 Scope

This specification covers fluoroelastomers used in static sealing of Crankcase Ventilation Systems for gas (flex fuel) and diesel engines using B5 to B20.

1.1 Material Description. Materials are divided into the following types:

1.1.1 Type A: Fluoroelastomer (FKM/FPM) gasket or O-ring for use as sealings for +150 °C permanent and +175 °C peak temperatures.

1.1.2 Type B: All Type 1 or Type 2 FKM/FPM gasket or O-ring compounds with a functional temperature range of -15 °C to 175 °C are defined by ASTM D1329 TR₁₀ and SAE J2236 respectively.

1.1.3 Type C: All Type 3 FKM/FPM compound(s) with a functional temperature range of -25 °C to 175 °C are defined by ASTM D1329 TR₁₀ and SAE J2236 respectively.

1.1.4 Type D: All FKM/FPM compound(s) with a functional temperature range of -30 °C to 175 °C are defined by ASTM D1329 TR₁₀ and SAE J2236 respectively. Type only (no subscript grade) specification descriptions indicate the approved compound met all the requirements per Table 2.

1.1.5 Grade Description. Compound approvals that require special designations by engine fluid resistance are designated with a subscript letter. These compounds met the requirements differing only by the select fuel in which they were tested. This permits a gas or diesel only approval.

1.1.5.1 Ag, Bg, Cg, Dg. These symbols identify material types with resistance to gas only. See Table 2.

1.1.5.2 Ad, Bd, Cd, Dd. These symbols identify material types with resistance to diesel only. See Table 2.

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

1.3 Applicability. The ventilation system transfers combustion (blow-by) gases, water and fuel vapor out of the engine crankcase. This standard covers the use of fluorocarbon elastomer whose function is to seal the vent system (plenum, air/oil separator, flow control devices - valves or orifices, quick-connect o-rings, fittings or caps). Hose and tubing is covered by other standards.

1.4 Remarks. The words must, shall or will as used in this document mean a mandatory requirement.

1.4.1 Fluorocarbons, when immersed in static (non-aerated) test fluids, often have higher property loss changes than in aerated fluids. These test conditions may not give direct correlation with service performance, but serve as comparative data for decision making.

1.4.2 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.

1.4.3 Recent studies by the Chemours Company recommend no metal oxide peroxide cure FKM/FPM compounds for maximum protection against biodiesel containing water. The metal oxides have no significant impact on FKM Type II, Type III, Type IV or Type V peroxide cure systems. There is no impact on color choice for carbon black filled and mineral filled systems. There are variations in what are called metal oxides. For example, ceramic type mineral systems are metal oxides and are being used successfully in mobility systems where zinc, calcium, or magnesium oxides would not be successful in that application.

1.4.4 Elastomers used in crankcase vent system purchased assemblies are 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, we reserve the right to define common rather than source specific requirements. Use this document in the appropriate Statement of Requirements and corporate prints and drawings as designated in Section 8, Coding.

1.4.5 Compound approvals are restricted to those material Types referenced in this standard (see 1.1).

1.4.6 Cost. Type 1 FKM/FPM (Type A and Type B) is approximately 500 USD to 600 USD per kilogram at the time of this latest revision. Type 3 FKM/FPM (Type C and Type D) is approximately 1000 USD to 2000 USD per kilogram. Given the specific gravity and part weight, one can approximately calculate the material cost of the total piece price

2 References

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

2.1 External Standards/Specifications.

ASTM D395	ASTM D1414	ISO 37	ISO 1817
ASTM D412	ASTM D1415	ISO 48	ISO 23529
ASTM D471	ASTM D1418	ISO 815-1	SAE AS568
ASTM D1329	ASTM SF105	ISO 1629	SAE J2236

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW16678	GMW17227
GMW3155	GMW14914	GMW17205	GMW17245

2.3 Additional References.

- Axel Products, Incorporated, 2255 S Industrial Highway, Ann Arbor, Michigan 48104 (www.axelproducts.com)
- Chemours Company - 1007 Market Street. P.O. Box 2047 Wilmington, Delaware 19899, U.S.A – (302)-773-1000
- Component Technical Specification (CTS)
- Test oil developed by Bayerische Motoren Werke AG (BMW) available from ISP - The Testing Institute - ISP Salzbergen GmbH and Co. KG - Neuenkirchener Str. 7 D-48499 Salzbergen - Telephone: +49 (0) 5976 9475 0 e-mail: isp@isp-institute.com
- Statement of Requirements (SOR)
- Supplier Technical Data Sheet

3 Requirements

3.1 Resources.

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

3.1.1.1 Samples are finished parts or to be taken from finished parts. Where the dimensions on the finished parts do not allow preparing of test pieces, tests are to be performed on sheet material of same production batch. The same state of cure between slabs or buttons and finished parts must be assured by appropriate tests, which must be described in the test report.

3.1.1.2 If not otherwise stated, mechanical properties in delivery state and after heat or fluid immersion are to be tested at $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and with the same test methods. Unless otherwise stated, ambient temperature test conditions shall be held to $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. Unless otherwise stated, all other temperatures except $+23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ shall be held to $\pm 3\text{ }^{\circ}\text{C}$.

3.1.1.3 Elastomer Test Specimen Preparation. Die-cut specimens used to develop Table 2 properties are prepared from ASTM D3182 or ISO 23529 sheet stock molded to the same conditions for actual parts with post cure if applicable. 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.

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

3.1.3 Equipment. Conforming to the relevant test procedure.

3.1.4 Calibration. The test facilities and 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 specification shall be determined correctly with respect to its physical definition.

3.1.6 Facilities. Conforming to the relevant test procedures.

3.1.7 Deviations. Deviations from the requirements of this standard shall have been agreed upon. Such deviations shall be specified on component drawings, test certificates, reports, etc.

3.2 Material and Performance Requirements.

3.2.1 Design or Product Validation Testing. Material and performance properties are summarized in Table 2. For full approval of a sealing, compliance to the requirements of Table 2 and Table 3 is needed. Three (3) to five (5) samples of material of at least three (3) production lots, shall be tested to each of the requirements for Design or Product Validation Testing. A GM data reporting sheet is available for this standard and will be used to submit all test results. The template document is available from Global Propulsion Systems Engine Materials Engineering.

3.2.2 Audit/Inspection Testing. If not defined otherwise, tests to Table 3 will be done for production audit testing. Three (3) samples of material shall be tested to each of the requirements for Audit/Inspection Testing.

3.2.3 Table 2 properties for Type B, Type C and Type D O-rings are based on cross section diameters of 1 mm to 3.5 mm found in SAE AS568.

3.2.4 These conditions are used to determine the tensile, modulus, and elongation of the Table 2 properties for Type B, Type C, and Type D O-rings.

3.2.4.1 For O-rings in the 7 mm to 100 mm inner diameter (ID) range, select the test conditions for size and speed.

3.2.5 Test Spool Diameters.

- O-rings with <12.7 mm ID shall, be pulled on 3.18 mm diameter spools.
- O-rings from 12.73 mm ID to 25.40 mm ID, shall be pulled on 6.35 mm diameter spools.
- O-rings >25.40 mm ID shall be pulled on 12.7 mm diameter spools.

3.2.6 Test Pull Rate.

- O-rings with < 12.7 mm ID shall be pulled at 152.4 mm per minute.
- O-rings from 12.73 mm ID to 38.1 mm ID shall be pulled at 254.0 mm per minute.
- O-rings > 38.1 mm ID shall be pulled at 508.0 mm per minute.

3.2.7 Biodiesel (B20) Test Fluid. Shelf life is limited (around 90 days) as defined on the supplier Technical Data Sheet. Expired test solution will cause a significant property data shift.

3.2.7.1 Bayerische Motoren Werke AG (BMW) Worst Case Used Oil. This test oil developed by BMW and is available from ISP Salzbergen GmbH and Co. KG at www.isp-testing.com. Other suppliers may become available. Because it is a mixture, long term storage will likely result in phase separation (see ASTM D1094 to evaluate phase separation). It must be shaken or stirred to a homogenous mix before entering the pressure vessel. During testing, the solution must be constantly stirred. The mixing controls, stability and batch to batch consistency are unknown, therefore, order only the amount required for completing testing. Record the fluid batch number in all test reports.