



O-Rings for Quick Connector Fittings for Fuel Systems

1 Scope

1.1 Material Description. Materials covered by this specification are divided into seven (7) types.

- **Type A:** Fluorosilicone rubber (FVMQ)/fluorocarbon rubber (FKM), color code: brown.
- **Type B:** FVMQ, color code: yellow.
- **Type C:** FVMQ/FKM, optional FKM, color code: black. The material of this O-ring must meet the conductivity requirement of Table 1 (Volume Resistance).
- **Type D:** Hydrogenated nitrile butadiene rubber (HNBR), color code: red brown. This type of O-ring is only to be used for fuel vapor line connections which are outside of the engine compartment.
- **Type E:** FKM, color code: green.
- **Type F:** Drawing defined (e.g., using SAE J200 or ASTM D2000 line callout).
- **Type G:** FKM, Low durometer, and low tensile modulus.

1.2 Symbols. Not applicable.

1.3 Applicability. This specification covers the materials and performance of elastomeric O-rings, used for quick connector fittings for fuel systems lines. Quick connectors contain two (2) different O-rings: one (1) for reduction of fuel permeation (Type A, Type C, Type E or Type G) and one (1) for cold resistance properties (generally Type B for liquid fuel applications, Type D for fuel vapor applications). If no type designation is given on the blueprint or in the math data, the O-rings required to be used must be one (1) of Type A and one (1) of Type B.

2 References

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

2.1 External Standards/Specifications.

ASTM D624	ASTM D2240	ISO 48	ISO 23529
ASTM D1329	ASTM D3182	ISO 188	SAE AS568-214
ASTM D1414	IEC 60093	ISO 815	SAE J200
ASTM D2000	ISO 37	ISO 1817	

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW15423
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2.3 Additional References.

Drawing/Math Data File
Part Detail Drawing
Relevant Test Method

3 Requirements

3.1 Resources.

3.1.1 Test Samples (General). Unless otherwise specified, the shape, size, and number of test pieces shall be in accordance with the relevant test method. Samples are finished parts or to be taken from finished parts. 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 $\pm 3\text{ }^{\circ}\text{C}$.

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

3.1.3 Equipment. Conforming to the relevant test methods.

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 methods.

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 Validation Testing. Material and performance requirements are summarized in Table 1, and Table 2. All testing of Table 1 and Table 2, must be completed to fulfill the requirements of design validation testing. Six (6) samples of material shall be tested to each of the requirements for design validation testing for Table 1 testing. Sampling requirements for Table 2 testing are defined in 3.3.

3.2.2 Production Validation Testing. If not defined otherwise, the testing required for production validation testing shall be all the testing listed in Table 1. Six (6) samples of material shall be tested to each of the requirements for production validation testing.

3.2.3 Audit Inspection Testing. If not defined otherwise, the testing required for audit inspection testing shall be all the testing listed in Table 1. Three (3) samples of material shall be tested to each of the requirements for audit inspection testing.

3.3 Test Samples, Table 2 (Type A, Type B, Type E, Type G). With noted exceptions, all data is generated from SAE AS568-214 O-rings tested to ASTM D1414 requirements. Test samples from the ASTM International laboratory must be molded per ASTM D3182 requirements.

3.3.1 Material specification values reported are based on a six (6) sigma limit spread in data from a minimum of five (5) production lots, five (5) samples per lot (for qualification). New materials (not a commercial compound) will be tentatively approved based on one (1) to three (3) pilot lots and one production lot. A material lot is a batch or batches of a compound mixed within a 24 h period, which is tested and approved under the same code designation. A part lot is a run of parts from the same material lot.

3.3.1.1 Materials approved to this specification can only be used in the connector designs in which they were performance tested. Thus, a connector source cannot use O-ring material tested in and approved for another source's connector design. Physical property data developed to initially qualify a material need not be repeated when only functional testing is required to approve the material for use in another connector design. Materials are not approved until all data is received and it passes the functional test requirements per Table 2. Connector sources must report bench test results to Materials Engineering, so the material can be added to the approval list. Dependent on the similarity of proposed new materials for approval to other materials already approved, and dependent on what database of test data is available for the material, the requirements for Engineering Source Approval may be modified by the GM Materials Engineer issuing the approval.

3.3.2 Specification ranges involving multiple sources are determined by the lowest and highest three (3) sigma value (not necessarily from the same source). Source capability is not measured to the specification range (table), but the specific manufacturer's process data. Data and tests for statistical process control (SPC) purposes must be negotiated between the supplier and the end user.

3.3.3 Shelf Life. The materials shall be packed to prevent permanent deformation when shipped or stored. It must meet all requirements of this specification after one (1) year of storage at $50\text{ }^{\circ}\text{C}$.

3.4 Test Requirements. See Table 2.

3.4.1 Density. The engineer has the option of requesting the value on the part detail drawing.

3.4.2 Sour Gas.

3.4.2.1 For purchase, preparations, and test of sour gas, see GMW15423.

3.4.2.2 Measure peroxide number twice each week.

3.4.2.3 Change sour gas if peroxide concentration is <432 mg/kg or >594 mg/kg.

3.4.2.4 For purchase, preparation, and test of sour gas see, GMW15423.

3.4.3 Resistance to 80% Fuel C/20% Methanol. Place the samples in freshly made blend solution each week to maintain a proper alcohol concentration. Water cooled condensers should be used for better blend ratio maintenance.

3.4.4 Complete performance specification testing of the materials and design comprising the assembly into which the quick connector has been incorporated is required for O-ring approval to this specification.

3.5 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 and Performance Properties, Type A thru Type G

Property	Test Method	Unit	Value
Hardness			
Type A and Type E	ISO 48 Method M (measured on cross section)	IRHD	70 + 5/-10
Type B	ISO 48 Method M (measured on cross section)	IRHD	65 + 10/-5
Type C	ISO 48 Method M (measured on cross section)	IRHD	75 ± 10
Type D	ISO 48 Method M (measured on cross section)	IRHD	70 ± 5
Type F, Type G	As specified on drawing/math data file	Shore A	As specified on drawing
Elongation at Break			
Type A and Type E	ISO 37, on complete O-ring 500 mm/minute ± 50 mm/minute	Percent (%)	115 minimum
Type B	ISO 37, on complete O-ring 500 mm/minute ± 50 mm/minute	%	140 minimum
Type C	ISO 37, on complete O-ring 500 mm/minute ± 50 mm/minute	%	80 minimum
Type D	ISO 37, on complete O-ring 500 mm/minute ± 50 mm/minute	%	200 minimum
Type F, Type G	As specified on drawing/math data file	%	As specified on drawing
Age Resistance (Heat Aging)			
Type A, Type B, Type C, Type E	ISO 188 Method B, 168 h -2 h at +150 °C ± 3 °C Change in Hardness	IRHD	+12 maximum
Type D	ISO 188 Method B, 168 h -2 h at +125 °C ± 3 °C Change in Hardness	IRHD	+10 maximum
Type F, Type G	As specified on drawing/math data file	Not applicable	As specified on drawing