



Valve Stem Seal Compound Requirement

1 Scope

This standard describes the requirements for commercial intake and exhaust valve stem seals used in automotive engine applications utilizing gasoline fuel and gasoline/alcohol fuel blends. Three (3) different types of valve stem seals are described herein. One hundred percent (100%) virgin elastomer is required in compound formulations. No reclaimed Fluorocarbon Rubber (FKM) is allowed.

1.1 Material Description.

- Type 1: Fluorocarbon rubber (FKM) for gasoline fueled engines.
- Type 2: Fluorocarbon rubber (FKM) for gasoline and ethanol blended fuels.
- Type 3: Fluorocarbon rubber (FKM) for gasoline and methanol blended fuels.

1.2 Symbols. Not applicable.

1.3 Applicability. Engine valve stem seals.

1.4 Remarks. The materials and constructions described in this standard are capable of operating in a -13 °C to 225 °C environment as defined by ASTM D1329 (TR10) and SAE J2236 respectively. FKM compounds meet these requirements. Seals of this construction and material have been demonstrated to work well at cylinder head temperatures of -40 °C. At this temperature, the temperature transitions occur rapidly enough to not impact material integrity.

2 References

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

2.1 External Standards/Specifications.

ASTM D297	ASTM D1505	ISO 48	ISO 4650
ASTM D395	ASTM D3182	ISO 815	ISO 9000
ASTM D412	ASTM D3677	ISO 1432	ISO 17025
ASTM D624	ASTM E1131	ISO 1817	ISO 23529
ASTM D1053	ASTM SF105	ISO 2393	SAE J1351
ASTM D1329	ISO 34-1	ISO 2781	SAE J2236
ASTM D1415	ISO 37	ISO 2921	

2.2 GM Standards/Specifications.

GMW3059	GMW16678	GMW16694	GMW16955
GMW14270			

2.3 Additional References.

- Association of Rubber Products Manufacturers (ARPM) OS-6, 7321 Shadeland Station Way, Suite 285, Indianapolis, Indiana 46256, (www.arpm.com)

3 Requirements

3.1 Requirements on Test Specimens.

3.1.1 Material and Performance Requirements. Material and performance requirements are summarized as follows; Properties for FKM (see Table 1), Fluid Immersion Properties (see Table 2) and Part Performance Requirements (see Table 3). Table 1 uses International Rubber Hardness Degrees (IRHD) as a unit of measure.

Table 1: Properties for FKM ^{Note 1}

Property	Test Procedure	Unit	Value
Hardness			
All Types	ASTM D1415, Type M or ISO 48, Method M	IRHD	See part drawing ± 4 point range
Density			
All Types	ASTM D297, ASTM D1505 or ISO 2781	g/cm ³	To be reported
Elongation at Break			
All Types	ASTM D412, Die C or ISO 37, Type 2 dumbbell, 200 mm/minute ± 20 mm/minute	%	180 minimum
Stress at 100 % Elongation			
All Types	ASTM D412, Die C or ISO 37, Type 2 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	three (3) minimum
Tensile Strength			
All Types	ASTM D412, Die C or ISO 37, Type 2 dumbbell, 200 mm/minute ± 20 mm/minute	MPa	nine (9) minimum
Tear Strength			
All Types	ASTM D624, Die C, specimen are un-nicked or ISO 34-1, Method A	kN/m N/mm	eighteen (18) minimum two (2) minimum
Age Resistance			
All Types	SAE J2236 1008 h at +200 °C Change in Elongation at break Change in Tensile strength	% %	-50 maximum -50 maximum
Low Temperature			
All Types	ASTM D1329 or ISO 2921	°C or colder	-13
(Optional Test) All Types	ASTM D1053 or ISO 1432	°C	T10 must be - 13 °C to -17 °C. The difference between T5 and T10 must not be more than 5 °C.
Compression Set			
All Types	ISO 815 Test piece Type B, 70 h at +200 °C ASTM D395 Method B, modified ^{Note 2}	% maximum	60

Note 1: Table property values are based on ASTM D3182 sheet data from ASTM D412, Die C specimens in the specified hardness range. Die C consistently produces lower property values than International Organization for Standardization (ISO) dies at rate. International Organization for Standardization (ISO) slabs are prepared to ISO 2393.

Note 2: GM Powertrain North America requires load to be maintained during cooling and measurement made in 10 minutes or less after load removed.

Table 2: Fluid Immersion Properties

Property	Test Procedure	Unit	Value
Oil Resistance (ONCE FOR INITIAL COMPOUND APPROVAL)			
All Types	ISO 1817, 336 h -2 h at +150 °C ± 3 °C in GMW16955 Fluid F Change in Tensile Strength, Change in Elongation at Break Change in Hardness Change in Volume	% % IRHD %	-20 to +5 -50 to +5 ± 10 ± 5
	ASTM D471, 336 h -2 h at +150 °C ± 3 °C in ASTM SF105 Change in Tensile Strength, Change in Elongation at Break Change in Hardness Change in Volume	% % IRHD %	-55 to +15 -80 to +5 ± 10 ± 5
Alcohol Fuel Resistance in Oil Compatibility (ONCE FOR INITIAL COMPOUND APPROVAL)			
Type 2	GMW16678, Test Solution E, Test Condition A 336 h +2 h, at 120 °C ± 3 °C in pressure vessel Change in Elongation at break Change in Tensile strength Change in Volume	% % %	-60 to +15 -80 to +15 -5 to +5
Type 3	GMW16678, Test Solution M, Test Condition A 336 h +2 h, at 120 °C ± 3 °C in pressure vessel Change in Elongation at break Change in Tensile strength Change in Volume	% % %	-60 to +15 -80 to +15 -5 to +5

Table 3: Part Performance Requirements

Valve Stem Seal Properties	Standard/Publication	Unit	All Types
Odor	SAE J1351	Number	1 to 3
Metered Oil Flow Rate	GMW16694	Grams per 5 h	Defined on part print
Lip Contact Load	ARPM OS-6	Newtons per cm	Defined on part print

3.1.2 See Section 8 for the correct part print designation criteria. The part print template, AVX 40704 located in GM Teamcenter, defines the remaining components of the valve stem seal assembly, namely the metal carrier, garter spring, primarily lip and compound designations.

3.1.3 Requirements on Test Specimens. For all constructions;

All rubber table data comes from test specimens obtained from ASTM D3182 or ISO 2393 sheet stock. Rubber test specimens are prepared from slabs to comply with ASTM D3182 or ISO 2393 dimensional requirements and vulcanized for a time and at a temperature specified by the compound source.

Note 1: Differences in process, time, temperature and pressure, post cure, etc., between slabs and the production process parts, usually results in lower property values for the part material. To minimize the effect, a reasonable effort shall be made in molding slabs to approximate the state of cure with processed part rubber.

Note 2: In order to minimize differences in test data, sufficient time must be present between molding slab and obtaining material properties to enable the test pieces to attain substantial equilibrium in accordance with