



Engine Oil Pan and Transmission Bottom Pan Gaskets

1 Scope

Note: This commodity standard describes the requirements for engine oil pan and transmission bottom pan gaskets. The constructional and component features covered by this standard are described in this section. Do not use this document for applications outside the scope and 1.3 applicability descriptions of this standard.

1.1 Material Description. Table 1 describes the Class (A, B, F, or S) for engine (E) and/or transmission (T) elastomers meeting the designated temperature range and application. If no small capital letter is beside a Class, it applies to both engine and transmission. A hardness range for compounds is assigned by type using a numeric or alpha numeric designation (see Table 3) Part Performance Requirements are in 3.19 and Table 11.

Table 1: Material and Application Criteria Designation

Class	Temperature Range °C ^{Note 1}	Application		Elastomer ^{Note 2}
AE	-40 to 165	Low volatile (oxygen sensor safe), non-post cured	Low Temperature. See Appendix A, Tables A3, A4 and A7.	VMQ
AT	-25/-20 to 150	Transmission	Standard Use. See Table 10, Transmission Requirements.	AEM/ACM
B	-20 to 165	Oil resistant	Standard use ^{Note 3} . See Table 3, Engine Class Requirements and Table 9, Engine Immersion Requirements.	ACM
B	-25 to 165			AEM
C	-15 to 175	High temperature and oil resistance	Standard use polymer.	FKM/FPM
DE	-29 to 165	Flex fuel and oil resistance	Improved low temperature, fuel dilution 5% to 10% by volume with constant immersion or high exposure. Use for new programs.	FKM/FPM
FE	-25/-20 to 165	Fuel/oil dilution resistant	Fuel dilution 5% to 10% by volume. Under constant immersion or high exposure. Use for new programs.	ACM
SE	-40 to 150	Formed-in-place or cured-in-place, low odor, low volatile ^{Note 4}	Standard use in joints with fastening and design features intended for this product. Fuel dilution 5% or less.	VMQ

Note 1: As defined by ASTM D1329 Low Temperature Retraction ((TR) 10) and SAE J2236 respectively.

Note 2: Nomenclature symbol as defined by ASTM D1418 or ISO 1629. Others will be added as needed. ACM = Polyacrylate, AEM = Ethylene Acrylic, FKM = Fluorocarbon Rubber, FPM = Fluorocarbon Rubber (by ISO International), VMQ = Silicone with Vinyl and Methyl Substituent Groups.

Note 3: Ethylene acrylic rubber (AEM) is not on GM Bill of Material for engines.

Note 4: See Table 2 on Sealants.

1.1.1 Part Constructions. Construction usage code letters that apply to this standard are in Table 2.

Table 2: Construction Usage Code Letters

Construction Feature	Code Letters ^{Note}
Elastomer with Carrier. Plastic carriers are designated with a lower case letter p after this letter.	Cp
Elastomer with Carrier. Metal carriers use a lower case “m” after this letter.	Cm
Elastomer Only. Press-in-place designs for a machined or as cast groove.	E
Sealants. Formed-in-place, cured-in-place or molded dispensed compounds, e.g., Room Temperature Vulcanized (RTV) sealants are specified by 998 bulk part number for GM North America (GMNA) prints. Print notes shall reference the appropriate functional performance elements (8.1) of this standard if sealants are the chosen compounds.	S

Note: Code letters designate specific tests that apply only to that construction and/or material for detail drawing specifications. See Section 8 for proper use protocol.

1.2 Symbols.

1.2.1 Plastic and rubber parts shall be marked with a symbol to designate the type of material from which the part was fabricated for the purpose of collection and handling of parts for recycling.

1.2.2 Elastomer Marking Symbol. Mark rubber parts weighing more than 200 g per ISO 1629. Marking size and location per SAE J2332.

For Example: Polyacrylate >ACM<.

If practical, place the part number, the molder's company Association of Rubber Product Manufacturer's (ARPM) code, cavity number and month/date on the part. Characters shall be visible, and not in a location that adversely affects form, fit, or function.

1.2.3 Plastic Marking Symbol. Mark plastic parts weighing more than 100 g per ISO 11469 Marking size and location per GMW17081.

For Example: Polyamide with glass fibers >PA-GF30<.

1.3 Applicability. Gaskets or seals for lower engine (below engine block) and transmission bottom pan joints. O-rings and rubber coated metal gaskets for these applications are covered in other requirements.

1.4 Remarks.

1.4.1 Approved compound properties for each type of elastomer are listed in Tables 3, 4, 9, 10 and 11. Table values by type are a compilation of data from multiple approved compounds. GM Powertrain GM engine only; ethylene acrylic (AEM) rubber is not permitted as part of the Assembly Fastening and Sealing Bill of Material (BOM). Properties from molded parts are found in Tables 4, 6 and 8.

1.4.2 Silicone elastomer gasket compounds approved to this standard are safe for use near oxygen sensors (comply with GMW17224 limit) and do not contribute to oil foaming (complies with 3.19.1.7). Parts made from silicone rubber approved to this standard are not post cured. Design is a critical factor for successful sealing when selecting silicone compounds. If properly protected and compressed, silicone is a satisfactory performer. See Appendix A, Tables A3, A4 and A7.

1.4.3 Satisfactory GMW3155 test results are **compound and design** dependent.

2 References

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

2.1 External Standards/Specifications.

AIAG D-22	ASTM D1505	ISO 37	ISO 11469
ASTM D297	ASTM D2240	ISO 48	ISO 13226
ASTM D395	ASTM D3182	ISO 815	ISO/IEC 17025
ASTM D412	ASTM D3418	ISO 1101	ISO/TS 16949
ASTM D471	ASTM D3677	ISO 1629	SAE 5W30
ASTM D624	ASTM D4485	ISO 1817	SAE J300
ASTM D892	ASTM E1131	ISO 4650	SAE J1351
ASTM D1329	ASTM SF105	ISO 7111	SAE J2236
ASTM D1415	IEEE/ASTM SI 10	ISO 7619-1	SAE J2332
ASTM D1418	ISO 34-1	ISO 11357	SAE J2643

2.2 GM Standards/Specifications.

9982257	GMW3116	GMW15827	GMW16955
9986153	GMW3155	GMW16137	GMW17081
GMW3059	GMW14872	GMW16177	GMW17113
GMW3083	GMW15117	GMW16678	GMW17224

2.3 Additional References.

- Association of Rubber Product Manufacturers Incorporated. Web site: www.arpminc.com
- ASTM Test Monitoring Center, 6555 Penn Avenue, Pittsburgh, PA 15206-4407
- Automotive Industry Action Group (AIAG) D-22, Best Practice Unified Procedure for Approval of Rubber and Plastic Formulation Ingredient Changes, 26200 Lahser Road, Suite 200, Southfield, MI 48033-7100
- Component Technical Specification (CTS)
- Southwest Research Institute (SwRI), Petroleum Products Research Department, 6220 Culebra Road, PO Drawer 28510, San Antonio, Texas 78238
- Statement of Requirements (SOR)
- Test Matrix available from GM Powertrain Materials Engine Engineering. Refer GMW3083
- TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com)
- Vehicle Technical Specification (VTS)

3 Requirements

3.1 Test Preparation and Evaluation.

3.1.1 Resources.

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

3.2 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 the cure time and temperature conditions for all molded specimens.

3.2.1 Elastomer Test Specimens Parts. Specimens can be die cut from production molds to a coupon size. When preparing tensile test specimens from finished parts, in some cases, not all dimensions of the (ISO 37 type 4) dumbbell can be obtained as specified, e.g., the width of the ends. These test specimens can still be used, if the narrow portion has the correct specified values and a widening of the ends of the dumbbell exists. The test specimen should have the following properties:

- The ends of the dumbbell where it is clamped should be at least twice the width of the narrow portion of the dumbbell. This increase in width should be symmetrical about the narrow portion of the test specimen.
- The length of the tab ends must be sufficient to insure secure clamping.

Note: Length is based on clamp type.

3.2.2 Metal and plastic specimens are prepared to the appropriate GMW standard referenced in this document or production drawing. If no GM standard is available, use the appropriate industry standard referenced in this document or appropriate detail drawing.

3.3 Test Units. Report data in the appropriate International System of Units (SI) using IEEE/ASTM SI 10.

3.4 Test Conditions. 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. Unless otherwise specified, conduct testing at 50% RH and 23 °C. If temperature and humidity are known not to significantly affect test results, use a relative humidity range of 30% to 55% and temperature range of 20 °C to 32 °C. All test conditions must be within ± 2 h, ± 2 °C and $\pm 5\%$ RH of the specified numbers unless otherwise indicated.

3.5 Elastomer Compound Table Data. Each approved elastomer compound shall meet its table and section item requirements. Individual compound property tests represent characteristics that are significant to the intended usage (see Table 1) per agreement between the compound supplier and GM engineering personnel. Type data can represent the collective property profile of more than one (1) compound (e.g., Type 6 in all Tables 3 thru 10). Therefore, it may be inappropriate to use this data for quality control of a single compound.

3.5.1 Global or Cross Regional Compounds. Compound formulations produced in more than one (1) mix facility, but sharing a common compound identification, shall be subject to review. The level of testing and approval may be by polymer source and/or mix site depending on the variation permitted in ingredient selection and process conditions. Approvers are responsible for tracking production compound history and managing local variation as part of the formal approval process.

3.5.1.1 Contingency. As part of the approval process, each compound supplier shall have a designated alternative mix operation. Compound from that location(s) shall be evaluated to 3.6 Table Data Requirements, tentative approval conditions.

3.6 Table Data Requirements. Approved elastomer compound specification values (with noted exceptions) are statistically based on a six sigma limit spread in (normal distribution) data from minimum of six (6) production lots (five (5) data points/lot). Tentative approval, signified by the letter **T**, will be given based on data from one (1) production and three (3) lab lots. Tier One sources will be responsible for continuing to submit data until the total number of samples is met for full qualifications as stated in the first line of this paragraph. Appropriate industry statistical standards, methods or practices should be used when generating data.

3.7 Test Frequency. Chemical requirements of 3.14.4, long term aging tests (1008 h or more) in Tables 3 thru 10, and part performance requirements in Table 11 (except part micro-hardness and adhesion), shall be performed **once for initial approval**. Unless otherwise specified in the test procedure, **all once for initial approval tests** and compression set tests shall be run on three (3) specimens from one (1) production batch with each meeting the requirements. The noted exceptions, part micro-hardness and adhesion (carrier gaskets) shall be run on five (5) random samples at two (2) widely diverging points on the part, from each of three (3) production lots. Report all individual values. The remaining tests in Tables 3 thru 10 shall be performed on a minimum of six (6) batches described in 3.6 Table Data Requirements. Upon completion of the data requirements for table development, the approved compound source is only required to satisfy ISO/TS 16949 requirements (Production Part Approval Process, Appendix D) and their internal test frequency. For statistical reporting of data, use the GMW3083 test matrix available from General Motors Powertrain Group (GMPTG) Materials Engineering.

3.8 Number of Test Specimens. New elastomer approvals shall be based on the median of five (5) specimens per test unless otherwise specified. Tests designated as once for initial approval (not for further statistical analysis) shall be run on a minimum of three (3) specimens, with each specimen meeting the stated requirements. Report all individual values.

3.9 Plastic Constructions (Cp). Part properties have to be defined on part drawing. References to plastic material should contain the appropriate General Motors Worldwide (GMW) or regional standards for the approved materials. Approved material sources are found in MATSPC. For applications, including GMNA, use GMW17081 to specify part properties.

3.10 Regrind. Regrind is defined in GMW3116. A production part molder/supplier must identify for development and production test parts, the intended level, and to test to that maximum level. It is the responsibility of the molder-fabricator and material source to establish what level can be used, number of reuses, blend ratios, etc., and provide data that the values stated on the detail drawing can be met (at that regrind level). Only dedicated, reprocessed approved material can be used with virgin stock. Reprocessed feed streams must be separated by percent base polymer (e.g., percent fluorine in fluorocarbon rubber, cure system, and color if integral), and used only in like compounds. Parts must be tested for specification limits and validated at the maximum production intent regrind level. A 10% maximum plastic regrind is recommended. Prints without a regrind reference or GMW17081 code are to use 100% virgin material.

3.11 Safety. This standard may involve hazardous materials, operations, and equipment. This standard does not address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3.12 Documentation. Samples of components or material released to this specification shall be tested for conformity with the requirements of this specification and approved by the responsible GM department before the start of delivery of production level components or materials.

3.12.1 Managing Change. Any change to the component or material, e.g., cost, design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to 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.

3.12.1.1 GM North America (GMNA) Powertrain Only. Elastomer polymer or ingredient changes to the approved production compounds are made by submitting the AIAG D-22 template 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 form to GMPT Materials Engineering before submitting a SPCR.

3.13 Deviations from Test Procedure. Deviations (improvements or corrections) from the requirements of the test procedure(s), not specification limits, shall have been agreed upon between tester and requester. Use of procedure deviations are considered temporary (up to six (6) months) until a consensus is reached and revisions made to this document. Such deviation requirements shall be specified on component drawings, test certificates, reports, etc. Once consensus is reached, all earlier print deviations must be corrected by an Engineering Work Order (EWO). See 8.1.6.

3.14 Requirements on Delivery.

3.14.1 Identify parts to 1.1 and Table 1 designations.

3.14.2 Specify part micro-hardness International Rubber Hardness Degree (IRHD) to ASTM D1415 or ISO 48 Method M on the part print.

3.14.3 Parts must meet 3.19 Performance Requirements.

3.14.4 Chemical Requirements Characterization Tests (Optional). To verify a finished part or slab specimen matches the original validated compound, compare them using one or a combination of the following tests:

3.14.4.1 Infrared Spectroscopy. ISO 4650 or ASTM D3677.

3.14.4.2 Thermogravimetric Analysis, Temperature Scanning Method. ISO 7111 or ASTM E1131, first derivative to determine composition.

3.14.4.3 Density or Specific Gravity. ASTM D297, hydrostatic method or ASTM D1505, density gradient. Values shall be included on the part print with a ± 0.02 range for mass calculation.

3.14.4.4 Micro-hardness.

3.14.4.4.1 Test Area. The test area is the location upon which the indenter is applied for measurement. The surface, if possible, shall be as molded, unbuffed or uncut. The surface shall be smooth, clean and free of surface defects.

3.14.4.4.2 Specimen Shape and Size. Parts with (to accommodate measurement) or without a pad feature, must be 4.4 mm or taller and have a 1.5 mm cross section or more to qualify for measurement.

- The upper and lower surfaces shall be flat, smooth and parallel.
- Tolerance of flatness: $t = 0.1$ mm per ISO 1101
- Tolerance of parallelism: $t = 0.2$ mm per ISO 1101 for a distance or diameter of 150 mm

3.14.4.4.3 Measurement. For non-destructive testing, use a fixture to support the measured sections. The fixture must not interfere with the measurements. For parts with a 4.4 mm × 4.4 mm square pad measurement feature, make a single measurement in the pad center on three (3) to five (5) parts from the same mold, in consecutive heats (if there are insufficient mold cavities), with the same compound batch. For parts without a pad measurement feature, measure three (3) surface locations, 10 mm apart. Laminated test pieces are not permitted.

3.14.4.4.4 Cross Section Micro-hardness. Because most part cross sections are non-standard dimensions, these readings are described as **apparent hardness** per ISO 48, Method M. For this reason, measurements are only meant for comparative and not specification limit purposes.

3.15 Property Requirements Engine. See Table 3. Follow ASTM International (ASTM) or International Organization of Standardization (ISO) method requirements for test specimen selection, if the compound is anisotropic or mill/flow direction is known. Report results in the direction indicated by the ASTM or ISO method. If no direction is indicated, test and report in the lowest result direction.

3.15.1 Additional Requirements Engine. See Table 9. Unless otherwise specified, for compound approval, GMPT and GMNA require testing only in the first four (4) rows of Table 9.

3.16 Property Requirements Transmission. See Table 10. Follow ASTM or ISO method requirements for test specimen selection if the compound is anisotropic or mill/flow direction is known. Report results in the direction indicated by the ASTM or ISO method. If no direction is indicated, test and report in the lowest result direction.

Table 3: Engine Class Requirements: Properties for the Material Note 1, Note 2

Properties ^{Note 1}	Standard	Unit		ACM						
Class				B			FE			
Type				6	6.5	7	6	7		
Hardness, Shore A	ASTM D2240 or ISO 7619-1	points	Range	60 ± 5	65 ± 5	70 ± 5	60 ± 5	70 ± 5		
Tensile Strength	ASTM D412, Die C, or ISO 37, type 2 specimen (ISO 37 200 mm/minute)	MPa	Minimum	7.5	7.5	8	7.5	7.5		
Tensile Stress at 100% Elongation		MPa	Minimum	1.8	2	2	1.8	2		
Elongation at Break		%	Minimum	160	190	180	170	180		
Tear Strength ^{Note 2}	ASTM D624, Die C or ISO 34-1, Method A	kN/m	Minimum	15	15	15	16	18		
		N/mm	Minimum	3	3	3	3	3		
Hardness, micro	ASTM D1415 or ISO 48 Method M	IRHD		As specified on part drawing. See 3.14.4.4.						
Heat Aging, 1008 h at 165 °C	SAE J2236									
Retained Tensile strength,		%	Minimum	50						
Retained Elongation		%	Minimum	50						

Properties ^{Note 1}	Standard	Unit		ACM						
Class				B			FE			
Type				6	6.5	7	6	7		
Low Temperature Retraction, TR ₁₀ .	ASTM D1329	°C	At or lower	-20	-20	-20	-20	-25		
(Optional): Glass Transition, T _g	ASTM D3418, or ISO 11357, part 2			-25	N/A	N/A	-30	N/A		
Compression Stress Relaxation (CSR) 1512 h at 150 °C	GMW17113 AC/AM2AD0	% RSF	Minimum	10	10	10	10	15		
CSR 1512 h at 150 °C in ASTM SF105	GMW17113 AC/AM2O1D0	% RSF	Minimum	15	15	20	20	25		
Compression Set, 22 h at 150 °C	ASTM D395, Method B or ISO 815 test piece Type B	%	Maximum	25	25	25	15	15		

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 ISO dies at rate.

Note 2: Tear specimens to ASTM D624 are un-nicked. (Kilonewton/meter and newton/millimeter are the same value).

Note: N/A = Not applicable, RSF = Retained Sealing Force.

Table 4: Engine Class Requirements: Properties on Finished Parts ^{Note 1, Note 2}

Properties ^{Note 1}	Standard	Unit		ACM						
Class				B			FE			
Type				6	6.5	7	6	7		
Tensile Strength	ISO 37, type 4 specimen ^{Note 2}	MPa	Minimum	7.5	7.5	8	7.5	7.5		
Tensile Stress at 100% Elongation		MPa	Minimum	1.8	2	2	1.8	1.8		
Elongation at Break		%	Minimum	160	190	180	170	180		
Hardness, micro	ASTM D1415 or ISO 48 Method M	IRHD			As specified on part drawing. See 3.14.4.4.					
Oil Resistance 168 h at 150 °C in GMW16955 Code F	ISO 1817 or ASTM D471	%	Maximum					-40		
Change Tensile		%	Maximum					-50		
Change Elongation		%	Range					-2 to 5		
Volume Swell		IRHD	Range					± 10		
Change. Micro-Hardness										
Compression Set, 22 h at 150 °C	ISO 815 Method B test piece cut from part. Compressed to retainer thickness.	%	Maximum	40	40	40	30	20		

Note 1: Tests to be performed on test pieces cut from finished part.

Note 2: If test dumbbells can be prepared from finished part.