GM	WORLDWIDE ENGINEERING STANDARDS	General Specification	GMW17294

Requirements for Single Layer Steel Rubber Coated Metal Gaskets

1 Introduction

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.

Note: In the event of conflicts between the content/intent of this document and a supplier version, this and only this document shall take precedence.

1.1 Purpose. The purpose of this standard is to maintain uniformity in reporting properties, to establish common requirements to all producers, and to guide the release engineering community in the application and construction of commercially available gaskets for engines and transmissions of Single Layer Steel (SLS) Rubber Coated Metal Gaskets.

1.2 Applicability. This standard covers requirements by application, construction and coating type. It is intended for machined joint gaskets and not rubber coated washers. Multi-layered metal constructions (e.g., cylinder head gaskets, etc.,) even if coated are not part of this specification; Single Layer Steel (SLS) only.

1.3 Remarks.

1.3.1 Table 1 Lists the Rubber Coated Metal (RCM) Classifications. Table 1 represents rubber coated metal gaskets supplied to GM engine and transmission global parts and components. It is not an industry standard (e.g., ASTM International (ASTM) or Organization for International Standardization (ISO)).

Table 1: Rubber Coated Metal Classes

Class	Solid Metal Core	Coating Type Note 1	Anti-Friction Coating Options Note 2	Embossment Type Note 3	Application Note 4
1	**Steel**	**Two (2) Sided**	**Two (2) Sided**		**Internal Use**
1A	1008/1010	NBR	None, Graphite or PTFE	Half Bead	Engine and Transmission Oil Resistant
1B	1008/1010	ACM	Graphite or PTFE	Half Bead	Transmission Fluid Resistant
1C	1010	NBR + fiber	None, Graphite or PTFE		Engine and Transmission Oil Resistant
Class 2	**Stainless**	**Two (2) Sided**	**Two (2) Sided**		**External, Corrosion Resistance**
2A	301	NBR	None, Graphite or PTFE	Half Bead	Engine and Transmission Fluid and Coolant Resistant
2B	301	NBR + Fiber	Graphite or PTFE		Engine and Transmission Fluid and Coolant Resistant
2C	301	NBR/SBR + Fiber	Graphite or PTFE		Engine and Transmission Fluid and Coolant Resistant
2-SR	301	See Class 2A, 2B and 2C	All Class 2 Coatings	Half Bead	Subcategory for Class 2A, 2B and 2C. Steam Resistant in Coolant Systems
Class 3	**Stainless**	**Two (2) Sided**	**Two (2) Sided**		**Improved Heat Resistance**
3A	301	FKM	Graphite or PTFE	Half Bead	Engine and Transmission Fluid Resistant

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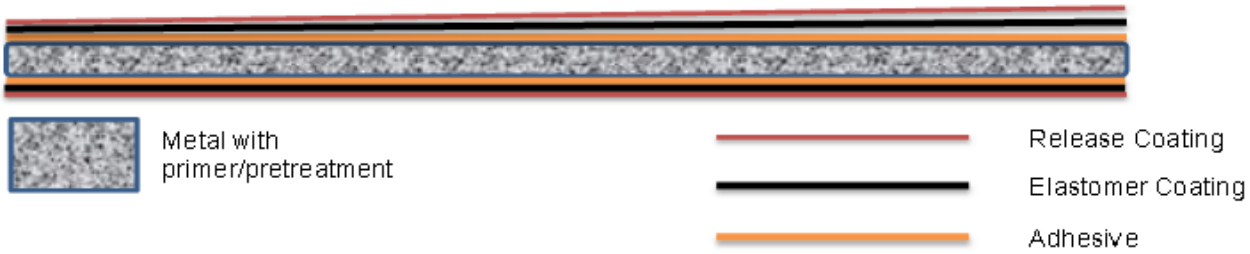
Note 1: ACM = Polyacrylate Rubber, FKM = Fluorocarbon Rubber, NBR = Nitrile Butadiene Rubber, PTFE = Polytetrafluoroethylene, SBR = Styrene-Butadiene.
Note 2: Silicone coatings are not permitted as they can contribute to oil foaming. Wax coating is permitted provided the Table 4 Anti-friction Surface Coating blocking resistance requirement is satisfied. The Production Print shall identify the coating type.
Note 3: The default is half bead, however full bead may be used for cold rolled steel (1008/1010) to achieve the proper contact loading.
Note 4: There are some application differences in shared class requirements.

1.3.2 Construction. Coils of clean rolled steel or preform sheet (one layer) are coated with a primer or pretreatment then coated with adhesive. Cured rubber, some with fiber reinforcement, is pelletized or ground and dissolved in solvent (e.g., toluene) to form the flow coating on the primed and adhesive coated metal. The coating thickness is controlled by a blade set at a gap to one surface. The applied wet coating is oven cured, cooled, then the coil is reversed for backside coating and cured again. Some operations coat both sides simultaneously, then cure. The coat coil or sheet receives a release coating and is rolled, cut or slit to size for shipment or part stamping. See Figure 1.

Figure 1: Rubber Coated Metal (RCM) Profile



Note: Water based rubber coatings are also in limited use in combination with a single layer pre-coated base metal avoiding the adhesive step.

1.3.3 End Use. The decision of which class to use is best determined by the choice of base metal, formed bead configuration, for the intended joint design. FKM coating is recommended where higher thermal and dynamic joint movement occur. Class 1 RCM is for internal joints where there are no corrosion concerns from external edge bond exposure. Class 2 and Class 3 stainless steel base metals have better corrosion and higher temperature resistance.

Coatings provide compliance to newly assembled joint surfaces and seal at the automotive assembly rates where air leak checks are performed. The long term function depends on the joint structure, thermal gradient and dynamics. In a static joint where both joint materials are similar, lower bond strength coatings may work. A bi-metal joint with significantly different thermal expansion requires a high bond strength. Fluid pressure pulses in and around a joint also require a strong coating bond (see GMW17284; Table 4 and Table 5 (Transmission Only) for the fluid erosion test).

There is no industry test that accurately defines the coating temperature use or its contribution beyond the chosen functional performance testing temperature limit. GMW3155 is used to validate RCM sealing performance, the maximum test temperature is 150 °C for hydraulic fluids and 125 °C for coolant. If the tested coating degrades or loses bond at the end of functional testing, it can be assumed its end use limits were exceeded. The GM Global Propulsion Systems (GPS) Global Sealing Technical Specialist is restricting RCM temperature use based on the reinforced and non-reinforced coating/adhesive and not the base metal. For NBR coating, the upper temperature limit (excursion) is 150 °C, for ACM coating the upper temperature limit (excursion) is 165 °C and for FKM coating the upper temperature limit (excursion) is 200 °C.

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2 References

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

2.1 External Standards/Specifications.

ASTM A109	ASTM F38	EN 10139	JIS G4313
ASTM A666	ASTM F607	ISO 17025	SAE J403
ASTM D4541	ASTM F1276	ISO/TS 16949	
ASTM D4968	EN 10088-2	JIS G3141	
ASTM F36	EN 10130	JIS G3313	

2.2 GM Standards/Specifications.

9985809	GMW3420	GMW17205	GMW17332
GMW3059	GMW14872	GMW17284	
GMW3155	GMW16444	GMW17286	

2.3 Additional References.

- Component Statement of Requirements (SOR)
- Component Technical Specification (CTS) or Production Intent Print
- Detail Production Intent Drawing
- Global Document Management system (GDM)
- Global Propulsion Systems Materials Engineering GMW17294 Data Spreadsheet (available from Global Propulsion Systems (GPS) Engine Materials Engineering)
- Henkel Corporation (Loctite), Madison Heights, Michigan (www.henkelna.com)
- ThreeBond International, Incorporated, West Chester, Ohio (www/threebond.com)
- Production Print

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Facilities. A suitable area or room for conducting testing with a stable and conditioned environment.

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

3.1.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.2 Equipment. Follow the referenced test standard requirements listed in Table 2 and Table 4.

3.1.3 Test Vehicle/Test Piece.

3.1.3.1 RCM Test Specimens Preparation. Specimens shall represent the ends of the roll or sheet. End specimens shall be at least 50 mm from the trimmed edge. Coated roll or sheet shall be from the beginning or end of a run, provided it meets the Production Intent Print dimension requirements. Precondition specimens at 20% Relative Humidity (RH) to 70% RH and 23 °C for at least 16 h before testing.

3.1.3.2 Part Test Specimens. Specimens may be cut from production parts provided there is sufficient flat contact area for at least two (2) test locations and space for clamping down the test area. The minimum distance from the bonded stub (12 mm in diameter) outside diameter to any part edge is 20 mm. One or both sides of the coated part may be tested.

3.1.3.3 Metal specimens are prepared to the appropriate standard referenced in this document or production drawing.

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3.1.4 Test Time. Times are an approximation with test hours representing all tests. Calendar time is the longest test.

Calendar time:	60 days
Test time:	700 hours
Coordination time:	20 hours

3.1.5 Test Required Information.

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 titled "Information on ISO Equivalency". 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.

3.1.5.2 Additional Requirements (Engine). See Table 4. Unless otherwise specified, for compound approval, Global Propulsion Systems, North America requires testing only in engine oil and coolant test fluids. Steam resistance is a special requirement for coolant applications and is designated only on specific Production Prints requiring it.

3.1.5.3 Property Requirements (Transmission). See Table 4. 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.

3.1.5.4 Test Fluids. Unless otherwise specified, test coatings designated in 4.3 (see Table 4 and Table 5). Consult the responsible GM engineering fluids or materials group to obtain current fluid information.

3.1.6 Personnel/Skills. Technicians running these tests and performing the adhesive analysis must be source lab qualified as proficient without supervision.

3.2 Preparation. Follow the sampling and test requirements as directed by the relevant standard or this document.

3.3 Conditions.

3.3.1 Environmental 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 (RH) 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 ± 5% RH of the specified numbers, unless otherwise indicated.

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

3.3.2.1 Performance. Table 4 and Table 5 reference GMW3155 as a functional joint specific requirement. Whether the Statement of Requirements (SOR) for the part or component requires GMW3155 or not, placing this standard and all it contains on a production intent print takes effect including GMW3155 for external or peripheral sealing joints. As stated in 3.3.3, GMW3155 may not be waived.

3.3.3 Deviations. Permitted deviations are related to test conditions (e.g., time, temperature, pressure, etc.), however, the tests required by the application may not be waived.

3.4 Instructions. Separation modes (4.3.7) are for reporting the actual coating adhesion test results. Table 4, Composite Requirements, requires only one separation condition be met. When reporting, the actual result (if different from the table requirement) may be used implying the condition of Table 4 was satisfied, or use of the word "PASS" to indicate the condition was satisfied.

3.5 Data.

3.5.1 Accredited Data. GM North America Global Propulsion Systems only. All data must be generated by an ISO 17025 or ISO/TS 16949 accredited lab.

3.5.2 Minimum Data for Qualification. A minimum of three (3) production batches or lots from roll or sheet stock shall be tested. Use the Global Propulsion Systems Materials Engineering GMW17294 Data Spreadsheet

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(available from Global Propulsion Systems (GPS) Engine Materials Engineering) when reporting results. This data is attached to the certificate at time of approval.

3.6 Safety. This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., 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 prior to 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.

3.7.1 Test Results. When reporting the data results for approval use a spreadsheet with columns listing the property measured, requirement and the result. Where numerical limits or ranges are specified, report the actual test value. Highlight any value not in compliance. Photographs of coating adhesion results (see 4.3.7.6, and Figure 5) are required in noncompliance situations.

3.8 Document References and Changes. Use the latest published version at the time of submission for approval. The intent of this subsection is to provide part compliance with the latest document requirements, including service parts. This is strictly about managing content change. Any contract or other non-material issues resulting from compliance to this standard are independent and must be resolved by the responsible parties.

3.8.1 Role and Responsibility. After approval, if the referenced standard changes, Global Propulsion Systems expects the tiered supplier (1, 2, 3, etc.,) to monitor industry standard documents for changes and evaluate the impact of the change to determine if it affects required limits. GM is responsible for timely notification to suppliers of its own test standards referenced in this document.

3.8.2 New Data Requirements and Timing. A change herein is defined as procedural and/or a new limit or range requirement. Data is required only where the change level affects specified limits. A tiered supplier only needs to acknowledge awareness and use for procedure only change(s) that do not produce a requirement change (e.g., conversion of a regional to a global standard). A supplier is only required to run or acknowledge a change(s) that occurred since the supplier's initial full data approval. Data must be submitted to Global Propulsion Systems Engine Material Engineering within 180 business days of the published revision in GM Global Document Management (GDM) (for GM Standards), or date document arrives at the external standards contract distributor. Time limits may be extended for regulatory health and safety issues only. No testing is required if the revised document has no changes (revision date only change) or if the changes do not involve fit, form or function as defined in GMW17205.

3.8.3 How Document Changes Affect RCM Compliance. All product produced after the changes are published in GM GDM shall meet the new requirements. Product approved under the previous edition requirements and already in the delivery pipeline or in inventory will be used until the product is used. Proper inventory management practices are implied in the elimination of previously tested parts in a timely manner. This includes marking of new compliance parts to adequately identify conforming stock. Decisions involving regulatory changes will be handled separately, and existing product may be immediately removed as a result.

4 Requirements and Procedure

4.1 Material Requirements.

4.1.1 Metal Specification. Test to the minimum properties specified in the referenced standard.

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4.1.1.1 Purpose. Table 2 is a representation of what is currently supplied to GM globally, for coil or panel metal with minimum standard content requirements, to provide regional supply consistency in quality and performance.

4.1.1.2 Applicability. Typically a 91 cm wide coil is coated, slit and the metal core gasket thickness is 0.20 mm ± 0.01 mm. Only the full hard condition is used. Although not intended as a purchase specification requirement; chemistry, hardness and physical properties are necessary. All the referenced standards of a grade are selected for their equivalence in chemistry, hardness and physical properties, to promote global acceptance.

4.1.1.3 Monitoring Frequency. Upon initial production part approval and continuous for shipment.

4.1.1.4 Criteria. All referenced standards must be available in English, otherwise, the standards cannot be used. International System of Units (SI) are used on all Global Propulsion Systems drawings. If the production intent part print does not specify a cold work condition, the Table 2 non-optional value becomes the default.

4.1.2 Coating Specification. Some part configurations may not be suitable for property evaluation (insufficient area). This document requires test specimens from roll, sheet or parts (reference) representing the production process.

Table 2: Metal Requirements

Metal Grade	Standard	Tested Thickness	Chemical Composition	Cold Work Condition Note 1	Tensile (megapascals) in Cold Worked Condition
1008/1010	ASTM A109 Note 2	Per Print	SAE J403, Type 1008/1010	Temper (T) 3 (¼ Hard)	T3: 310 to 450
				Temper 2 (½ Hard) Optional	T2: 380 to 520
	EN 10130		See Grade DC01 1.0330 per EN 10139	C390	390 to 540
	EN 10139			C490 (Optional)	490 to 640
	JIS G3141 Note 3		JIS G3141	Temper 4 (¼ Hard)	270 minimum
				Temper 2 (½ Hard) Optional	
	JIS G3313		JIS G3313	Temper 8 (⅛ Hard) Optional	270 minimum
				Temper 1 (Full Hard) Optional	550 minimum
301 (Austenitic)	ASTM A666	Per Production Part Print	Type 301	Full Hard (H)	1275 minimum
	EN 10088-2		See Material Number 1.4310 per EN 10088-2 (X10CrNi18-8)	C1300	1300 to 1500
	JIS G4313		SUS301-CSP (Steel Grade)	Full Hard (H) HV430 Hardness Minimum	1320 minimum
				¾ Hard, HV370 Hardness Minimum	1130 minimum
				½ Hard, HV310 Hardness Minimum	930 minimum

Note 1: Custom specific usages for 301 (stainless steel core) like "extra hard or extra full hard" require a minimum yield strength (megapascals) at room temperature that is adequate for the application and placed on the detail drawing.
Note 2: ASTM standard covers only hardness at thickness specified.
Note 3: Tensile is required for the print designated thickness.

4.2 Additional; Coating Finish Quality.

4.2.1 Purpose. This subsection provides the minimum requirements of as received finished gaskets into GM assembly operations. A common and consistent set of requirements was created since, the process of coating and producing gaskets comes from one or more suppliers, each with their own criteria. No separate, nor

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