

ENGINE MANIFOLD GASKETS

GM214M

1 SCOPE. This specification covers the requirements of materials used for engine manifold composite gaskets. The constructional and component features covered by this standard are described below.

1.1 APPLICATION DESIGNATIONS. This document uses the ASTM F868 classification system to describe or specify the individual components in the gasket construction.

1.2 COMPONENT MATERIAL SPECIFICATION PROTOCOL. Gasket fabricators must describe their approved gasket construction elements using the following protocol:

Non-asbestos Facing. Use ASTM F104 line callout and necessary suffix requirements.

Metal Carrier. Use AISI or SAE standards.

Rubber Seal. Use SAE J200 or equivalent, with appropriate suffix requirements.

Plastic Carrier. Use GMP specs.

1.2.1 The gasket construction protocol content and individual component feature data requirements is the responsibility of the fabricator (tier one source) and their sub-suppliers (tier two or three sources). Protocol test requirements must be relevant to the application and type requirements of this standard. GM Powertrain reserves the right to require additional information if the description content or data is considered deficient. GM Powertrain uses this information to describe the approved construction, and maintain content continuity or verification.

1.3 APPLICATION REQUIREMENTS.

TYPE I: Any plastic carrier with molded rubber seal. Current approval is a silicone rubber seal chemically bonded to a glass reinforced nylon carrier per ASTM F868, 2RPR6 (Table 2). Initial usage, 3.1 L Lwr. Intke Man. Gskt.

TYPE II: Any laminated composite gasket made of a double-sided, beater addition reinforced fiber material with a rubber binder, chemically and/or mechanically bonded to a steel core. Current approval is a LCGM per ASTM F868, 2FMF2 (Table 3). Initial usage, LT1 Lwr. Intke. Man. Gskt., P/N 12552928; LT4 Lwr. Intke. Man. Gskt., P/N 12551489.

1.4 LIMITATIONS.

TYPE I: Silicone sealing elements: Continuous service temperature range of -55 to 135°C. Poor resistance to hydraulic fluids (diesel oil, gas, etc.). Design must protect material from continuous fluid exposure. Beware of engine conditions prone to consistent oil dilution with fuel. Low tear resistance. Silicone rubber seal materials are safe for use near oxygen sensors, but are not approved for use in alternative fuel vehicles. Parts made from the silicone rubber compound(s) specified are not post cured and have been adapted for injection molding.

TYPE II: Continuous operating temperature range of -40 to 177°C. Optimum load range of 13 350 to 44 500 N.

1.4.1 The data obtained by these methods are applicable to the material and parts under conditions of the particular test and are not necessarily the same as those obtained in a vehicle.

1.4.2 General, long term, once for initial approval tests are intended to provide 'robust' material and basic part requirements for all specified materials. Short duration tests (<100 h) for specific compounds represent material properties related to functional end use proficiency and material/test consistency, not process control. This specification is not intended for use as a quality control document. Data is required only for purposes of establishing statistically meaningful test values.

1.5 Additional materials may be added to this specification at the discretion of engine materials engineering personnel.

1.6 RESTRICTED AND REPORTABLE CHEMICALS (GM1000M). By 1997 start of saleable vehicles, all materials supplied to this specification must comply with the requirements listed in GM1000M, "Restricted and Reportable Chemicals."

1.7 RECYCLING GUIDELINES (GM502M). Materials developed to this specification shall be optimized to provide maximum end-of-life cycle value utilizing the Recyclability Checklist and GM Recycling Design Guidelines. Recycled content shall be reported to the approving and procuring Materials Engineering Department utilizing the Recycled Content Report Form. Reference the GM Recycling Design Guide, GM502M.

1.8 NOTE TO USERS. To properly reference this standard on a detail drawing requires the following: A title statement referencing this standard number, including the type.

1.9 DRAWING MATERIAL NOTE EXAMPLE. Use the following format when referencing this standard on detail drawings: Gasket must meet GM214M, Type II.

2 REFERENCED STANDARDS.

GM502M	ASTM D297	ASTM D2240
GM1000M	ASTM D395	ASTM D3182
GM9009P	ASTM D412	ISO 25
GMPA66.013	ASTM D471	ISO 9000
9985809	ASTM F607	SAE J200
ASTM F37	ASTM D624	SAE J1344
ASTM F38	ASTM F806	SAE J1351
ASTM F104	ASTM F868	SAE J2236
ASTM F146	ASTM D1329	
ASTM F152	ASTM D1418	

3 MATERIAL SAMPLING REQUIREMENTS.

3.1 Rubber test specimens shall be prepared from slabs to ASTM D3182 dimensional requirements, and vulcanized for a time and at a temperature specified by the material source, unless otherwise specified, with no post cure. Material slabs shall be preconditioned at 50% RH and 23°C for at least 16 h prior to testing.

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3.2 Test LCGM's from production sheet stock with all specified finished treatments. The facing stock properties described in the ASTM F104 line callout are from sheet stock, not coated or encapsulated. Specification values are based on gauge thicknesses from part drawings referencing this document. Parts with thicknesses beyond the stated limits will have different test results. New part sources are required to supply data to the appropriate GM Powertrain materials engineer, any revisions or changes in the gauge limits that would affect table data in this document.

3.3 Material minimum and maximum specification limits are based on a 6 sigma limit spread in (normal distribution) data from a minimum of 6 production lots. Tentative approval - signified by the letter 'T' - will be given based on data from one production and three lab lots. Tier one sources will be responsible for continuing to submit data until the total number of samples is met for full qualification as stated in the first line of this paragraph. Appropriate industry statistical standards, methods or practices should be used when generating data.

3.4 New material approvals shall be based on the median of 5 samples per test unless otherwise specified. Tests designated as **once for initial approval** (not for further statistical analysis) shall be run on one production batch using a minimum of 5 samples, with each test meeting the stated requirements.

3.5 All data must be generated by a GM approved lab, or a lab accredited by the A2LA or Std. Council of Canada. At the discretion of the GM Accreditation Gp., a limited approval may be given to off-shore labs with ISO 25/ISO 9000 accreditation.

4 TEST CONDITIONS.

4.1 GENERAL. Unless otherwise specified, materials whose test results are affected by temperature and humidity must be tested @ 23°C room temperature and 50% RH humidity. Test all other materials from 30 to 80% RH @ 20 to 30°C. Unless otherwise indicated, all test conditions must be within ± 2 h, $\pm 2^\circ\text{C}$ and $\pm 5\%$ RH of the specified numbers.

4.2 Tests shall be conducted using the latest issue of the test methods indicated. This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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.

4.3 Conduct LCGM tests following the conditioning period specified in ASTM F868 for the appropriate materials. Use ASTM F104, Type I sample condition requirements if none are specified.

5 REQUIREMENTS: MATERIAL.

5.1 RUBBER (R). All materials must meet the general requirements (Table 1). Each approved material must also meet its own table or section requirements. Individual material property tests represent characteristics that are significant to the intended usage per agreement between the material supplier and GM Powertrain materials personnel.

5.1.1 All of the following tests are **once for initial approval** unless otherwise specified on the part detail drawing or the GP warrant for the designated part number.

5.1.2 Long Term Heat Aging. Test slabs according to temperatures indicated in Table 1 per SAE J2236 material guidelines. If material is anisotropic, report results in the direction of highest tensile strength.

5.1.3 Long Term Fluid Aging. Test slabs according to conditions indicated in Table 1. Use compounds meeting SAE J2236 definition requirements.

5.1.4 Low Temperature Retraction, TR₁₀, ASTM D1329.

5.1.5 Fuel Aging. Use sufficient samples to permit data for test Sequence 1 and Sequence 1 and 2 combined.

Sequence 1: Soak 1 ± 0.1 h @ 23°C in ASTM Fuel C. Immediately follow with 70 h @ 23°C in Fuel C vapor. Suspend sample over fuel inside test tubes per ASTM D471. Test slabs must meet Table 2 requirements.

Sequence 2: Remove samples and dry for 24 h @ 225°C in air circulating oven. Test slabs must meet Table 2 requirements.

5.2 COMPOSITE GASKETS.

5.2.1 Type II: Laminated Composite Gasket Material (LCGM) per ASTM F868, 2FMF2 (Table 3); F=cellulose, inorganic filler with nitrile binder per ASTM F104, F729900B7M5; M=steel, grade AISI 1008.

5.2.2 Composite Requirements. See Table 3.

5.3 REGRIND OR REPROCESSED MATERIAL.

If pre-consumer or post-consumer materials are used, it is the responsibility of the fabricator and base material source(s) to establish what level can be used, the number of reuses, blend ratios, etc. and provide data that the part drawing requirements can be met at that recycled content level. Only dedicated, reprocessed approved materials can be used based on agreement between the fabricator and end user. The GM502M, Recycling Design Guide will help define process requirements.

6 SUGGESTED COMPOUND VERIFICATION.

Inherent compound properties and test procedures that may be used to identify the specified rubber and plastic materials are listed below. Check the appropriate table for property values.

Infrared Characterization Scan
Capillary Rheometer
Mooney Rheometer
Specific Gravity
Thermal Analysis Characterization Scan

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7 REQUIREMENTS: PART.

7.1 GENERAL. All finished parts with 'R' and/or 'P' classification codes must meet the following requirements (Table 1). All of the following tests are **once for initial approval** unless otherwise specified on the part detail drawing or the GP warrant for the designated part number. The tier 1 source is responsible for these items.

7.1.1 Color. The rubber seal material must be uniform in finish, color and meet all the requirements of this specification and any referenced subsidiary specifications, drawings, or other documents. See detail drawing.

7.1.2 Odor Test. Test part within 6 h of the minimum time required for an emergency shipment to reach any GM assembly location.

7.1.3 Appearance Criteria. No fully cured parts shall have these conditions:

- a. Surface irregularities (knot, splay, and flow lines or internal porosity) of gasket that would be objectionable or cause functional failure.
- b. Irregular color.
- c. Seal tearing upon demolding due to low hot tear strength.
- d. Distortion that would not permit proper assembly, pass dimensional requirements or lead to functional failure.
- e. Striation or delamination.
- f. Excessively soft or tacky to touch.
- g. Required identification must be legible (Item 9).
- h. Sharp edges.
- i. Eyelet splits or cracks at 2X magnification.
- j. Bubbles or creases in surface face stock. Tearing of facing stock, especially around eyelets.
- k. Protruding tanged metal core ends visible at surface of facing stock.
- l. Other irregularities that would be objectionable in appearance to the customer or cause functional or durability failure.

7.2 VOLATILITY. Test to GM9009P according to the requirements specified in Table 1 for silicone rubber only.

7.3 FACING TO NONPERFORATED CORE ADHESION. Immerse a 50 x 50 mm production part sample in MEK for 60 minutes @ 23°C. Remove sample and immediately after placing it on a counter top, exert moderate finger pressure laterally along the wet sample upper surface. Any facing that slides from the main core or floated off during immersion is unacceptable. Multiple samples must be physically separated during testing.

7.4 BENCH TESTING. Initial qualification testing will be conducted by the NAO Sealing Lab or GM Powertrain approved test facilities using the required equipment, fixtures and procedures. The number of tests and samples will be negotiated between the user and supplier. The release responsible engineer must supply the necessary hardware and information required prior to testing.

7.4.1 Sealability. Armstrong World Industries EMALT® or approved test unit. Test specimen is a ring 75.2 and 82.5 mm o.d. Internal pressure, 0.0966 MPa of nitrogen. Run at the external load(s) specified (Table 3) and report the leak rate (Table 3).

7.4.2 Hot Shear Test (Nonperforated Comb). Initial qualification testing or process/material change to include "Hot Shear Test". Test piece is a section of the production gasket approximately 95 mm length x 30 mm width made from the end sections of the production gasket. The test fixture consists of 2 sets of 19 mm thick x 109 mm length x 33 mm width aluminum bars with the surfaces facing the test sample machined to 15 - 25 μ in. Holes are drilled at each end of the bars to accommodate fixture mounting and simulated flange conditions. The fasteners used to mount the fixture in the tensile machine are 11 mm fasteners. The fasteners used to represent flange conditions are 3/8 in. in which the test sample is clamped between the aluminum bars. The applied fastener load is sufficient to achieve 20.7 MPa flange clamp load. The mounted sample and fixture are heated for 10 minutes at 121°C. For those extensometers without a hot box, immediately mount the fixture using the distance equivalent to the assembly. Using a 5 mm/minute crosshead speed pull the sample until the yield point of the metal is reached. Plot curve of force (N) on a y-axis and time on the x-axis. Report test piece clamped area (MM²) and the failure mode. Acceptable failure mode of metal yield and insufficient clamp load acceptable. Any evidence of shear, slip, or release of facing stock prior to metal yield unacceptable. See Fixture 1.

7.4.2.1 Fastener size, clamp load, surface finish, temperature and time may be modified to fit specific engine to manifold gasket conditions. The part fabricator and appropriate release engineer are responsible for notifying the controlling group or individual author of this document to include those changes in the document.