



Requirements for Formed-In-Place One Component Room Temperature Vulcanizing (RTV) Sealant for Engine Sealing

1 Scope

This document lists GM global propulsion systems requirements to suppliers developing a formed-in-place adhesive/sealant candidate for eventual use in original equipment manufacturer (OEM) engines produced in, sold to or serviced globally. The intent is a consistent protocol across all engine groups and regions.

1.1 Material Description. This document content is intended for a one component, formed-in-place, moisture cure, room temperature vulcanizing sealant.

1.2 Symbols. Not applicable.

1.3 Applicability. This document identifies the minimum essential test content for a supplier proposed sealant; see technology level two (2), three (3) or four (4) per Table 1. Candidates that can successfully complete the tests (see Table 2) are considered ready for the next stages of approval. Additional production intent sealant requirements are found in the relevant 998XXXX specification or a material specification.

Note: Appendix A and Appendix B capture standard test details for 998XXXX specification development including sealant test frequency requirements after the 998XXXX specification is published.

Table 1: Sealant Technology Level

Technology Level	Description/Intent
1	Production: In GM, known, proven. To refine existing product (998XXXX) or consolidation.
2	Verification: Known, proven, not in GM but competitive production. Needs verification to GM requirements.
3	Development: Known, proven. Needs modification to meet GM requirements.
4	Feasibility: Known, not proven, concept demonstrated, no production applications. Needs significant engineering design, analysis and evaluation.
5	Concept: New product chemistry. Limited production experience. Needs technical direction and solution.

1.4 Remarks.

1.4.1 Drivers for Sealant Development. A candidate must be sponsored by the release responsible group, including intended applications by the release responsible engineer. Sponsorship is granted under the following conditions, see 1.4.1.1 thru 1.4.1.6.

1.4.1.1 Warranty and/or performance improvement.

1.4.1.2 Cost Initiative, presenting a clear supporting business case.

1.4.1.3 Change in regulatory requirements.

1.4.1.4 Impending obsolesce of current production sealant.

1.4.1.5 Significant formulation changes affecting regulation, application, and function.

1.4.1.6 Inadequate availability of existing product. Local content laws prohibit/restrict use of existing sealant.

1.4.2 Rules Governing Testing. The candidate sealant formulation and process must be stable and no further formula or process modifications will occur until all testing is completed.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 1 of 13



Documents

Document Sharing Hub

1.4.3 Efficiency. Running these essential tests saves time and money toward determining a fit-for-use sealant.

2 References

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

2.1 External Standards/Specifications.

ASME B46	ASTM D471	ASTM D3164	ISO 1817
ASTM C679	ASTM D892	ASTM D4339	ISO 4287
ASTM C1183	ASTM D1002	ASTM F2523	ISO 4587
ASTM D297	ASTM D1881	EPA Method 24	SAE J1351
ASTM D412	ASTM D2202	ISO 37	SAE J1864
ASTM D445	ASTM D2468	ISO 845	SAE J2236

2.2 GM Standards/Specifications.

9982257	9986495	GMW3420	GMW16678
9985776	GMW3016	GMW14270	GMW17224
9985809	GMW3038	GMW15735	GMW17332
9985990	GMW3059	GMW16095	
9986350	GMW3155	GMW16270	

2.3 Additional References.

- Approved Test Laboratory List (see Table 2, Note 2)
- APR10324 and APR11721 (www.act-laboratories.com)
- GM Guidelines (see Table 2)
- GM Regulatory Resources (GMR2) Program, portal (<https://gmr2.ttsvcs.com/gmr2portal/Home.aspx>)
- QD412 and A412/AR-14 (www.q-panel.com)
- Taylor Hobson Limited, 1725 Western Drive, West Chicago, Illinois 60185

3 Requirements

3.1 Requirements. Table 2 describes the minimum essential criteria. A candidate is rejected if it fails to meet any requirement. Place initial emphasis on cost, regulatory and shelf-life before starting any laboratory tests. The release responsible engineer and sealant supplier decide the sequence of testing. All tests must be performed before further qualification proceeds.

3.1.1 Slump Resistance. A process requirement measuring the vertical surface stability of sealant using ASTM D2202. Distance on vertical face should not exceed 1 mm. Repeat the procedure after filling the fixture with sealant pumped (sheared) from production intent equipment at the dispensing nozzle. Distance of flow shall remain 1 mm maximum.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 2 of 15



Documents

Document Sharing Hub

Table 2: Minimum Essential Sealant Test Requirements

Requirements	Test Method/Conditions	Value Required	Purpose
A. Product Performance Tests			
1. Total Volatiles (Silicone Only)	GMW17224	0.6% maximum	Prevent oxygen sensor contamination. Only for silicone chemistry. All major sealant suppliers routinely perform this test.
2. Thermal Cycle Test for Life Assessment Note 1	GMW3155 a. Use procedure specified oil. b. 50/50 mix (by volume) of potable water and Extended Life Coolant - Dexcool meeting GMW3420. Test clean and contaminated joints.	No Leaks	Relates to North America and European customer driving cycle. Sealant is exposed to appropriate media. Test results are design dependent. Do not run this until all coupon adhesion is completed. Sealants intended for one media shall only be tested in that media.
3. Coupon Adhesion (dry) Shear (in tension loading)	0.5 mm and 1 mm gap and cure time specified by manufacturer. For plastic to metal coupons, ASTM D3164.	All appropriate substrates and finishes.	Sealant must adhere to a variety of substrates and finishes in dry and simulated oily surfaces.
Shear(wet)	For metal to metal coupons, ISO 4587, 12 mm overlap. See Appendix A, A1.3 Repeat tests with oily surface. See Appendix A, A1.4	Equivalent or better than current production sealant Note 2	Assessing a sealants ability to cut through oil films is critical for in plant and service repairs. Screen sealant prior to availability of joint hardware.
B. Regulatory			
1. MSDS/IMDS	GMW3059 Material Safety Data System (MSDS) or International Material Data Sheet (IMDS)	GM Guidelines IMDS requirements.	Review of ingredients that are potentially harmful to workers or the environment. Guide the disposal.
2. PMRV	Productive Material Review (PMRV) Process. GM North America plants only where sealant is applied.	Within federal, state and local requirements.	GM Regulatory Resources (GMR2) review of Occupational Safety and Health Act (OSHA) and Environmental Protection Agency (EPA) regulations at each GM plant.
3. Volatile Organic Compound (VOC)	GMW3016, EPA Method 24	Within federal, state and local requirements.	Environmental Protection Agency (EPA) regulations at each GM plant. Sealant's contribution to air quality.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 3 of 15

Requirements	Test Method/Conditions	Value Required	Purpose
C. Process			
1. Coupon Adhesion (dry) Shear (in tension loading)	0.5 mm and 1 mm gap and cure time specified by manufacturer. For metal to metal coupons, ISO 4587, 12 mm overlap. Repeat tests after running test coupons through selected washer operations. Let sample coupons sit for 30 minutes before applying sealant	All appropriate substrates and finishes. Equivalent or better than current production sealant.	Sealant must adhere to a variety of washed substrates and finishes. Some cleaner residues reduce adhesion. Since cleaning systems change, monitoring changes is important. Adhesion test coupons can be run through the washing system. Screen sealant prior to availability of joint hardware.
2. Extrusion Rate Shear Sensitivity	Trial with dispensing equipment from production container. Measure application rate from filled cartridges per ASTM C1183 (see template for details). Test un-pumped (sit for 48 h to 72 h) and pumped samples (collected after 5 minute purge).	Change equivalent or better than current production sealant	Material must not be shear sensitive when pumped by production intent dispensing equipment. Sensitivity measured by application rate must remain stable to prevent sealant from leveling (hold dispensed bead dimensions) or flowing off applied surface.
3. Blowout Resistance	ASTM F2523 fixture with shims to control gap. Apply 30 kPa air pressure for 60 s. Test conditions 18 °C to 32 °C at 20% to 90% relative humidity (RH). See Appendix A, Figure A2 GM blowout fixture design.	No blowout ≤1.5 mm gap Start at 0.5 mm gap and increase 0.2 mm gap steps.	Resistance to assembly plant air pressure leak tests. Evaluate sealant vertical gap sealing limits given engine part stack tolerance variation. GM fixture evaluates the impact of the flange design on blowout.
4. Odor (Wet or Cured)	a. ASTM D4339 using previous plant sealant as reference. b. SAE J1351 (when no reference is specified)	Odor must be less than or equal to reference. Rating of three (3) or better.	A curing sealant odor must not be objectionable. A sealant reference is desired, if it has past production of satisfactory olfactory.
5. Shelf Life	As defined by sealant manufacturer. Minimum times at maximum storage temperature of 35 °C.	Twelve (12) months: Customer Care and Aftersales (CCA) 183 days: OEM	Practical global storage stability for shipped containers. GM CCA must have a 12 month minimum stability.
6. Open Time/Work Life	Tack Free Time, ASTM C679	Change equivalent or better than current production sealant.	Plant build schedule as a 20 minute work and 30 minute lunch. Personnel need to know maximum time permitted to complete assembly and still have good sealant flow on joint closure.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 4 of 15

Requirements	Test Method/Conditions	Value Required			Purpose
D. Economics					
1. Cost	United States dollars (USD) per pound times relative specific gravity (wet) gives cost per unit volume. Cost includes use or replacement of existing dispensing equipment. Maintenance contracts included for number of stations.	Cost per unit volume If unit pricing only one value is needed. If cost varies by container, each cost is provided.			Sealants are compared by cost per unit volume and the number of applications per container. Is the sealant cost the same for all size containers? Cost shall be compared with current production sealant.
E. Compatibility					
1. Oil Gel Test. See Appendix A, A1.1 for procedure.	No comparative data needed: Fluid A: 0W20 meeting GMW17332 Fluid B: 5W30 meeting GMW16095	No gel formation (visual).			Contact compatibility with engine oil during sealant curing. Engines are oil filled soon after sealant application.
2. Oil Foam and Stability Foam volume milliliters (mL), maximum. Change in kinematic viscosity. Phase Separation.	No comparative data needed. Fluid A: 0W20 meeting GMW17332 and Fluid B: 5W30 meeting GMW16095 See Appendix A, A1.5. ASTM D892, Sequence One (1) through Sequence Three (3) ASTM D445 at 40 °C Visual	Sequence One (1): (5/10 time 15/0)			Short time effect of cured sealant on contact fluid foaming and viscosity. Foam tendency measured at 5 minutes and stability at 10 minutes. Test at Southwest Research Incorporated (San Antonio, Texas).
		Sequence Two (2): (5/10 time 5/0)			
		Sequence Three (3): (5/10 time 5/0)			
		N/A	N/A	± 3%	
		None	None	None	
3. Concentrated Coolant Foam and Stability. Supporting GMW3420 only Phase Separation	No comparative data needed. ASTM D1881 Visual	Requirements in GMW3420. Increase in volume, 50 mL maximum at 88 °C Break time, 5 s or less at 88 °C Meets volume or break time limits after exposure to sealant. None			Short time effect of cured sealant on contact with fluid foaming. Only for sealants with coolant compatibility.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

December 2017

Page 5 of 15