



Adhesion Promoter Coating for Room Temperature Vulcanized (RTV) Sealants

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: The words **must**, **shall** or **will** as used in this document, are a mandatory requirement.

1.1 Purpose. To define the product, its qualifications for use including application methods and monitoring the applied coating in the end use application. This specification describes a ready-to-use, single source liquid that dries to a thin coating before application of Room Temperature Vulcanized (RTV) sealant.

1.2 Applicability. A remedial surface treatment for machined aluminum or cast grey iron joint surfaces that may be used in engine joint applications to provide the best possible adhesion of RTV sealant to the metal surface. This liquid product is **not** to be used on plastics, composites, or other similar non-metallic components.

1.2.1 The intent of this liquid product is to improve the adhesion of the sealant to clean mating surfaces and not to resolve surface contamination problems.

1.2.2 Terminology. The manufacturer describes this liquid as a chromate free conversion coating. It is a protective surface layer on a metal that; is created by a chemical reaction between the metal, and this chemical solution. This document title; "Adhesion Promoter Coating for Room Temperature Vulcanized (RTV) Sealants" reflects the intended function or benefit of the coating.

1.3 Remarks.

1.3.1 Table 1 describes the ready-to-use liquid properties as received and the dried coating.

1.3.2 Table 2 lists the standard test panels used to test for bond performance.

1.3.3 Table 3 demonstrates the improvement in lap shear adhesion on a single RTV sealant using the Table 2 standard test panels. This Table 3 is **not** to be, used for quality control purposes. It only demonstrates the level of enhanced adhesion possible through proper coating use.

1.3.4 Coating Detection Limits. Currently only point contact thickness measurements verify coating presence (see Table 1 and 3.1.2.1). Because the product dries clear, visual confirmation of coverage uniformity on a machined surface is not possible.

1.3.5 Coating Thickness. The lower value in Table 1 is the minimum level required to provide bonding enhancement. The maximum value is not to be exceeded in the event the coating is applied multiple times. No more than two coatings, wet on wet, or wet over dry, is recommended by the product manufacturer.

1.3.6 Application Temperature and Drying Time. Unless otherwise specified by the product manufacturer, apply this product on the intended surface whose temperature is from 20 °C to 40 °C. Below 20 °C the coverage is less uniform and drying rate slows. Drying time under these conditions is 90 s to 120 s with no air flow and roughly 20 s with one cubic foot per minute air flow. Hot air knives directed at the applied coating can speed drying and warm parts out of a heated washer system can see a 10 s to 30 s dry time. It is the responsibility of the applicator and the product manufacturer to establish the accepted conditions, e.g., process time from applied coating to the RTV sealant bead application, to provide acceptable adhesion.

2 References

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

2.1 External Standards/Specifications.

ASTM A48	ASTM D2578	EPA Method 24	IATF 16949
ASTM D297	ASTM D4339	ISO 845	ISO 17025
ASTM D1002	ASTM D4968	ISO 4587	MIL-A-46146
ASTM D1505	ASTM E70	ISO 8296	

2.2 GM Standards/Specifications.

9986350	GMW3059	GMW15735	GMW17205
GMW3016			

2.3 Additional References.

- 998 Sealant Data Spreadsheet
- Brighton Technologies Group; 1006 Kieley Place, Cincinnati, OH 45317-1100 or <http://www.btgnow.com>
- Dyne Solutions and Dyne Level Testing: <http://www.dynetesting.com/>
- Engine Assembly Document
- GM Regulatory Resources (GMR2) Program; portal [<https://gmr2.ttsvcs.com/gmr2portal/Home.aspx>]
- Production Drawing
- Proper Shipping Instructions
- Proper Storage Conditions
- Relevant Assembly Process Document
- Tetra Technologies Incorporated Engineering and Consulting Services, 710 Avis Drive. Ann Arbor, Michigan 48108

3 Test Preparation and Evaluation**3.1 Resources.**

3.1.1 Facilities. A suitable area or room to conduct, 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 1 and Table 3.

3.1.2.1 Coating Thickness Measurement. Coating thickness is, measured by X-Ray Fluorescence (XRF). The portable XRF tool is a point measurement on the metal surface. Use of a "Niton XL2 NRF" Analyzer or similar equipment, which is properly calibrated to the production substrate and coating chemistry in use, is required for accurate and reproducible results. These devices run \$20 000 to \$30 000 United States dollars each.

3.1.2.2 Liquid Coating Wet Out Contact Angle Measurement. Suitable surface cleanliness measurements for coating application are to be, taken with.

- Surface Analyst Two (2) Device from Brighton Technologies Group.
- Surface Tension Test Fluids; Dyne Solutions. Available from a number of sources. Dyne Level Testing is performed to ASTM D2578 or ISO 8296. Use dyne levels from 30 dynes/cm through 70 dynes/cm. Solution shelf life is approximately five (5) months.

3.1.3 Test Vehicle/Test Piece. See, Table 1, Table 2 and Table 3.

3.1.4 Test Time. Times are approximate and relative to a combination of all tests.

3.1.5 Test Required Information. See 3.5.

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, see the 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 International Organization for

Standardization (ISO) standard and "vice versa". Only use the equivalent standards listed in Table 2. This also means the approved compounds are equivalent.

3.1.6 Personnel/Skills. Technicians running these tests and performing the testing and 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, properties in delivery state and dried coating are to be, tested at +23 °C and with the same test methods. Unless otherwise specified, conduct testing at 50% relative humidity (RH) and 23 °C. If temperature and humidity are known, not to significantly affect test results, use a RH range of 30% to 75% and temperature range of 18 °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.

3.3.2 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.

3.4 Instructions.

3.5 Data. Report the data according to the specified test method or standard document.

3.5.1 Accredited Data. All data must be, generated by an ISO 17025 or IATF 16949 accredited lab.

3.5.2 Minimum Data for Qualification. A minimum of three (3) production batches or lots from the liquid manufacturing process shall be tested. Use the 998 Sealant Data Spreadsheet when reporting results. This data result is attached to the global repository of GM approved materials 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.

3.6.1 Safety Precautions.

3.6.1.1 Due to the liquids very acidic (low pH), nitrile rubber gloves and eye protection are required. Wear an apron to protect clothing from prolonged use.

3.6.1.2 Use of Dyne Solutions for measuring surface cleanliness also requires safe handling practices to avoid skin and eye contact.

3.7 Documentation. Released samples of components or material 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. Report the actual test values regardless of specified numerical limits or ranges. Highlight any value not in compliance. Photographs of coating adhesion results (Table 3) are required.

3.8 Coating Compliance to Document References and Changes. Use the latest published version at the time of submission for approval. After initial approval the purpose of this subsection is to manage future changes and provide approved sealant compliance to those changes in a timely manner.

3.8.1 Role and Responsibility. After initial approval if the referenced standard changes, GM Global Propulsion Systems expects the coating supplier 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. The coating 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 their initial full data approval. Submit data to GM Global Propulsion Systems Engine Material Engineering within 180 business days of the published revision (dd/mm/yy) in GM Global Document Management ((GDM) for GM Standards Database) or date document arrives at the external standards contract distributor. Extended time limits given for regulatory health and safety issues only. No testing is required if the revised document has no changes (revision date only change) or the changes don't involve fit, form or function as defined in GMW17205.

3.8.3 How Document Changes Affect Liquid Compliance. All product produced after the changes are published in GM Global Document Management shall meet the new requirements. Use product approved under the previous version requirements and that is already in the delivery pipeline or in inventory until the product reached the expiration date. Regarding decisions involving regulatory changes; handle separately as immediate removal of existing product may result.

4 Requirements and Procedure

4.1 Requirements on Delivery.

4.1.1 Ready-to-Use Liquid Requirement. See Table 1.

4.1.2 Color. See Table 1. Liquid becomes a darker yellow with age.

4.1.3 Hydrogen Ion Concentration (pH). See Table 1.

4.1.4 Concentration; Total Acidity. Measure the concentration level of the as received liquid and for monitoring changes after use in recovery recirculation systems or long term storage. See Table 1.

4.1.5 Odor (ASTM D4339). The liquid shall not have an objectionable odor in the uncured state and shall not have a perceptible odor during or after drying. Use potable water as a reference. GM Global Propulsion Systems Engine Materials Engineering recommends a ventilated area for all ready-to-use liquid. This reduces the likelihood of objectionable odor.

4.1.6 Specific Gravity. To be determined, and set as part of the specification, at the time of approval. For uncured adhesive/sealant use the ASTM D297 pycnometer method or ISO 845.

4.1.7 Storage Stability (4.3.2 in GMW15735). The material when conditioned to the recommended supplier storage conditions (8 °C to 21 °C) must be capable of passing all the performance requirements in Table 1.

4.1.7.1 Shipping Stability (4.3.1 in GMW15735). As shipped, the material shall be capable of passing all the performance requirements in Table 1. Run the low temperature stability Cycle B per GMW15735.

4.1.7.2 Shelf Life. The shelf life of the liquid, as shipped, in closed containers shall be a minimum of 24 months at a temperature not to exceed 28 °C. Shelf life of the material commences upon receipt of the material from the manufacturer. In such cases where the shelf life exceeds the minimum 24 month requirement, the manufacturer shall identify and affix a "Do Not Use After" date on the shipping container that shall establish the shelf life; however in no case shall the shelf life be less than the minimum 24 months. Expired adhesive/sealant is under no circumstances used for production build.

4.2 Dry Coating Requirements.

4.2.1 Thickness. See Table 1

4.2.2 Noncorrosive to Metals. See Appendix A, A1.1 for procedure. Evaluate the compatibility of cure reaction by-product with metals. **Note:** C2 = 1008/1010 steel, C3 = AA319 or AA356T6 aluminum. For coated metals, test on production approved coating as specified on the sealant applied joint.