



Resin, Impregnation, Heat Cured (Catalyst Ultraseal DB42 with a 1.5 minute to 3 minute Resin Gel Time)

1 Scope

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

1.1 Material Description. This specification describes requirements and tests for a thermocure resin intended for the impregnation of porous metal castings and powdered metal components for transmission and engine applications. See 7.1.2.

1.2 Symbols. Not applicable.

1.3 Applicability.

1.3.1 Application Limit. Intended as a single application to components that do not initially pass final leak test due to porosity in the metal. Multiple applications, three (3) or more, of any sealant typically indicates large porosity. For engine blocks and transmissions usually up to two (2) impregnations are allowed. In stating this we assume the impregnation system is being operated within specification and operates a modern process – dry vacuum, correct vacuum level, good chemical control, etc.

1.3.2 Usage and Temperature Limits. After impregnation, under no circumstances should the continuous or excursion product temperatures of the material manufacturer be exceeded. This is a Class B product suitable for components operating in the continuous temperature range (see Table 1, Class B). Discuss with the resin supplier the nature and frequency of the excursions before making a selection. See Table 1. Do not confuse this with storage shelf life, 3.9.4.

Table 1: Temperature Classification

Class	Maximum Continuous Temperature Limit (°C) ^{Note 1}	Maximum Excursion ^{Note 1} Temperature Limit (°C)
Class A	149	177
Class B	175	205
Class C	225	260
Class D	260	295

Note 1: Excursion time at temperature is determined by the resin manufacturer. Consult with manufacturer regarding the specific application before selecting the product.

1.3.3 Process Sequence.

1.3.3.1 The product is applied after all heat treatments and before or after final machining.

1.3.3.2 This product is only intended to seal porosity and no other process defect.

1.3.3.3 Use of impregnation product is strictly a temporary measure to resolve a porosity condition. The condition limits, under which use is allowed, are defined in the Component Technical Specifications (CTS) or the Statement of Requirements (SOR) for the part or component. If no provisions are stated, no impregnation is permitted.

1.3.3.4 Precautions. Resin use is recommended only as a temporary preventative measure to fill porosity contributing to air or fluid leak(s) until a metal forming process solution to eliminate porosity leakage is satisfactorily completed. The long term durability of this impregnation product is not known because it is rarely

used. GMW3155 testing of impregnated parts is highly recommended to assist in defining long term sealing performance.

1.3.3.5 Expired Product. Even if properly stored (see 3.9.4) **do not** use this product past its expiration or use before date. **Do not** contact GM Materials Engineering and request permission to use expired product.

1.4 Remarks.

1.4.1 This material is introduced into a clean and dry part by a vacuum and/or pressure process. It reaches a cured state with the addition of heat.

1.4.2 Air leakage of the part or component determines before and after if the impregnation process is suitable. Consult the Statement of Requirements or Component Technical Specifications for the part or component.

1.4.3 Resin discoloration may occur after impregnation. This is normal and shall not be cause for rejection of the component.

1.4.4 Normally pressure penetration testing (3.10.4.5) occurs on non-machined specimens, however, since machined parts are impregnated, the testing requires machined and etched surfaces.

1.4.5 For Aluminum Military (MIL) rings (see 3.10.4.1) order several thousand at a time. The alloy specified in the MIL specification is 99% aluminum, however 95% or higher is acceptable to manage cost.

1.4.6 For Iron MIL Type II rings order a small number as they are rarely used. The Ultraseal test ring produced by Oilite (Beemer) is acceptable. It is within the porosity limits defined by MIL (around 20%) and is suitable not just in a laboratory but also through an impregnation line.

1.4.7 Impregnation MIL Standard Limitations. MIL specifications listed in Section 2 are not maintained/updated. Just because an impregnant is on the MIL-I-17563C approval list doesn't mean it will pass the requirements in this document. MIL-I-17563C is a supply specification, meaning the approval is tied to the location of manufacture at the time of approval. Over time locations are added, move and equipment changes, so old approvals may not be relevant. A number of the referenced material specifications in MIL-I-17563C have been superseded resulting in considerable time finding specified materials or identify valid alternatives and requiring confirmation from Naval Sea Systems Command (NAVSEA) that the selected material is allowed. One or both of the materials needed for the environmental conditioning tests is not available and NAVSEA must supply the material. Our 998 ignores the MIL irrelevant parts, e.g., weight per gallon, etc., which are not in any way related to performance.

2 References

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

2.1 External Standards/Specifications.

ASTM D92	ASTM E100	ISO 2592	MIL-I-17563C
ASTM D2196	ASTM E1252	ISO 3675	MIL-STD-276A

2.2 GM Standards/Specifications.

9986153	GMW3221	GMW14270	GMW17205
GMW3059	GMW3420	GMW16444	GMW17332
GMW3155			

2.3 Additional References.

- Beemer Precision, Incorporated (Oilite), 230 New York Drive, Post Office Box 3080, Fort Washington, Pennsylvania 19034-0980
Email: info@beemerprecision.com
- Component Technical Specification (CTS).
- Metal Powder Products, 16855 Southpark Drive, Suite 100, Westfield, Indiana 46074-9373.
- Naval Sea Systems Command (NAVSEA), 1333 Isaac Hull Avenue, South East, Washington Navy Yard, District of Columbia 20376
- Statement of Requirements (SOR).
- Ultraseal International, Lyons Park, Coventry, CV5 9PF, United Kingdom

2.3.1 Document References and Changes. Use the latest published version at the time of submission for approval. Change(s) in an existing test method or procedure referenced in a GM Standard must be evaluated for compliance or non-compliance to the document limit(s) at the time of the change.

2.3.2 Applicability. To maintain approved source compliance as running changes occur. Typically, standard's content is reviewed and revised every five years (e.g., "refreshed"). See section 9 Release and Revisions.

2.3.3 Monitoring and Frequency. GM Global Propulsion Systems (GPS) expects the Tier one (1), Tier two (2) and Tier (3) supplier to monitor external standards 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. Check for changes every third month after initial production part approval. Less monitoring is required if the pending changes are communicated by a known committee or team release timing schedule.

2.3.4 Data and Timing for Change Compliance. Data is required only where the change level affects specified limits. Data must be submitted to GM GPS Engine Material Engineering within 180 business days of the published revision (dd/mm/yy) 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 the changes don't involve fit, form or function as defined in GMW17205.

2.3.5 Data Reporting Criteria. Test and report only the changes (existing or new) since the initial qualification. Suppliers must not make an impact verification decision before sharing the information with GM GPS Materials Engineering. Both parties must review the information before a formal decision is reached. All relevant data will be kept by both parties to the limit required by their company record retention protocol. For source and material approvals already listed in the GM Material Approved Source List, only the new data file needs to be entered. No testing is required if the latest document has no changes from the previous one, or from the requirements at the point of initial approval (revision date only change).

3 Requirements

3.1 Requirements on Test Specimens. Conditioning as specified in the referenced test. Reference GMW3221, Code A for unspecified conditioning.

3.1.1 Minimum Data Requirements. Compliance testing for initial approval will consist of data submitted from a minimum of three production batches. One of those batches will be at least 12 months old to evaluate compliance to 3.9.4 shelf life to the required tests in that paragraph.

3.2 Base Resin. Blend of methacrylate monomers, see 3.10.1.

3.3 All materials supplied to this standard must comply with GMW3059, Restricted and Reportable Substances, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

3.4 Visual Appearance. Clear, amber liquid.

3.4.1 Fluorescence. The purchased product must fluoresce when examined (corrective vision) after illumination with a 365 nm black light. Use a black light intensity of 400 $\mu\text{W}/\text{cm}^2$ to 800 $\mu\text{W}/\text{cm}^2$.

3.5 Coolant Resistance. Test two (2) impregnated specimens. No air leakage is permitted. See 3.10.4.7 procedure.

3.6 Oil Resistance. Test two (2) impregnated specimens. No air leakage is permitted. See 3.10.4.8 procedure.

3.7 Automatic Transmission Fluid (ATF) Resistance. Test two (2) impregnated specimens in designated transmission fluid per GM part/component Statement of Requirements (SOR). If no ATF is defined, use the default ATF Dexron® VI per 9986153 and GMW16444. No air leakage is permitted. See 3.10.4.9 procedure.

3.8 Resin Quality Control Tests.

3.8.1 Viscosity. ASTM D2196, Method A (DV-I Prime Brookfield viscometer, spindle Number two (2), 60 rpm, 5 MPa s to 9 MPa s).

3.8.2 Specific Gravity. ASTM E100 or ISO 3675 hydrometer, 0.910 sp.g to 0.935 sp.g.

3.9 Process Control Tests.

3.9.1 Resin Stability, Not Catalyzed. Minimum 1440 minutes. See 3.10.2 for the test conditions.