



Requirements for Liquid Anaerobic Compounds Used for Thread Locking, Retaining and Sealing

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.

1.1 Purpose. This procedure describes tests measuring properties of single component, self-curing liquid anaerobic compounds used for locking, retaining, or sealing of machined flange surfaces, and threaded or cylindrical assemblies. Anaerobics used for sealing casting porosity are not covered by this standard.

1.2 Applicability.

1.2.1 Classification (see 4.2 thru 4.3.18). Relate to product selection, consistency and short-term compatibility in application use and storage. Comparison of production compounds is permitted.

1.2.2 Performance Tests (see 4.3.19). Evaluates the retaining and sealing required in locking, retaining or sealing of machined flange surfaces, threaded or cylindrical assemblies in contact with the adequate fluids. They permit comparison and measure the performance level of production compounds.

1.2.3 Finish Influence. General tests for breakaway and prevailing torque, static shear strength (pin and collar), and fluid compatibility use test parts with plain finishes to minimize their effect on anaerobic test results. These standard tests achieve repeatable and reproducible results to compare liquid anaerobic compounds. The tester and end user may test production released finishes to measure their influence on general or performance test results in the specified documents.

1.2.3.1 Base Metal Influence. Tests for anaerobic strength and cure are affected by the surface chemistry of base metals. The tester and end user should test no finish or uncoated production released surfaces to measure their influence on general or performance test results in the specified documents.

1.2.3.2 Applicable Anaerobic Compounds. Global materials referencing this document are listed in Table 5. Table 5 content consists of designated older active standards (e.g., GM North America 998XXXX) where the category test protocol may not be clear (see Appendix A, Table A1). New releases following publication will identify the proper test category referencing this document.

1.2.3.2.1 Managing Change. Until the older standard (e.g., GM North America 998XXXX) content is revised or refreshed, any changes in approved products or suppliers to that standard will follow the mandatory tests in the appropriate Appendix A, Table A1 category of this standard and not the test content of the unrevised standard (e.g., GM North America 998XXXX).

1.2.4 Related Documents. This document does NOT cover pre-applied thread sealants. Those applications are covered in GMW14657.

Note: GMW14657 is managed by the GM Fasteners Committee.

1.3 Remarks.

1.3.1 This document identifies which tests (see Appendix A, Table A1) are assigned to each functional application (e.g., locking, sealing, retaining, etc.)

1.3.2 Test Selection. This document provides test selection content criteria for creating and revising anaerobic specifications. Use Appendix A, Table A1 to select the appropriate tests for the chosen anaerobic use.

1.3.2.1 In Appendix A, Table A1, tests marked "M" are mandatory and must be part of the standard (e.g., GM North America 998XXXX).

1.3.3 This document is referenced in specific standards (e.g., GM North America 998XXXX) to maintain a focal point for test content, procedures, and eliminates the need to reproduce them in each document.

1.3.4 Media. Approving global anaerobic formulations presents test selection challenges for determining media compatibility (see 4.3.16). Since initial standard (e.g., GM North America 998XXXX) approvals may be by region, media testing may only represent regional and application-specific choices. Regional document authors should consider using standard test media with controlled, single source formulations (e.g., ASTM D471, standard test liquids) that are moderately more aggressive to anaerobic than current production fluids. Further, consideration should be given to testing all potential media use as part of the initial approval. Authors are encouraged to contact the Global Powertrain Integration and Sealant Specialist Team, release responsible engineer, manufacturing liaison engineer, and the anaerobic supplier to coordinate and identify all appropriate media.

2 References

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

2.1 External Standards/Specifications.

ASA Standard Number B4.1	ASTM D3828	IEC 811	ISO 9000
ASTM A109	ASTM D4562	ISO 188	ISO 10123
ASTM B36	ASTM D4800	ISO 898/1	ISO 10964
ASTM B209	ASTM D5363	ISO 898/2	ISO 17025
ASTM D445	ASTM D5423	ISO 965	JIS B 0209
ASTM D471	ASTM D5649	ISO 3104	JIS B 1051
ASTM D573	ASTM D5657	ISO 3679	JIS B 1180
ASTM D1084	ASTM D6396	ISO 3680	JIS B 1181
ASTM D1141	ASTM E100	ISO 4587	SAE J429
ASTM D3278	FF-N-836	ISO 4759/1	SAE J1681

2.2 GM Standards/Specifications.

9985266	9985399	GMW3420	GMW15357
9985283	9985460	GMW14657	GMW15359
9985299	9985729	GMW14658	GMW15735
9985306	9985768	GMW14729	GMW16676
9985345	GMW3155	GMW14735	

2.3 Additional References.

- Appropriate Test Procedure (see 4.3.9)
- GM Bill of Material (see 4.3.13)
- Regional Standard Requirements (see 4.3.15)
- Regional Test Document for Sealing Test Specimens (see 3.3.6)
- Regional Test Document for Static Shear Test Specimens (see 3.3.5)
- Relevant Referenced Test Document for Gauging (see 3.3.3)
- Relevant Requirements in the 998 specification (see section 8)
- Relevant Test Method (see 4.1.3.1)
- Specific Compound Specification (see 4.3.5)
- Specified Test Documents for Torque Test Specimens (see 3.3.1)
- Specified Test Joint Fastening Specifications (see 3.2.1.1)
- Specified Test Procedure for Preparation (see 4.1.2)

2.3.1 Documentation.

- American Society for Quality Control (ASQC)/Automotive Industry Action Group (AIAG) Production Part Approval Process (PPAP) Manual

2.3.2 Web Sites.

- ACT Laboratories web site is; www.actlaboratories.com.
- Q Panel web site is; www.q-panel.com.

3 Resources

3.1 Facilities. A suitable area or room for conducting testing with a stable and known environment. See 4.2.1.

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

3.1.2 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.

3.2 Equipment. This section lists items not described in the referenced test standards.

3.2.1 Required Basic. All test labs must have the following equipment unless otherwise specified. Minor variations between test labs are permitted provided it doesn't alter test results as verified in a common part test with a GM qualified laboratory(s).

3.2.1.1 Torque Measuring Device. Capable of measuring the specified test joint fastening specifications. A digital unit capable of torque/angle measurement, e.g., Sensor I from Ingersol Rand meets the requirements.

3.2.1.2 Oven. Capable of meeting ISO 188, IEC 811 or ASTM D5423, type one (1) requirements. Unit chamber interior must be of sufficient size to hold test specimens or fixture(s).

3.2.1.3 Scraper (see Figure 1) made of stainless steel, or 1008/1010 steel with nickel chrome finish.

3.2.2 Optional Equipment.

3.2.2.1 Timer (stopwatch) measuring in tenths of seconds.

3.2.2.2 Reflux condenser (fluid compatibility).

3.2.2.3 Heater (fluid compatibility).

3.2.2.4 Thermostat (fluid compatibility).

3.3 Test Vehicle/Test Piece.

3.3.1 Torque Test Specimens (Nut and Bolt). Use the test specimens described in each specified test document.

3.3.2 All released GM North America 998XXXX specifications before the year 2000, for breakaway and prevailing torque used un-oxidized finish hexagonal (hex) head bolts 3/8 inch size, 16 threads per inch, Unified National Coarse (UNC) thread series, Class two (2) fit (3/8-16 UNC, undamaged) Grade 5 in accordance with SAE J429. The minimum length is 25.4 mm (1 in). The hex nuts same thread and grade were Type II, Style four (4), nominally 8.3 mm (21/64 in) thick in accordance with federal specification FF-N-836. All new or revised 998XXXX specifications after year 2000 use Table 1.

Table 1: Specimen Requirements and International Standards

Material	Steel	Bolt	Nut
Thread	Tolerance	6g	6H
	International Standards	ISO 965 JIS B 0209	ISO 965 JIS B 0209
Mechanical Properties	Class ^{Note 1}	d < 39 mm 4.8	9 to 12
	International Standards	ISO 898/1 JIS B 1051	ISO 898/2
Tolerances	Product Grade	A	A for d < M16
	International Standards	ISO 4759/1	ISO 4759/1
Finish	Normal	Plain	Plain
	Optional	JIS B 1180 (finished)	
Associated Bolts		JIS B 1180 M10 P1.5 x 20 mm	
Associated Nuts		JIS B 1181 M10 P1.5	

Note 1: Property class designations follow ISO 898/1.

3.3.3 Gauging. Follow the requirements described in the relevant referenced test document for all test specimens used in one series of tests.

3.3.4 Criteria for Test Standards without Gauging Requirements. For referee purposes, gauge threaded test specimens using variable thread gauging. Remove test specimens for the following reasons.

3.3.4.1 Damaged thread forms, tight or excessively loose fits, sticking or galling.

3.3.4.2 Rust or visible corrosion.

3.3.4.3 Poor or irregular finish, drips or sags.

3.3.5 Static Shear Test Specimens (Pin and Collar). Unless otherwise specified by the regional test procedure, use test specimens described in ASTM D4562 or ISO 10123. See Table 3 category references.

3.3.6 Sealing Test Specimens (Pipe Tee or GM Sealing Flange Test Fixture). Unless otherwise specified by the regional test procedure, use test specimens described in ASTM D5657 or ASTM D6396. See Table 3 category references.

3.3.6.1 For each test, use a minimum of five (5) parts or assemblies per material batch for Production Part Approval Process (PPAP) submissions.

3.3.6.2 All test specimens are taken from one production lot or batch.

3.4 Test Time. Cumulative based on every batch testing of mandatory requirements (see Appendix A, Table A1).

Calendar time: 3 days

Test time: 24 hours

Coordination time: 72 hours

3.5 Test Required Information.

3.5.1 Appendix A, Table A1 identifies the test and frequency after initial approval.

3.5.2 Initial Qualification. New or reformulated anaerobic shall be tested to all relevant tests of its category see 7.1.10. See Appendix A, Table A1.

3.6 Personnel/Skills. Technicians (operators) must be experienced in these fixture and test procedures. It is an acquired skill learned through application. We recommend dedicated personnel for this procedure.

4 Procedure

4.1 Preparation. Follow the test specimen preparation procedures listed in Table 2 for the specified tests.

Table 2: Specifications Describing Anaerobic Preparation of Test Specimens

Test	Specification	Specification
Static Shear Strength. (Pin and Collar)	ASTM D4562 ASTM D5363	ISO 10123
Torque (Thread Forms)	ASTM D5649 ASTM D5363	ISO 10964
Sealing: Thread Forms (non-pipe thread) Tee (pipe thread) GM fixture (rigid flange)	ASTM D5657 ASTM D6396	Not applicable
Wicking	ASTM D5363	Not applicable
Lap Shear	Not applicable	ISO 4587

4.1.1 The accuracy of polymerized bond strength results, depend on the operator, substrate preparation, test equipment and bonding process assembly conditions. Unless otherwise specified between manufacturer and user, the anaerobic manufacturer specifies bonding conditions.

4.1.2 Use the specified test procedure for preparation. Required tests without anaerobic application procedures shall follow the preparation requirements described in 4.1.3.

4.1.3 To ensure complete information is available to the tester (independent lab), the anaerobic manufacturer shall furnish numerical values and specific information for the following:

4.1.3.1 Surface preparation procedure immediately before adhesive application. Cleaning and drying of test surfaces, and any special surface treatments that are not limited by the relevant test method.

4.1.3.2 Conditions for applying the anaerobic, including the rate of spread or film thickness, number of coats, if applied to one or both surfaces, and drying conditions between coats.

4.1.3.3 Assembly conditions, including time, temperature, and if an open or close assembly is used.

4.1.3.4 Curing conditions, including the amount of pressure/load applied, time under pressure, and the temperature maintained during curing. State if the temperature is either room or bondline.

4.1.3.5 Unless otherwise specified, conditioning procedure before testing, including time, temperature and relative humidity.

4.1.3.6 The anaerobic manufacturer can specify a range for any variable or combinations of variables, provided any value within that range will not significantly affect test results and is agreed upon in writing between manufacturer and user.

4.2 Conditions.

4.2.1 Environmental Conditions. Office-type air conditioning to minimize dust, maintain room temperature at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, and at 40% to 50% relative humidity for curing stage of testing only. Once test specimens are cured, tests may be conducted to the specified test procedure conditions.

4.2.2 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.

4.3 Instructions.

4.3.1 Color. Compound color is negotiated between supplier and user.

Note: Color is specified on the regional standard (e.g., GM North America 998XXXX) per ASTM D5363.

4.3.1.1 Color Change Management. Use of non-specified colored compound is grounds for rejection. A color waiver by the user product engineering department (not manufacturing) for a specific compound can be granted to the manufacturer. A waiver is limited up to and including 12 months from the date of issue. The waiver must be kept on file, and be available upon request. A copy of the waiver must accompany all affected compound shipments. Waivers only apply to compound batches manufactured or colored in their designated time limit.