



Preapplied Adhesive for Threaded Fasteners

1 Scope

This specification describes the test procedures and performance requirements used to evaluate the locking ability of preapplied adhesive coatings on threaded fasteners.

1.1 Material Description. The adhesive is mechanically applied in liquid form to the specified threads on the fastener. After drying, the fastener is clean and dry and can be handled normally until it is installed. Upon fastener installation, the adhesive will be activated and begin to cure. The fully cured properties are expected 72 h after installation. Three (3) grades of material are covered by this specification.

1.1.1 Grade A: Regular strength grade for use with fasteners with serviceability requirements with temperatures up to 135 °C. Lower adhesive strength allows for service removal of bolts with less potential for fastener and/or mating thread damage.

1.1.2 Grade B: Higher strength grade with locking/sealing performance up to 135 °C. Use of this material is not restricted to larger fastener sizes, but potential service removal concerns should be considered before use with M6 or smaller fasteners.

1.1.3 Grade C: Higher strength and temperature resistant grade with locking/sealing performance up to 200 °C. Use of this material is not restricted to larger fastener sizes, but potential service removal concerns should be considered before use with M6 or smaller fasteners.

1.2 Symbols. Not applicable.

1.3 Applicability. Threaded fasteners that require a preapplied adhesive for chemical locking and sealing to prevent self-loosening due to shock, vibration, and thermal effects.

1.4 Remarks. The preapplied thread locking adhesive compounds are dry to the touch and remain inert on threaded fasteners until they are engaged into the mating threads. The shearing action/forces of assembly activate the adhesive. After proper cure time and temperature, the adhesive hardens to form a chemical bond between the mating threads. This bond prevents loosening of fasteners from shock, vibration, and thermal effects.

Note: A fastener with preapplied adhesive shall not be reused.

1.4.1 The preapplied adhesive material approved to this specification is designed to perform up to the temperatures stated in 1.1. For severe service conditions, such as higher temperatures, vibration, and environmental conditions, it is recommended that the fastened joint be validated using intended components, preapplied material and process before release.

1.4.2 The performance of the preapplied adhesive material may not perform as well as expected if coated parts are exposed to excessive humidity, oil and dirt. It is recommended that coated parts be handled with care after coating. Similarly, over time, the coating material will degrade from oxidation and other environmental effects. If coated parts are to be stored for more than one (1) year, it is recommended that the appropriate performance test be performed prior to installation.

1.4.3 Not all finishes (coating/plating) are tested to be compatible with all GM approved preapplied adhesive materials. It is recommended that the appropriate performance test be performed to ensure compatibility.

2 References

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

2.1 External Standards/Specifications.

ASTM F467M
DIN 267-27

ISO 10964

ISO 16047

SAE/USCAR-10

2.2 GM Standards/Specifications.

9985809	GMW3044	GMW3221	GMW16072
9986153	GMW3059	GMW3359	GMW16551
9986333	GMW3179		

3 Requirements**3.1 Requirements on Test Specimens.** Reference GMW3221.**3.1.1 Condition of Parts.**

3.1.2 Pre-Coat Condition. Thread surfaces shall be clean, dry, and free of surface contamination just prior to application of preapplied adhesive coating.

3.1.3 Dry to Touch. The adhesive coated fasteners shall be dry to the touch, yet not flake off during handling or use. Dry to the touch shall be confirmed by laying thirty (30) parts individually on dry tissue paper for 4 h. There shall be no change in appearance of the tissue.

3.1.4 Coverage. Unless otherwise specified on the drawing, the thread adhesive shall cover $1.5 \times$ bolt diameter, starting at the third (3rd) full thread. The first two (2) and last two (2) full threads leading and trailing threads, respective, shall be free of adhesive material. See Figure 1. On shorter bolts where $1.5 \times$ bolt diameter is not possible, a shortened adhesive length is allowed requiring that the first two (2) full threads and last two (2) full threads shall be free of adhesive.

Note: Shortened coverage length of adhesive may substantially affect performance. Actual values for nonstandard lengths are to be determined with actual testing of the part.

3.1.5 Thread Fill. Coated threads shall have an average of at least 50% fill for each full thread within the minimum coverage length with no sags resulting in less than 20% fill. The leading and trailing full threads may have less than 50% fill. Examination of coated threads shall be by optical comparator or microscope at $10 \times$ minimum. See Figure 1.

3.2 Test Specimens for Material Qualification.

3.2.1 All fastener test specimens used in one (1) series of tests shall be taken from one (1) fastener and coating/plating lot and shall meet all dimensional requirements after application of coatings/plating.

3.2.2 A minimum of thirty (30) nut/bolt assemblies shall be prepared for each test performed except chemical resistance test. For each chemical resistance immersion condition, five (5) nut/bolt assemblies shall be used. Test samples shall not be reused for multiple tests.

3.2.2.1 Test Bolts. Bolt test samples for initial material qualification shall conform to the requirements of GMW16551 after coating/plating. Finish materials and applicators used must be per the respective specifications, including the usage of approved material and applicators.

3.2.2.2 Test Bolt Sizes.

- M6 $\times$ 1: 6 h, Grade 8.8.
- M8 $\times$ 1.25: 6 h, Grade 8.8.
- M10 $\times$ 1.50: 6 h, Grade 10.9.
- M12 $\times$ 1.75: 6 h, Grade 10.9.

3.2.2.3 Test Bolt Finishes.

- Zinc phosphate and organic topcoat per GMW3179, Code G.
- Non-electrolytically applied zinc rich coating per GMW3359.
- Zinc plating and friction modifying topcoat per GMW3044 8K240/120, Code G.
- Zinc plating with no topcoat per GMW3044 8K240/120, Code N.

3.2.2.4 Apply thread adhesive to the test bolts per 3.1.1 through 3.1.4.

3.2.2.5 Test Nuts. Steel test nuts shall conform to the nuts described in SAE/USCAR-10. Aluminum test nuts shall be uncoated wrought aluminum alloy per ASTM F467M requirements. General dimensional requirements per GMW16551. All thread tolerances shall be Class 6H.

3.2.2.6 Adhesives shall not be applied to the threads of test nuts.

3.2.3 All test specimens shall be gaged before test to ensure all relevant dimensions are met. This data shall be made available upon request.

3.2.4 Test specimens shall be examined for defects and be removed for the following reasons:

- Damaged thread forms, tight or excessively loose fits, sticking, or galling.
- Rust or visible corrosion.
- Poor or irregular finish drips or sags.

3.3 Test Procedures. For new material approval testing, use parts and finishes described in 3.2 and Table 1. For Production Part Approval Process (PPAP), production lot certification, and for referee purposes, use actual production parts.

3.3.1 Prevailing on Torque. Test coated samples per ISO 10964. Assemble coated bolts per Section 8 of ISO 10964, Unseated Assembly. Torque readings shall be measured during assembly for the maximum prevailing on torque.

3.3.2 Breakaway Torque. After tightening per 3.3.1, allow test samples to cure for 72 h at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and 40% to 50% relative humidity. The fastener shall then be rotated in the off direction at a rate of 10 rpm to 20 rpm with a torque measuring device of suitable capacity and sensitivity, and disassembly for the breakaway torque.

Note: Cure time may be reduced per the adhesive supplier's recommendations.

3.3.3 Chemical Resistance Test. Assemble adhesive coated bolts (M10 $\times$ 1.5 only) and steel nuts per 3.2.2.5. After curing, immerse test assemblies in the fluids and temperatures indicated as follows for 168 h.

- Commercial 5W30 engine oil; $150\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- DOT3 Brake Fluid (GMW16072); $150\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- 50%/50% by volume mix of water and 9985809; Long life engine coolant; $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- 9986153 or 9986333: Transmission Fluid; $150\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- Commercially available gasoline; $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

Upon removal of the test specimens from the test fluid, the bolt-nut assemblies shall be held at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a minimum of 1 h. The breakaway torque shall be determined per 3.3.2. The breakaway torque value of each assembly shall conform to the requirements specified in Table 2.

Note: This test is only required for initial material approval.

3.3.4 Hot Strength. Assemble adhesive coated bolts (M10 $\times$ 1.5 only) and steel nuts per 3.3.1. After curing, place the test assemblies in an air-circulating oven for 2 h at the following temperatures:

- $135\text{ }^{\circ}\text{C}$ for Grade A and B.
- $200\text{ }^{\circ}\text{C}$ for Grade C.

After 2 h at temperature, take the assemblies out and immediately measure breakaway torque at the elevated temperature per 3.3. The breakaway torque value of each assembly shall conform to the requirements specified in Table 2.

Note: This test is only required for initial material approval.

3.3.5 Thermal Cycling. Assemble adhesive coated bolts (M10 $\times$ 1.5 only) and aluminum test nuts per 3.3.1.

- After curing, place specimens in a thermal cycling chamber capable of $-30\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$.
- Begin cycle at $25\text{ }^{\circ}\text{C}$ and ramp at $2\text{ }^{\circ}\text{C}/\text{minute}$ to $135\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for Grade A and Grade B and $200\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for Grade C.
- Hold at temperature for 1 h. Then ramp down at $2\text{ }^{\circ}\text{C}/\text{minute}$ to $-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and hold for 1 h. The cycle shall be repeated to a total of 25 times.
- After cycling, the breakaway torque shall be tested per 3.3.2.

Note: This test is only required for initial material approval.

3.3.6 Heat Age. Assemble and test parts per 3.3.4, except the exposure time is 500 h.

Note: This test is only required for initial material approval.

3.3.7 Shelf Life Test. Store fifty (50) coated test bolts in an open box for six (6) months at $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and then test breakaway torque per 3.3.2. All parts must exhibit the same performance as before the six (6) month storage.

Note: This test is only required for initial material approval.