

INCH-POUND

MIL-PRF-9117F

23 September 2014

SUPERSEDING

MIL-PRF-9117E

31 December 1996

PERFORMANCE SPECIFICATION

ADHESIVE; SEALING, FOR AROMATIC FUEL CELLS AND GENERAL REPAIR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a one-part sealing adhesive for fuel cell repair work and for other general repairs where resistance to aromatic fuel is required.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 or 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

FED-STD-313

Material Safety Data, Transportation Data, and Disposal
Data for Hazardous Materials Furnished to Government
Activities

Comments, suggestions, or questions on this document should be addressed to: AFLCMC/WNZEB, Robins AFB GA 31098. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>

AMSC N/A

FSC 8040

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(Copies of these documents are available online at <http://quicksearch.dla.mil/> or <https://assist.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D471	Standard Test Method for Rubber Property-Effects of Liquids
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(Copies of ASTM standards may be obtained from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. Electronic copies of ASTM standards may be obtained from <http://www.astm.org>)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS3217/1	Test Slabs, Acrylonitrile Butadiene (NBR -H), Medium-High Acrylonitrile, 65-75
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(Application for copies should be addressed to SAE, Inc., 400 Commonwealth Drive, Warrendale PA 15096.) Electronic copies may be obtained from <http://www.sae.org/servlets/index> .

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article inspection. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Material. The material shall be a one-part adhesive suitable for bonding NBR-H surfaces such as those used in aircraft fuel cells.

3.3 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

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3.4 Bond strength.

3.4.1 Minimum bond strength. The minimum bond strength shall be 5.0 lb. after 4 hours of cure and 10.0 lb. after 24 hours of cure when prepared and tested in accordance with 4.4.3.2.

3.4.2 Bond strength upon exposure to aromatic fuels. After exposure to aromatic fuels the bond strength shall be a minimum of 6 lb when prepared and tested in accordance with 4.4.3.3.

3.4.3 Bond strength after storage. The bond strength of cured specimens prepared using aged adhesive shall be at least 80 percent of the strength obtained for the 24 hour cure on the unaged adhesive (see 4.4.4.2).

3.5 Heat resistance. The adhesive, when applied and cured properly, shall be able to withstand exposure to elevated operating temperatures (158°F) without failure of the adhesive bond under a shear load of 2 pounds per square inch (see 4.4.5.2).

3.6 Storage stability. The adhesive, when aged, shall show no signs of gelling, or deterioration such as lumping, coagulation, or separation of adhesive components, and shall be readily brushable (see 4.4.4.1).

3.7 Photochemical requirements. The manufacturer shall certify that materials used in the adhesive are non-photochemically reactive.

3.8 Environmental requirements. The adhesive shall not contain any EPA Class I ozone depleting substances or hazardous materials as defined in FED-STD-313, nor shall it contain any chemical listed in the current report of known carcinogens of the National Toxicology Program.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 First article inspection. First article testing shall be accomplished using two containers of adhesive when a first article sample is required (3.1). One container shall be used to prepare and test specimens in accordance with paragraphs 4.4.3 and 4.4.5. The second container shall be used for storage stability testing in accordance with paragraph 4.4.4. Failure to pass any examination or test shall be cause for rejection of the first article.

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4.3 Conformance inspection. Conformance testing shall be accomplished using two containers of adhesive representative of each lot or order. Unless otherwise specified, a lot shall consist of all adhesive manufactured at one time from one batch, forming part of one contract or order, and submitted for inspection at the same time and place. One container shall be used to prepare and test specimens in accordance with 4.4.3 and 4.4.5. The second container will be used for storage stability testing, 4.4.4. Failure of any sample to pass any examination or test shall be cause for rejection of the lot or order.

4.4 Test methods.

REQUIREMENT	VERIFICATION
3.4.1	4.4.3.2
3.4.2	4.4.3.3
3.4.3	4.4.4.2
3.5	4.4.5.2
3.6	4.4.4.1

4.4.1 Standard conditions. Standard conditions during the make-up of samples and during air cure shall be $77^{\circ}\pm 2^{\circ}\text{F}$, and $50^{\circ}\pm 5\%$ relative humidity.

4.4.2 Test specimens. The standard NBR-H stock used for tests shall conform to SAE AMS3217/1 or equivalent material as certified by the supplier.

4.4.3 Bond testing. Nine samples will be prepared using aged adhesive as described in paragraph 4.4.3.1. Three will be strip-back tested per 4.4.3.2 after 4 hours cure time, three will be strip-back tested per 4.4.3.2 after 24 hours cure time and three will be strip-back tested after immersion in aromatic fuel, 4.4.3.3.

4.4.3.1 Specimen preparation bond for strength testing. The standard NBR-H stock sheet shall be cut into 1 1/2 inch by 6 inch strips and washed with a suitable solvent. Buffing of the strips will not be allowed. After the strips have dried, apply two coats of adhesive with wait times per manufacturer's recommendations. The adhesive shall be allowed to air cure as specified by the manufacturer, and then reactivated with the manufacturer's recommended solvent. The reactivated surfaces shall be placed together within one minute and appropriate pressure applied in accordance with the manufacturer's instructions. After the curing time specified for the particular test, 1 inch by 6 inch strips shall be cut from the center portion of the 1 1/2 inch by 6 inch strips and tested.

4.4.3.2 Strip-back test. Strips bonded in accordance with 3.4.1 to be tested shall be separated by hand at one end of the strip specimen for a distance sufficient to permit the attachment of the jaws of the testing machine. The free ends of the strips shall be clamped in the jaws of a pendulum type test machine and pulled apart at an angle of 180 degrees to each other at a jaw separation rate of 2 inches per minute. The first and last inch of the bonded section shall not be considered in the test. The average constant peak load of each specimen shall be recorded. If any sample falls below the minimum requirement the adhesive shall be rejected.

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4.4.3.3 Exposure to aromatic fuels. After preparing three samples as described in paragraph 4.4.3.1 with bond strength as specified in 3.4.2, the samples will be air cured for at least 24 hours at standard conditions before cutting to test size. The samples shall then be fully immersed in standard test fluid conforming to Type III of ASTM-D471 for 7 days. After immersion, the strip-back test, 4.4.3.2, shall be conducted. If any sample tested falls below the minimum requirement the adhesive shall be rejected.

4.4.4 Storage stability. One unopened container of adhesive shall be placed in an oven, maintained at a temperature of $120 \pm 2^\circ$ F, and allowed to age 4 weeks. The adhesive shall then be cooled to standard temperature and tested.

4.4.4.1 Visual examination. The adhesive shall conform to the requirements listed in paragraph 3.6 after aging.

4.4.4.2 Bond strength. Contingent upon passing the visual examination of 4.4.4.1, three samples shall be prepared in accordance with paragraph 4.4.3.1 using aged adhesive and tested for bond strength per 4.4.3.2. Any failure to meet the requirements of 3.4.3 shall constitute failure of the material.

4.4.5 Heat resistance.

4.4.5.1 Sample preparation. Three specimens shall be prepared for testing in the following manner. Using strips of the standard NBR-H stock, a lap joint shall be made in such a way that the area bonded is 1 square inch. The surfaces shall be cleaned with a suitable solvent prior to application of two coats of the adhesive with wait times per the manufacturer's recommendations. The adhesive will be allowed to air cure as specified by the manufacturer, and then reactivated per the manufacturer's instructions. The bond shall be made within one minute after reactivating, appropriate pressure applied as specified by the manufacturer and air cured at least 18 hours at room temperature before testing.

4.4.5.2 Heat resistance test. The cured samples as specified in 3.5 shall be placed in a dry-air oven and aged for 24 hours at a temperature of $158^\circ \pm 2^\circ$ F. The bond shall then be subjected to a continuous dead-weight shear load of 2 pounds while maintained at the elevated temperature for another 24 hours. If any sample fails, the adhesive shall be rejected.

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5. PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The adhesive is intended for use in fuel cell repair work, or for other general repair work, where aromatic fuel resistance is necessary.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this performance specification.
- b. Packaging requirements (see 5.1).
- c. When a first article is required (see 3.1 and 4.2).
- d. Any additional marking requirements (see 6.3).
- e. Material Safety Data Sheets, if required (see 6.4).

6.3 Marking. Unless specified otherwise, (see 6.2), containers and boxes shall be marked with appropriate precautionary statements in accordance with the manufacturers' standard commercial practice.

6.4 Material Safety Data Sheets. When specified (see 6.2) Material Safety Data Sheets will be provided in accordance with FED-STD-313.

6.5 Key Words.

Butadiene
Medium High Acrylonitrile
NBR-H
Test Slabs

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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