

INCH-POUND

MIL-A-47284A (MI)

24 September 1991

SUPERSEDING

MIL-A-47284

9 August 1974

MILITARY SPECIFICATION

ADHESIVE, EPOXY RESIN BASE

This specification is approved for use by the U.S. Army Missile Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one type of adhesive consisting of an epoxy resin base and an amine type curing agent.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8040

DISTRIBUTION STATEMENT A.
unlimited.

Approved for public release; distribution is

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SPECIFICATIONS

FEDERAL

- | | | |
|------------|---|--|
| PPP-C-96 | - | Cans, Metal, 28 Gage and Lighter |
| PPP-C-2020 | - | Chemicals, Liquid, Dry, and Paste:
Packaging of |
| QQ-A-250/5 | - | Aluminum Alloy Alclad 2024, Plate and
Sheet |

STANDARDS

MILITARY

- | | | |
|----------------|---|--|
| MIL-STD-129 | - | Marking for Shipment and Storage |
| MIL-STD-2073-1 | - | DOD Materiel Procedures for Development
and Application of Packaging Requirements |

(Unless otherwise indicated, copies of the federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | | |
|-------------|---|---|
| ASTM D 638 | - | Tensile Properties of Plastics, Standard
Test Method for |
| ASTM D 1002 | - | Strength Properties of Adhesives in Shear
by Tension Loading (Metal-To-Metal),
Standard Test Method for |
| ASTM D 1084 | - | Viscosity of Adhesives, Standard Test
Methods for |
| ASTM D 1475 | - | Density of Paint, Varnish, Lacquer, and
Related Products, Standard Test Method for |
| ASTM D 2240 | - | Rubber Property - Durometer Hardness,
Standard Test Method for |
| ASTM D 2369 | - | Volatile Content of Coatings, Standard
Test Method for |

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.3.

3.2 Material. The adhesive shall consist of a 2-component system consisting of an epoxy resin formulation with an inorganic filler and an amine type activator.

3.3 Chemical and physical properties of uncured resin and curing agent.

3.3.1 Epoxy resin.

3.3.1.1 Viscosity. The viscosity shall be not less than 40 centipoises and not less than 100 centipoises at 23° Celsius (C).

3.3.1.2 Specific gravity. The specific gravity shall be not less than 1.6 and not greater than 1.76 at 25°C.

3.3.1.3 Solids content. The solids content shall be not less than 99 percent (%).

3.3.2 Curing agent.

3.3.2.1 Viscosity. The viscosity of the curing agent shall be not less than 5 nor greater than 15 centipoises at 23°C.

3.3.2.2 Specific gravity. The specific gravity of the curing agent shall be not less than 0.940 and not greater than 0.960 at 25°C.

3.4 Mechanical properties of cured epoxy. The material shall meet the requirements specified in 3.4.1 through 3.4.4 at $23 \pm 1.1^\circ\text{C}$ when tested in accordance with the applicable tests in 4.7.1.

3.4.1 Tensile strength. The tensile strength of the cured epoxy shall be not less than 2200 pounds force per square inch (lbf/in²).

3.4.2 Elongation. The percentage of elongation of the cured epoxy shall be greater than 1% and less than 3%.

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3.4.3 Shear strength. The shear strength of the cured epoxy shall be not less than 1600 lbf/in².

3.4.4 Hardness. The hardness of the cured epoxy shall be not less than 85 Shore D.

3.5 Physical property. The material shall meet the requirements specified in 3.5.1 when tested according to the applicable test in 4.7.2.

3.5.1 Shelf life. The shelf life of the resin and activator in unopened containers shall be not less than 1 year from date of manufacture when stored at a temperature less than 27°C.

3.6 Workmanship. The workmanship shall be such as to insure a product which is uniform and in conformance with this specification. The resin and activator shall be free of dirt, foreign material or other contaminants.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

- a. First article inspection (see 4.3)
- b. Quality conformance inspection (see 4.4).

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4.3 First article inspection. When specified, (see 6.2), a sample shall be subjected to first article inspection in accordance with all tests and inspections specified herein.

4.4 Quality conformance inspection. Quality conformance inspections shall be as specified in table I.

TABLE I. Quality conformance inspection.

Inspection	Requirement paragraph	Test paragraph
Epoxy resin		
Viscosity	3.3.1.1	4.6.1.1
Specific gravity	3.3.1.2	4.6.2
Solids contents	3.3.1.3	4.6.3
Curing agent		
Viscosity	3.3.2.1	4.6.1.2
Specific gravity	3.3.2.2	4.6.2
Hardness	3.4.4	4.7.1.3

4.5 Lot formation. An inspection lot shall consist of a group of like items produced at the same place utilizing the same batches of materials, lots of components, process runs, fabrication techniques, assembly techniques, tools, equipment, and facilities, but shall not exceed one month's production. Upon submittal to the procuring activity for acceptance, each lot shall be accompanied by in-process inspection records and inspection results as required by the procuring inspector and this specification.

4.5.1 Lot size. A lot size shall consist of all the material submitted for acceptance at the same time which has been prepared by the same company without change in materials or processes in one continuous period of operation.

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4.5.2 Sampling. Unless specified in the contract or order, sampling for inspection or conformance shall be as specified in table II. A sample of filled containers of epoxy and curing agent shall be selected from each lot for inspection.

TABLE II. Sampling for quality conformance inspection.

Lot Size	Sample Size
2 to 3	All
4 to 25	3
26 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1200	15
1201 to 3200	18
3201 to 10,000	22
10,001 and over	29
In all cases: Acceptance number is ZERO Rejection number is ONE	

4.5.3 Inspection methods.

4.5.3.1 Examination. Each container in the sample shall be visually examined to verify the requirements of 5.1 and 5.2.

4.5.3.2 Preparation and tests of specimens.

4.5.3.2.1 Specimen examination. Remove a required amount of epoxy and curing agent from each container in the sample and perform on each specimen the examinations and tests specified in 4.6, 4.7.1.2 and 4.7.1.3.

4.5.3.2.2 Specimen test. Remove a required amount of epoxy and curing agent from two containers of each in the sample and perform on each specimen the tests specified in 4.7.1.1.

4.5.3.3 Certification of compliance. A qualified manufacturer may satisfy the requirement of 3.5.1 by supplying a certificate of compliance accompanied by objective evidence of conformance (see 6.2).

4.6 Test methods for chemical and physical properties of uncured resin and curing agents.

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4.6.1 Viscosity.

4.6.1.1 Epoxy resin. The viscosity of the epoxy resin shall be determined in accordance with ASTM D 1084 using a Brookfield Viscometer Model RVF or an approved equivalent with a size 7 spindle at 4 revolutions per minute (rpm).

4.6.1.2 Curing agent. The viscosity of the curing agent shall be determined in accordance with ASTM D 1084 using a Brookfield Viscometer Model RVF, or approved equivalent with a size 1 spindle at 20 rpm.

4.6.2 Specific gravity. The specific gravity of the epoxy resin and curing agent shall be determined in accordance with ASTM D 1475.

4.6.3 Solids content. The solids content of the epoxy resin shall be determined in accordance with ASTM D 2369.

4.7 Test methods for physical properties of cured epoxy.4.7.1 Mechanical property tests.

4.7.1.1 Tensile strength and elongation. The tensile strength and elongation shall be determined in accordance with ASTM D 638. The speed of testing shall be 0.20 to 0.25 inches per minute.

4.7.1.1.1 Test specimen preparation. The test specimen shall be cured for not less than 7 days at $25 \pm 3^{\circ}\text{C}$ or not less than 2 hours at $75 \pm 3^{\circ}\text{C}$. The test specimen size shall conform to ASTM D 638 with the following exceptions:

- a. Overall width shall be 0.970 to 1.030 inches
- b. Width of flat section shall be 0.360 to 0.390 inches
- c. Radius of fillet shall be 0.470 to 0.530 inches
- d. Thickness of specimen shall be 0.235 to 0.265 inches.

4.7.1.2 Shear strength. The shear strength shall be determined in accordance with ASTM D 1002 using aluminum test specimens conforming to QQ-A-250/5. The test specimen shall be cured as specified in 4.7.1.1.1.

4.7.1.3 Hardness. The hardness shall be determined in accordance with ASTM D 2240. The specimen shall be cured as specified in 4.7.1.1.1.

4.7.2 Physical property test.

4.7.2.1 Shelf life. The adhesive shall be tested for conformance with all the requirements specified herein after completion of storage period.

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4.8 Inspection of packaging. The sampling and inspection of the preservation, packaging, and container marking shall be in accordance with the requirements of MIL-STD-2073-1.

5. PACKAGING

5.1 Preservation, packaging, packing and marking. The adhesive shall be packed as a two part kit consisting of one container each of resin and activator packaged in accordance with PPP-C-96 or PPP-C-2020. Each kit shall be packaged, packed, and marked in accordance with requirements of MIL-STD-2073-1 for level specified (see 6.2).

5.2 Marking. Each container or kit of resin and activator shall be legibly and durably marked in accordance with MIL-STD-129. Marking information shall include, but shall not necessarily be limited to, the following:

- a. Title, number and date of this specification
- b. Lot or batch number
- c. Mixing ratios
- d. Necessary precautionary notices.

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 covered by this specification is intended for use in bonding metal to metal. Other constructions such as metal to plastic or plastic to plastic may be bonded provided the use of the adhesive is substantiated by testing the combination of the materials in question.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1)
- c. When first article is required (see 3.1 and 4.3)
- d. Conditions for quality conformance inspection (see 4.4)
- e. First article sample size (see 4.5.1)

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f. Applicable level(s) of preservation, packaging and marking (see 4.8 and Section 5)

g. Records and other data to provide adequate objective evidence of compliance with the shelf life requirements of 3.5.1 (see 4.5.3.3).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerers whether the item(s) should be a first article sample, a first production item, or a number of items to be tested as specified in 4.3. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Metrication. Metric equivalents in accordance with FED-STD-376 are acceptable for use in this specification.

6.5 Subject term (keyword) listing.

Bonding agent
Glue
Sealing Material

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 extensiveness of the changes.

Custodian:
Army - MI

Preparing Activity:
Army - MI

(Project No. 8040 - A162)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:		1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
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4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
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a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
B. PREPARING ACTIVITY			
a. NAME		b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON	
c. ADDRESS (Include Zip Code)		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	