

MIL-S-22473E

12 April 1983

SUPERSEDING

MIL-S-22473D

23 August 1968

MILITARY SPECIFICATION

SEALING, LOCKING, AND RETAINING COMPOUNDS:
(SINGLE-COMPONENT)

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

1. SCOPE

1.1 Scope. This specification covers single component compounds and their primers suitable for sealing, locking and retaining metal parts (see 6.14). The compounds are normally liquid and are converted to an insoluble state when confined between closely fitting metal surfaces.

1.2 Classification.

1.2.1 Sealing compounds. The sealing compounds shall be of the following grades based on viscosity and locking torque, as specified in table I; AA, A, D, AV, AVV, B, C, CV, CVV, E, EV, H, HV, HVV, JV.

TABLE I - Color, viscosity, and locking torque of unpolymerized sealing compounds

Grade	Color code	Viscosity, centipoises (pascal-seconds)		Locking torque ^a , inch- pounds (newton-metres)	
AA	Green	10-25	(0.01- 0.025)	150-375	(16.9 -42.4)
A	Red	10-25	(0.01- 0.025)	100-250	(11.3 -28.2)
D	Orange	40-80	(0.04- 0.08)	100-250	(11.3 -28.2)
AV	Red	100-250	(0.10- 0.25)	100-250	(11.3 -28.2)
AVV	Red	1000-10,000	(1.0 -10.0)	100-250	(11.3 -28.2)
B	Yellow	100-200	(0.10- 0.20)	70-175	(7.90 -19.8)
C	Blue	10-25	(0.01- 0.25)	40-100	(4.52 -11.3)
CV	Blue	100-250	(0.10- 0.25)	40-100	(4.52 -11.3)
CVV	Blue	1000-10,000	(1.0 -10.0)	40-100	(4.52 -11.3)
E	Purple	10-25	(0.01- 0.025)	20-50	(2.26 - 5.65)
EV	Purple	100-250	(0.10- 0.25)	20-50	(2.26 - 5.65)
H	Brown	10-25	(0.01- 0.025)	10-25	(1.13 - 2.82)
HV	Brown	100-250	(0.10- 0.25)	10-25	(1.13 - 2.82)
HVV	Brown	1000-10,000	(1.0 -10.0)	10-25	(1.13 - 2.82)
JV	Yellow	100-250	(0.10- 0.25)	7-13	(0.79 - 1.47)
	(Clear)				

^a 3/8-inch (9.53 mm) bolt (see 4.6.2.1.2)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Materials and Mechanics Research Center, ATTN: DRXMR-SMS, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1.2.2 Surface primers. The surface primers and cleaners shall be of the following grades, forms and colors as specified (see 6.2):

<u>Grade</u>	<u>Form (see 6.2)</u>	<u>Compound</u>	<u>Color</u>
N	C	Primer, Normal (Concentrated)	Green
N	k	Primer, Normal (Ready to Use)	Green
T	R	Primer, Quick (Ready to Use)	Yellow or Green

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

- O-A-548 - Antifreeze/Coolant, Engine: Ethylene Glycol, Inhibited, Concentrated
- FF-N-836 - Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat
- QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
- QQ-B-613 - Brass, Leaded and Nonleaded: Flat Products (Plate, Bar, Sheet, and Strip)
- QQ-P-416 - Plating, Cadmium (Electrodeposited)
- TI-S-735 - Standard Test Fluids, Hydrocarbon
- TT-T-548 - Toluene: Technical
- PPP-B-566 - Boxes, Folding, Paperboard
- PPP-B-601 - Boxes, Wood, Cleated - Plywood
- PPP-B-636 - Boxes, Shipping, Fiberboard
- PPP-B-676 - Boxes, Setup

MILITARY

- MIL-L-2104 - Lubricating Oil, Internal-Combustion Engine, Tactical Service
- MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-810 - Environmental Test Methods
 - Method 508.2 - Fungus

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents form a part of this specification to the extent specified herein.

DEPARTMENT OF TRANSPORTATION

49 CFR (Code of Federal Regulations), Parts 100 to 199 - Department of Transportation rules and regulations for the transportation of hazardous materials by air, motor, rail, and water.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 109 - Steel, Carbon, Cold-Rolled Strip
- A 366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
- A 568 - Steel, Carbon and High-Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet, General Requirements
- A 568M - Steel, Carbon and High-Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet, General Requirements (Metric)
- A 569 - Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality
- A 570 - Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- A 611 - Steel, Cold-Rolled Sheet, Carbon, Structural
- A 619 - Steel Sheet, Carbon, Cold-Rolled, Drawing Quality
- A 620 - Steel Sheet, Carbon, Cold-Rolled, Drawing Quality, Special Killed
- A 621 - Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality
- A 622 - Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality, Special Killed
- A 635 - Hot-Rolled Carbon Steel Sheet and Strip, Commercial Quality, heavy-Thickness Coils (Formerly Plate)
- B 633 - Electrodeposited Coatings of Zinc on Iron and Steel
- D 56 - Flash Point By Tag Closed Tester
- D 304 - Normal Butyl Alcohol (Butanol)
- D 445 - Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
- D 1084 - Consistency of Adhesives

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

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OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd St., New York 16, N.Y.)

(Industry association specifications and standards are generally available for reference from libraries. They are distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Preproduction sample. Before production is commenced and at regular intervals (see 4.3.1 and 4.3.2.1) a sample of the compound to be furnished shall be submitted for examination and tests. Approval of the preproduction sample by the procuring activity shall not relieve the contractor of his obligation to supply compound and containers that shall conform to the requirements of this specification. Any change or deviation in the formulation or method of manufacture from the preproduction sample shall be subject to the approval of the procuring activity.

3.2 Suitability for use with explosives. When applicable (see 6.2) suitability of the sealing compound for use with a particular explosive shall be as specified by the procuring activity. The using agency shall specify the Government laboratory to which the sample is to be sent for tests and the method of testing. When applicable the compound and primer should be designated with the initials EC after the grade to insure optimum compatibility with explosives.

3.3 Unpolymerized sealing compound.

3.3.1 Color. Unless otherwise specified (see 6.2), each compound shall be of the color as specified in table I when viewed in daylight (see 4.5).

3.3.1.1 Ultraviolet illumination. Each compound shall be visible in ultraviolet illumination when tested as specified in 4.6.1.1.

3.3.2 Viscosity. The unpolymerized compound shall have a viscosity within the range, as applicable, specified in table I, when tested as specified in 4.6.1.2.

3.3.3 Flash point. The unpolymerized compound shall have a flash point of not less than 200°F (93°C) when tested as specified in 4.6.1.3.

3.3.4 Solubility. The unpolymerized compound shall be soluble in a solution of trichloroethylene containing 5 percent by volume of acetone when tested as specified in 4.6.1.4.

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3.3.5 Wettability. The unpolymerized compound shall wet steel, aluminum alloy, and brass when tested as specified in 4.6.1.5.

3.3.6 Corrosivity. The unpolymerized compound shall not be corrosive to steel, aluminum alloy, or brass when tested as specified in 4.6.1.6.

3.3.7 Storage stability. The unpolymerized compound packaged in original bottles shall not show excessive deterioration when stored for 10 days at $120^{\circ} \pm 3^{\circ}\text{F}$ ($48.9^{\circ} \pm 1.7^{\circ}\text{C}$) and tested as specified 4.6.1.7.

3.3.8 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate department medical service who will act as an advisor to the procuring activity (see 4.6.1.8).

3.4 Polymerized sealing compound.

3.4.1 Locking torque after normal curing. The compound shall have an average locking torque exclusive of break-away, within the range specified in table I when tested as specified in 4.6.2.1.2.

3.4.2 Locking torque after immersion in solvents. The locking torque exclusive of break-away of each grade of compound shall be not less than the minimum value specified in table I after immersion in distilled water, butyl alcohol, toluene, lubricating oil grade 10, hydrocarbon standard test fluid medium No. 6, JP-4 and JP-5 jet fuel, and ethylene glycol when tested as specified in 4.6.2.1.3.

3.4.3 Speed of curing. The average locking torque of the compound after 6 hours of normal curing shall be not less than 50 percent, and after 24 hours not less than 100 percent of the minimum value specified in table I, when tested as specified in 4.6.2.1.4.

3.4.4 Hot strength. The locking torque shall be not less than 60 percent of the minimum value specified in table I, after exposure, for grades AA, A, AVV, C, CVV, E, h, HVV and JV to a temperature of 300°F (149°C) for a period of two hours; for grades AV, B, CV, D, EV and HV to a temperature of 200°F (93°C) for a period of two hours, when tested as specified in 4.6.2.1.5.

3.4.5 Heat aging. The locking torque of each grade of sealing compound shall be not less than 50 percent of the minimum locking torque as applicable, specified in table I when aged at 300°F (149°C) for 1000 hours and tested as specified in 4.6.2.1.6.

3.4.6 Low temperature torque. The locking torque at $-65^{\circ} \pm 2^{\circ}\text{F}$ ($-53.9^{\circ} \pm 1^{\circ}\text{C}$) shall be not less than the minimum values specified in table I when tested as specified in 4.6.2.1.7.

3.4.7 Fluid tightness. The compound shall be capable of making leak-tight assemblies when tested as specified in 4.6.2.2.

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3.4.8 Fungus resistance. The polymerized compound shall not support the growth of fungus when tested as specified in 4.6.2.3.

3.5 Primers.

3.5.1 Grade N primer (speed of curing). Grade N primer, when applied to unpolished and untreated cadmium or zinc surfaces plated in accordance with QQ-P-416 or ASTM B 633, shall cause polymerization of sealants specified herein to meet the speed-of-curing requirement of 3.4.3, when tested as specified in 4.6.3.1.

3.5.2 Grade T primer (speed of curing). Grade T primer, when applied to unpolished and untreated cadmium or zinc surfaces, shall cause polymerization of sealants specified herein after 30 minutes of normal curing to provide a locking torque not less than 50 percent and after 2 hours not less than 100 percent of the minimum value specified in table I; and when applied to steel surfaces shall cause polymerization of sealants specified herein after 10 minutes of normal curing to provide a locking torque not less than 50 percent, and after 40 minutes not less than 100 percent of the minimum value specified in table I, when tested as specified in 4.6.3.1.

3.5.3 Storage stability primer. The primer, packaged in original bottles or spray cans shall meet the requirements of this specification when conditioned for 10 days at 120°F (49°C) and tested as specified in 4.6.3.2.

3.5.4 Toxicity primer. The primer shall have no adverse effect on the health of personnel when used for its intended purpose (see 3.3.8).

3.6 Workmanship. The unpolymerized compound shall be smooth and homogeneous, free from lumps, caked material, and particles of foreign matter. The primer shall be clear, homogeneous, and free of solid particles.

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 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot. For purposes of sampling, a lot shall consist of all sealing compound of the same grade, or all primer of the same grade and form, manufactured as one batch and offered for inspection at one time.

4.3 Classification of tests. The tests for the sealing compounds (and primer when required) shall be classified as follows:

- (a) Preproduction tests
- (b) Quality conformance tests

4.3.1 Preproduction tests. Preproduction tests shall consist of all tests in this specification.

4.3.2 Quality conformance tests. Quality conformance tests shall consist of:

- (a) Comparison tests
- (b) Individual lot tests

4.3.2.1 Comparison tests. The procuring activity may require that the subsequent lots of compound be subjected to any or all preproduction tests at intervals of not less than once a year, or once in each 20 lots, whichever is more frequent. If a lot should fail a comparison test no further lot will be accepted until the contractor has presented sufficient evidence to show that the condition which caused the failure, has been corrected. A test report showing the results of the preproduction tests and the last comparison tests shall be made available to the procuring activity.

4.3.2.2 Individual lot tests. Individual lot tests to verify specification conformance shall consist of the following tests (see 4.6):

- (a) Viscosity
- (b) Locking torque after normal curing
- (c) Speed of curing
- (d) Speed of curing with primer (when primer is required) (see 6.2)

Failure of any sample to conform to the specified tests shall be cause for rejection of the lot.

4.4 Sampling.

4.4.1 For examination. A random sample of filled containers shall be selected for examination (see 4.5) in accordance with MIL-STD-105. The inspection level shall be as specified in table II.

4.4.2 For preproduction tests. A 250-cc sample of sealing compound and 4-ounce (113-g) bottle or 6-ounce (170-g) can of primer (when required) shall be taken from the preproduction batch (lot). All of the tests shall be performed on these samples except the storage stability tests. For the storage stability tests, 5 representative bottles of each grade of sealing compound and 5 representative bottles or cans of each grade of primer (when required) shall be selected from the preproduction batch (lot).

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4.4.3 Quality conformance samples.

4.4.3.1 Comparison tests. Samples as specified in 4.4.2 shall be taken from the first production lot and from subsequent lots for the comparison tests of 4.3.2.1.

4.4.3.2 Individual lot tests. A 50-cc sample of sealing compound and a 4-ounce (113-g) bottle or 6-ounce (170-g) can of primer (if required) which are representative of the lot shall be selected from each lot for individual lot tests of 4.3.2.2.

4.5 Examination. Sample units selected in accordance with 4.4.1 shall be examined for color (see 1.2.2 and table I) workmanship (see 3.6) and packaging (see section 5) at the acceptable quality levels shown in table II.

4.6 Test methods. Samples of sealing compound and primer (when required) shall be selected in accordance with 4.4.2 or 4.4.3 as applicable. Except as otherwise specified herein, all tests shall be made at a temperature of not less than 70°F (21°C) nor more than 77°F (25°C) without treatment or preconditioning of the compound. Tests shall be made in accordance with the referenced paragraphs of table III.

4.6.1 Unpolymerized compound.

4.6.1.1 Ultraviolet illumination. The unpolymerized compound when applied to metal surfaces shall glow under ultraviolet illumination (see 6.5).

4.6.1.2 Viscosity. The viscosity shall be determined by ASTM D445 or by method B of ASTM D1084. For ASTM D445 conversion to centipoises shall be made by multiplying the centistokes by the density of the compound.

4.6.1.3 Flash point. The flash point shall be determined with a Tag Closed-cup flash-point tester using ASTM D 56.

4.6.1.4 Solubility. One cubic centimeter of the compound shall be placed in 10 cubic centimeters of a solution of trichloroethylene containing 5 percent by volume of acetone. After shaking the mix thoroughly, the solution shall be examined under transmitted light. The solution shall be clear and free from precipitate.

4.6.1.5 Wettability. Sheets of steel, aluminum alloy, and brass as specified in ASTM A109, A366, A568, A568M, A569, A570, A611, A619, A620, A621, A622 or A635; QQ-A-250/4; and QQ-B-613, copper alloy no. 268, respectively, shall be degreased and cleaned by buffing with number 400 emery cloth. A few drops of the compound (approximately 0.03 cc) shall be applied to the prepared surfaces of each of the metals. The compound shall be considered wettable if there is clear evidence of the migration of the compound to cover an area greater than that initially wet by the drops.

TABLE II - Methods of examination

Material	Inspection level and AQL	Classification or defects	Defect	Method of inspection
		Critical	None defined	
Sealing compound (see 3.3.1 and 3.6)	Level S-1 All must pass	Major 101	Wrong color	Visual
		Major 102	Not smooth and homogeneous	Visual
		Major 103	Lumps or caked material	Visual
		Major 104	Foreign particles	Visual
Primer (see 1.2.2 and 3.6)	Level S-1 All must pass	Major 105	Wrong color ¹ or grade	Visual
		Major 106	Wrong form	Visual
		Major 107	Not clear	Visual
		Major 108	Not homogeneous	Visual
		Major 109	Not free of solid particles	Visual
Bottles of compound (see 5.1.1.1 or 5.1.2.1 and 5.3)	Level I 2.5 AQL	Major 110	Improper size	Visual
		Major 111	Improper type	Approved scale ³
		Major 112	Improper closure or leakage	Visual
Bottles or cans of primer (see 5.1.1.2 or 5.1.2.2) and 5.3		Major 113	Improper fill ²	Visual
Intermediate package (see 5.1.1.3 and 5.1.1.4 or 5.1.2.3), 5.3 and 5.4	Level I 2.5 AQL	Major 114	Wrong size	Visual
		Major 115	Wrong type	Visual
		Major 116	Improper closure	Visual
		Major 117	Missing or improper instructions	Visual
		Major 118	Improper marking	Visual
Boxes open (see 5.2 and 5.3)	Level I 2.5 AQL	Major 119	Improper type	Visual
		Major 120	Improper size	Visual
		Major 121	Not properly packed	Visual
Boxes closed (see 5.2 and 5.4)	Level II 2.5 AQL	Major 122	Improper closing	Visual
		Major 123	Lack of or improper strapping	Visual
		Major 124	Improper marking	Visual
		Major 125	Excessive weight	Approved scale ³

¹ The color may be determined by dipping an edge of white paper into the material.

² A properly filled bottle or can shall be weighed and this weight used as a standard for determining the fill of other bottles or cans.

³ Approved by procuring activity.

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TABLE III. Test methods

Test	Requirement paragraph	Test paragraph	Number of determinations
Unpolymerized Compound			
Ultraviolet illumination	3.3.1.1	4.6.1.1	3
*Viscosity	3.3.2	4.6.1.2	<u>1</u> /
Flash point	3.3.3	4.6.1.3	<u>1</u> /
Solubility	3.3.4	4.6.1.4	1
Wettability	3.3.5	4.6.1.5	1
Corrosivity	3.3.6	4.6.1.6	1
Storage stability	3.3.7	4.6.1.7	5
Toxicity	3.3.8	4.6.1.8	1
Polymerized Compound			
Locking torque			5
*after nominal curing	3.4.1	4.6.2.1.2	
after immersion in solvents	3.4.2	4.6.2.1.3	5 each for test fluid
*Speed of curing	3.4.3	4.6.2.1.4	5
Hot strength	3.4.4	4.6.2.1.5	5
Heat aging	3.4.5	4.6.2.1.6	5
Low temperature torque	3.4.6	4.6.2.1.7	5
Fluid tightness	3.4.7	4.6.2.2	3
Fungus resistance	3.4.8	4.6.2.3	5
Primer Compound			
*Speed of curing Grade N	3.5.1	4.6.3.1	<u>5</u> ² /
*Speed of curing Grade T	3.5.2	4.6.3.1	<u>5</u> ³ /
Storage stability	3.5.3	4.6.3.2	1

*Individual lot tests.

1/Duplicate determinations shall agree within the tolerances specified in the test method.

2/Five assemblies with cadmium plated threads and 5 assemblies with zinc plated threads, using fluids as required from 1 sample of primer and 1 sample of the sealant.

3/Five assemblies with cadmium plated threads, 5 with zinc plated threads and 5 with uncoated steel threads, using fluids as required from 1 sample of primer and 1 sample of the sealant.

4.6.1.6 Corrosivity. Specimens of steel, aluminum alloy and brass as specified in 4.6.1.5 and prepared as specified in 4.6.1.5 shall be partially coated with the compound. The specimens shall then be allowed to stand for 10 days at room temperature. The compound shall be removed by wiping with a nonabrasive cloth wet with water or trichloroethylene and the surface examined. Any permanent discoloration in film formed on the metals which does not buff off with the nonabrasive cloth shall be considered as evidence of corrosivity.

4.6.1.7 Storage stability. Five bottles of each size container shall be conditioned for 10 days at $120^{\circ} \pm 3^{\circ}\text{F}$ ($49^{\circ} \pm 1.7^{\circ}\text{C}$). After cooling to room temperature, the compound shall be tested for viscosity (see 4.6.1.2) and locking torque after nominal curing (see 4.6.2.1.2). An increase in viscosity in excess of 50 percent, or failure of the compound to meet the locking torque specified in table 1 shall constitute excessive deterioration.

4.6.1.7.1 Certification of compliance. Pending the results of the storage stability test the procuring activity may accept a certificate of compliance. The certificate shall state that the sealing and retaining compound or primer (see 4.6.3.2.1) as applicable meets the storage stability requirements of 3.3.7 or 3.5.3, respectively, and shall be signed by a responsible agent of the certifying organization and shall be accompanied by evidence of this agent's authority to bind his principal.

4.6.1.8 Toxicity. The supplier shall furnish the toxicological data and formulations required to evaluate the safety of the material for the proposed use.

4.6.2 Polymerized compound.

4.6.2.1 Locking torque.

4.6.2.1.1 Preparation of specimens. The threaded fasteners used in the tests shall be 3/8-inch (9.7 mm) size, 24 threads per inch, unified fine thread series, class 2 fit (3/8 - 24 UNF2) unoxidized steel bolts and nuts conforming to FF-N-836. The bolt shall have a nominal length of 1 inch (25.4 mm) and may have square or hexagonal heads, and may be unfinished, or finished. The nuts shall be style 1 (nominally 21/64 inch (8.3 mm) thick), heavy, finished, or unfinished. All bolts used in one series of tests shall be taken from 1 lot. All bolts and nuts shall be vapor degreased, stored in an atmosphere of low humidity, and kept clean. The bolts and nuts shall be 100 percent examined for damaged threads and any such damaged bolts or nuts shall not be used for these tests. One nut shall be screwed onto each bolt and moved back and forth with the fingers, care being taken to avoid fingerprints on the threads. Bolt-nut pairs showing excessively tight or excessively loose fits, or sticking due to burrs, shall be rejected. However, no effort shall be made to select pairs having matched clearances and the threads shall not be cleaned with file, tap or die. The assemblies shall be stored until time for the application of sealant with the nuts screwed on until 1/2 to 9/16 inch (12.7 to 14.3 mm) of the threaded end of the bolt protrudes. The assemblies shall be selected at random for the various tests.

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To start a test, sufficient compound shall be applied by means of the applicator nozzle supplied with the product to cover completely the protruding threads of the bolt. The nut shall then be unscrewed over the compound until the end of the nut is flush with the end of the bolt (full nut engagement) and then screwed back on the bolt until 1/8 to 3/16 inch (3.2 to 4.8 mm) of bolt protrudes to assure complete coverage of the compound in the engaged area.

4.6.2.1.2 Locking torque after normal curing. The coated assemblies prepared in accordance with 4.6.2.1.1 shall be allowed to age in air at from 70°F. to 77°F (21 to 25°C) for from 24 to 26 hours. The nuts shall then be unscrewed with a torque wrench of suitable capacity and sensitivity. Torque readings shall be taken at 1/4, 1/2 and 3/4, and 1 full turn. The average of these 4 readings shall be considered the average locking torque of the specimen and shall be within the range specified in table I, as applicable.

4.6.2.1.3 Locking torque after immersion. The coated assemblies prepared in accordance with 4.6.2.1.1 shall be allowed to age in air at 70 to 77°F (21 to 25°C) for from 24 to 26 hours. After aging, 5 specimens shall be immersed for 168 hours at 188 ± 5°F (87 ± 3°C) (in a flask equipped with a reflux condenser) in each of the test fluids conforming to specifications as follows:

<u>Liquid</u>	<u>Application specification</u>
(a) Distilled water	-----
(b) Butyl alcohol normal	ASTM D 304
(c) Toluene	TT-T-548
(d) Lubricating Oil (Grade 10)	MIL-L-2104
(e) Hydrocarbon standard test fluid medium No. 6	TT-S-735
(f) JP-4 turbine fuel	MIL-T-5624
(g) JP-5 turbine fuel	MIL-T-5624
(h) Ethylene glycol	O-A-548

Immediately upon removal of the test specimens from the test fluids, the locking torque shall be determined in accordance with 4.6.2.1.2.

4.6.2.1.4 Speed of curing. The speed of cure shall be determined by the method of 4.6.2.1.2 except that the curing time shall be 6 hours.

4.6.2.1.5 Hot strength. Specimens shall be prepared and tested as specified in 4.6.2.1.2 except that after 24 hours of normal curing, the specimens shall be heated in an oven for 2 hours. The heating temperature for grades AA, A, AVV, C, CVV, E, H, HVV and JV shall be 300°F (149°C). The heating temperature for grades AV, B, CV, D, EV, and HV shall be 200°F (93°C). The locking torque test shall be made within 30 seconds after removal of the assembly from the oven.

4.6.2.1.6 Heat aging. Bolt and nut assemblies shall be prepared as specified in 4.6.2.1.2 and aged in air in an oven at $300^{\circ} \pm 10^{\circ}\text{F}$ ($149^{\circ} \pm 5.5^{\circ}\text{C}$) for 1000 hours. The specimens shall be cooled to room temperature, and locking torque determined in accordance with 4.6.2.1.2.

4.6.2.1.7 Low temperature torque. Specimens prepared as specified in 4.6.2.1.1 shall be placed in a container having a temperature of $-65^{\circ} \pm 2^{\circ}\text{F}$ ($-54 \pm 1^{\circ}\text{C}$) and conditioned at this temperature for 2 hours. The specimens shall then be taken out of the container and tested within 30 seconds for locking torque in accordance with 4.6.2.1.2.

4.6.2.2 Fluid tightness.

4.6.2.2.1 Apparatus. The apparatus as shown in figure 1 shall consist of: (A) A pressure vessel provided with a means of filling with soapy water. The pressure vessel shall be capable of applying, withstanding and measuring 50 psi (345 kPa) pressure of the soapy water; (B) A flat metal plate approximately 3/8-inch (9.5 mm) thick drilled with a 3/8-inch (9.5 mm) hole at its approximate center; (C) A rubber "O" ring or flat rubber gasket; and (D) A means of pressing the nut of the compound-treated specimen (E) against the "O" ring or gasket with sufficient force to prevent leakage between the plate (B) and the washer face of the nut. Figure 1 is a schematic illustration of one permissible design of apparatus. (A) and (B) constitute the pressure vessel equipped with an air inlet for supplying the pressure and a gage for reading the pressure. The 3/8 inch (9.5 mm) drilled hole in plate (B) is counterbored 5/8-inch (15.9 mm) diameter by 1/16 inch (1.6 mm) deep to provide for the "O" ring 5/8 inch (15.9 mm) outside diameter by 7/16 inch (11.1 mm) inside diameter by 3/32 inch (2.4 mm) thick. To assemble, the apparatus is positioned with plate (B) up. Soapy water is added through the hole in (B), the "O" ring and the specimen (consisting of a stud-and-nut assembly treated with compound under test), are set in place, plate (D) slipped over the specimen and studs (F), and the nut of the specimen forced against the "O" ring by tightening the nuts (G). The assembled apparatus is then repositioned so that the fluid level is above the sealant-treated, stud-and-nut assembly. The positioning may be modified to test bolts with heads by changing the clamping device. The apparatus may be made stationary by adding a fluid inlet and drain. A washer-faced, heavy nut (FF-N-836 having 11/16 inch (17.5 mm) nominal width across the flats should be used in order to provide adequate sealing area against the "O" ring. For the same reason, the nut and the plate (B) must have smooth surfaces in contact with the "O" ring or gasket.

4.6.2.2.2 Specimens. The specimens shall consist of steel bolts, threaded rods or studs, as shown in figure 1 treated with the compound being tested, inserted into steel, hexagonal nuts conforming to FF-N-836, and conditioned for 24 to 26 hours at 70 to 77°F (21 to 25°C). The thread system shall be 3/8-24 UNF2, as specified in 4.6.2.1.1. Only those threaded components inspected and found free from damaged threads, burrs, and not having too loose or too tight fit shall be used for test. The compound shall be applied in a manner specified in 4.6.2.1.1 and the assemblies shall be aged as specified in 4.6.2.1.2.

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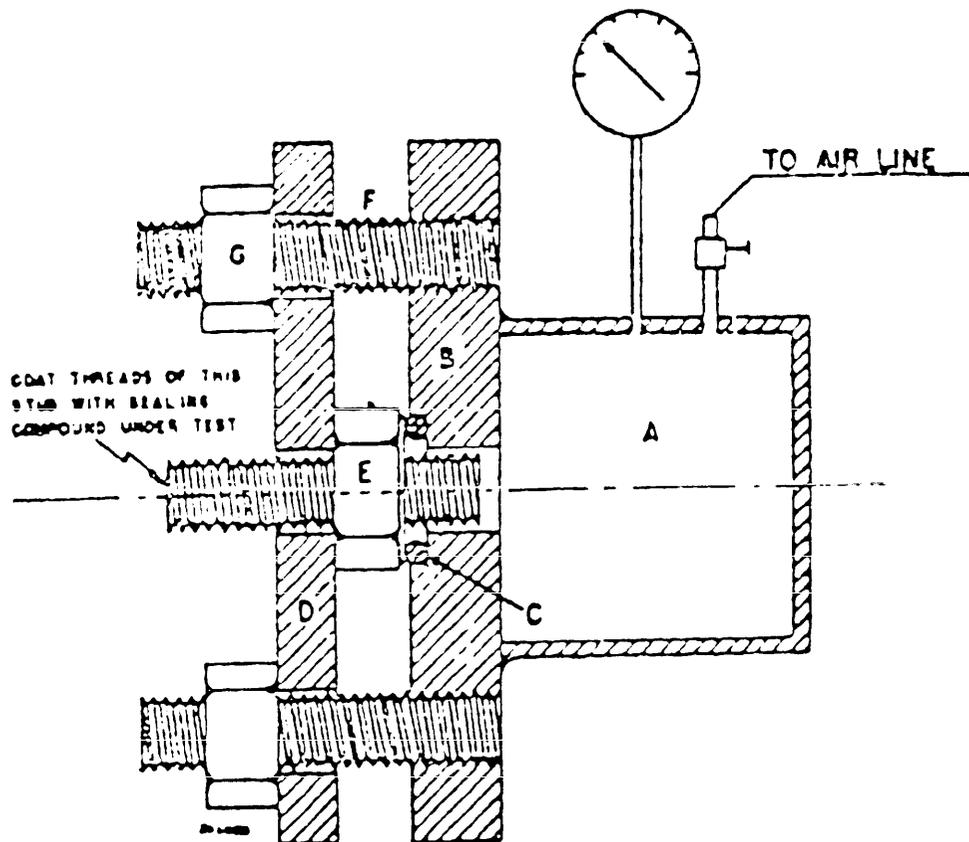


FIGURE 1. Fluid tightness test jig.

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4.6.2.2.3 Procedure. From each sample of compound, 3 specimens shall be prepared in accordance with 4.6.2.1.1 and tested as follows: The pressure vessel shall be filled with water at normal room temperature to which sufficient soap or synthetic wetting agent has been added to reduce its surface tension to a low value. The specimen shall be clamped in position, 50 \pm 5 psi (345 \pm 34.5 kPa) shall be applied to the water and maintained for one minute. Any leakage through the thread between the bolt, stud or threaded rod and the nut shall constitute a failure. All 3 specimens of each compound must pass.

4.6.2.3 Fungus resistance. Compound polymerized in accordance with the directions of the manufacturer shall be tested for fungus resistance in accordance with method 508.2 of MIL-STD-810.

4.6.3 Primer.

4.6.3.1 Speed of curing (grades N and T). Grades N and T primers shall be tested for conformity to 3.5.1 and 3.5.2, respectively. Test specimens shall be prepared as specified in 4.6.2.1.1 except that unpolished and untreated cadmium plated and zinc plated steel fastener components shall be used. Each primer shall be applied by dipping the fastener components therein and allowing to dry in air. The concentrated primer N (Form C) shall be diluted in accordance with the directions of the supplier (see 5.1.1.4 and 6.6.2).

4.6.3.2 Storage stability. Five bottles of each grade of primer shall be conditioned for 10 days at 120 \pm 30F (49 $^{\circ}$ \pm 1.7 $^{\circ}$ C). After cooling to room temperature, each primer shall be examined for conformity to 3.6 and tested for speed of cure (see 4.6.3.1). Each of the 5 specimens must pass.

4.6.3.2.1 Certificate of compliance. When authorized by the procuring activity a certificate of storage-stability compliance in accordance with 4.6.1.7.1 may also be accepted for the primer.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or C as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Bottles (compound). Unless otherwise specified (see 6.2), the compound shall be furnished in 10-cc (1/3 fluid ounce), 50-cc (1-2/3 fluid ounces), 60-cc (2 fluid ounces), or 250-cc (8-1/3 fluid ounces) plastic squeeze bottles, as specified (see 6.2). Bottles of 10-cc (1/3 fluid ounce), 50-cc (1-2/3 fluid ounces), and 60-cc (2 fluid ounces) capacities shall be fitted with dispenser nozzles and suitable closure caps with knurlings or facets for easy opening. The bottle shall neither affect nor be affected by the product during extended storage.

5.1.1.2 Bottles or cans (primer). Unless otherwise specified, when primer is required (see 6.2), it shall be packaged in one of the bottles or cans as specified in table IV.

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Table IV. Primer containers (see 6.6.2)

Primer containers	Grade N (Green)		Grade T (Yellow)	
	Concentrate	Ready to use	(see 6.1.2)	Ready-to-use
4 oz (113 g) glass bottle	X	X		
6 oz (170 g) aerosol can	-----	X		X
1 gallon (0.0038 m ³) can	X	X		X

5.1.1.3 Intermediate packing. Bottles of the same size of sealing compound and primer (when required) shall be packed in snug fitting boxes conforming to either PPP-B-566 or PPP-B-676 at the option of the contractor. Quantity and arrangement shall be in accordance with commercial practice. Box closures shall be as specified in the box specification.

5.1.1.4 Instructions. Each bottle or can of primer shall be marked to indicate the speed of cure (Grade N or Grade T) (see 3.5.1 and 3.5.2). A label shall be furnished with each bottle or can, or an instruction sheet shall be furnished with each intermediate package that shall contain as a minimum information on the following:

- (a) Method of application (for sealing compound and for primer when required).
- (b) Shelf life, if limited.
- (c) Types of surfaces on which the compound will and will not produce a satisfactory seal or lock.
- (d) Dilution instructions if concentrate primer is required.

Method: The instruction sheet shall be submitted to the Government for approval. No change shall be made in the instruction sheet without the permission of the procuring activity.

5.1.2 Level C.

5.1.2.1 Sealing compound. Sealing compound bottles in the size and quantities specified (see 6.2) and with the type of dispenser specified (see 6.3) shall be packaged in accordance with the contractors commercial practice.

5.1.2.2 Primer. When primer is required it shall be packaged in accordance with the contractors commercial practice.

5.1.2.3 Instructions. Instructions shall be in accordance with 5.1.1.4. When no labels are provided and intermediate packaging is not a requirement of the procuring activity, contract, purchase order, invitation for bids, etc., one (1) instruction sheet shall be provided for every twelve (12) or less, units of compound within each separate container.

5.2 Packing. Packing shall be level A, B or C as specified (see 6.2).

5.2.1 Level A. Bottles or cans, preserved as specified, shall be packed in boxes conforming to PPP-B-601, overseas type, style I. Weight of contents shall not exceed 200 pounds.

5.2.2 Level B. Bottles and cans, preserved as specified, shall be packed in boxes conforming to PPP-B-636, class weather resistant. Weight of contents shall not exceed the limits specified by the box specification.

5.2.3 Level C. Compound packaged as specified (see 6.2) shall be packed in a manner to insure carrier acceptance and safe delivery at destination. Containers shall be in accordance with Uniform Freight Classification Rules and Regulations or other carrier regulations as applicable to the mode of transportation.

5.3 Department of Transportation Regulations. In addition to the requirements specified in 5.1 and 5.2, the material shall be packaged and packed in accordance with the applicable requirements of the rules and regulations for the transportation of hazardous materials of the Department of Transportation.

5.4 Marking. In addition to any special marking required by the contract or order or herein, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129 and with the applicable requirements of the rules and regulations for the transportation of hazardous materials of the Department of Transportation. The date of manufacture shall also be included.

6. NOTES

6.1 Intended use. The sealants are normally liquid and are caused to convert to an infusible, insoluble state by confinement between closely fitting metal surfaces. The compounds are intended for use in sealing threaded fasteners, plugs, and other threaded fittings against fluid pressure; for locking such threaded assemblies against working loose under shock and vibration; and for retaining existing or replacement ball bearings in worn housings, thereby obviating the need for establishing a press fit. The low viscosity compounds are intended for use in closely fitting joints or for application to the outside of an assembled joint into which the compound should flow by capillary action. The high locking strength compounds are intended for use on high strength assemblies or short engagements or where a permanent or semipermanent joint is required. The weaker compounds are intended for use on long threads or on weak metals where the stronger compounds might lock so tightly as to cause the assembly to break on attempted disassembly.

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6.1.1 Examples of end-use applications. Some of the end-use applications for sealing compounds covered by this specification are as follows:

- (a) Securing set-screws that tend to rotate under vibration.
- (b) Securing studs, particularly where the class 5 interference thread fit may be eliminated, or where the class 5 threads fit has been tapped slightly oversized.
- (c) Housing screws on instruments, electric and electronic equipment.
- (d) Where it is difficult to obtain locking with mechanical devices, and where using the compound is economically advantageous.
- (e) For smaller sizes of screws, where the sealing compounds will generally be more economical than other locking devices.
- (f) For adjustment screws, where backlash is not desired, or where parts must be positioned with a great deal of accuracy. (By selection of the proper grade of the compound, varying degrees of holding power can be obtained, and a compromise between resistance to vibration and ease of adjustment obtained).
- (g) For through-screws, plugs, and fittings in fluid-filled housings to prevent both loosening and leakage.
- (h) For retaining and sealing ball bearings, oil seals, sleeves, gears, pulleys, fans and rotors; to replace a press fit and thereby eliminate distortion and close tolerances; to seal a press fit against leakage under fluid pressure; or in conjunction with a press fit for additional strength and reliability and to eliminate fretting corrosion. (Fretting corrosion is a form of damage to the mating surfaces of metal parts which are subject to slight relative motion under load. The fretting phenomenon, sometimes called "wear oxidation" or "chafing" often affects tightly clamped parts.)
- (i) To restore the fit of a replacement bearing to a worn housing, where concentricity requirements permit.
- (j) To retain bearings in aluminum castings, eliminating the need for steel sleeves and avoiding the possibility of splitting the castings.
- (k) To seal hydraulic fittings against loosening the leakage under high pressure fluids, including lubricating oils, fuels, hydraulic fluids.
- (l) To seal threaded joints against leakage in pneumatic control systems and cylinder gas systems, and steam lines where temperature requirements permit.

- (m) The very viscous grades (AVV, CVV and HVV) are designed to fill large clearances. Uses to be considered for pipe thread sealing up to 6 inches (152.4 mm) in diameter, for gasketing in lieu of traditional gaskets, and for locking and sealing fasteners, including studs, where radial clearances exceed 0.004 inch (0.10 mm).

6.1.1.1 Naval aircraft use limitations. Application of MIL-S-22473 compounds on naval aircraft shall be in accordance with MS18069(AS), Compounds, Adhesive, Aircraft Design and Usage Limitations for Threaded Components Retained or Sealed by.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Grade of sealing compound required (see 1.2.1).
- (c) Grade and form of primer if required (see 1.2.2).
- (d) Quantities of sealing compound (and primer if required).
- (e) Whether the compound must be suitable for use with explosives as determined by the using agency (see 3.2).
- (f) Color required, when other than as specified in table I.
- (g) Size of bottles or cans required (see 5.1.1.1, 5.1.1.2 and 6.3).
- (h) Selection of applicable levels of packaging and packing (see 5.1 and 5.2).
- (i) When level C packaging specify type of dispenser (see 6.3).

6.3 Temperature effects. Continued satisfactory service of the materials specified herein may be expected within the range -65 to 300°F (-54 to 149°C). As for the effect of temperature on speed of curing, the set-up time is approximately halved for every 20°F (11°C) increase, and approximately doubled for every 20°F (11°C) decrease. When applied at temperatures below 40°F (4.4°C), metal surfaces should be treated with Grade T primer.

6.4 Disassembly and reuse of treated parts. When proper grade has been used, treated parts may be disengaged by back-off torquing in excess of the maximum loads specified in 1.2.1. The sealant parts which are engaged too tightly may be softened by the application of heat such as by means of a soldering iron or torch. Disassembled parts should be cleaned (see 6.4) and retreated prior to assembly.

6.5 Bottles. The sealing compound is usually bottled in accordance with 5.1.1.1 and the primer in accordance with 5.1.1.2.

6.6 Removal of excess compound. Excess compound spilled during application may be wiped off with a cloth moistened with water or trichloroethylene. However, compound which has set is insoluble and can be removed by wire brushing, or in the case of threaded fasteners, running the nut off and on until the old sealant has worn away.

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6.7 Ultraviolet fluorescence. Fluorescence under ultraviolet illumination required in 3.3.1.1 is essential to facilitate detection of sealant when disassembled parts are inspected.

6.8 Application. Clean parts of the common metals will require no particular surface treatments. When the metals have had preservative treatments or contain greases and oils, the usual degreasing (solvent) operations will be sufficient. Unusually smooth surfaces such as bright nickel or chromimum platings should be slightly roughened; otherwise, relatively weak bonding will result.

6.8.1 Primers for inert surfaces. Cleaner primers are available from the producers of the compounds described in this specification. Such primers may be applied to parts as a priming rinse prior to assembly with the compound. Their function is to increase the speed of cure, while at the same time serving as a mild degreasing solvent. Surfaces such as zinc, cadmium, and gold platings and plastic parts require the use of a primer in order to meet the curing rate requirement of 3.4.3. Primers may be used on other metals to reduce curing time. Primers are usually applied as a 1 to 5 percent solution in a degreasing solvent such as trichloroethylene into which the parts are dipped and allowed to drain and dry before application of the compound. The primer solution may be used repeatedly until too dirty to degrease efficiently. Parts thus treated with Grade N or T primer may be expected to keep their activation not to exceed 30 days after treatment.

6.8.2 Concentrate versus ready-to-use primer. The matter of concentrate versus ready-to-use forms of primer N stems from the preference of certain users for smaller containerization, easier storage, and reduced shipping costs. Concentrate must be diluted before use in accordance with the suppliers directions.

6.9 Handling. Containers used in handling the sealing compounds should be washed before the compounds harden by using a degreasing solvent. Hardened compounds can be removed from containers by prolonged soaking in hot caustic soda, rinsing, and then wire brushing. The compounds may soften some plastics or damage organic finishes, particularly lacquers. Hence prior to painting, excess compound should be removed from parts, by wiping or degreasing while the compound is still liquid.

6.10 Application to fastener components prior to assembly. Surfaces to be joined should be wet with the applicable grade of sealing compound by brushing, dipping, or tumbling, etc. Where brushing is employed, a camel-hair brush is recommended. Use of the applicator nozzle furnished with each container is also recommended. There is no advantage in using more of the compound than the surface will retain. Except for the very viscous grades use about 1 cc to cover 40 to 100 square inches (258 to 645 cm²) depending on the viscosity. For the very viscous grades (AVV, CVV and HVV) use about 1 cc to cover approximately 20 to 50 square inches (129 to 323 cm²).

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6.11 Application to assembled fasteners. The sealing compounds may be applied economically to assembled fasteners by touching the dispenser nozzle to the screw thread where it enters the mating part. Adequate filling is assured when a ring of liquid around the screw at one point of entry persists for an hour or more. This ring of liquid acts as a reservoir on which the threaded spaces can draw until fully impregnated, provided displaced air can escape from the opposite end. Where the thread fit is rather loose, a second treatment may be necessary or it may be necessary to use a more viscous grade.

6.12 Application by tumbling. Where small fasteners are used in quantity, the sealing compound may be applied economically by tumbling. Information relative to the best methods for tumbling may be obtained from the producers of the compounds.

6.13 Storage to prevent contamination and polymerization. The storage life of the sealant is dependent upon maintaining air over the surface of the compound and upon keeping the compound clean. Therefore, the manufacturer's recommendations relative to storage should be strictly followed. In no case should parts be dipped into the sealant while it is in the storage container as this will result in severe contamination and destroy the usefulness of the sealant in a very short time.

6.14 Caution. Certain plastic materials and varnishes may be adversely affected in contact with compound covered by this specification. Also sealants from one manufacturer should not be mixed with primers of another manufacturer because the compound may not cure properly.

6.15 Primers and chlorinated cleaning solvents. Primers and chlorinated cleaning solvents are not to be used with titanium, thermoplastics, or other materials which might be affected by these chemicals. The reaction is more severe with these materials under stress, particularly titanium and thermoplastics.

6.16 Supersession data. Table V gives the corresponding classes and grades of sealing compounds and primers as covered in MIL-S-40083 (Ord), and MIL-S-22473 with all of the revisions.

6.17 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
 Army - MR
 Navy - AS
 Air Force - 11

Preparing activity:
 Army - MR
 Project No. 8030-0496

Review Activities:
 Army - ER, MD, ME, MI
 Air Force - 99
 MISC - DS

User activities:
 Army - ME
 Navy - SH

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TABLE V. Class and grade equivalents in superseded specifications

MIL-S-40083 (Ord) Class	MIL-S-22473 Grade	MIL-S-22473A Grade	MIL-S-22473B Grade	MIL-S-22473C Grade	MIL-S-22473D, MIL-S-22473E Grade
<u>SEALING COMPOUNDS</u>					
10	10	AA A	AA A D AV	AA A D AV AVV	AA A D AV AVV
11	11	AV	AV	AVV	AVV
20	20	B Low visc (Rev A only)	B	Med Visc (Rev B, C, and D only)	
21	21			C	B
30	30	C	CV	CV	C
	31	CV	CV	CVV	CV
	40	E EV H	E EV H	E EV H	E EV H
31	41	Dropped on Rev A	HV	HV HVV	HV HVV JV
<u>PRIMERS</u>					
		N	N	N	N
		Q	Q	Q	T

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DEPARTMENT OF THE ARMY



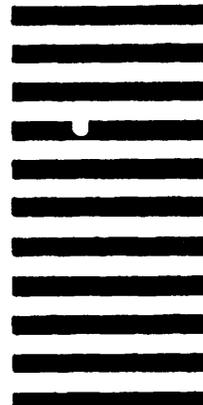
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(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-S-22473E		2. DOCUMENT TITLE SEALING, LOCKING, AND RETAINING COMPOUNDS; (SINGLE-COMPONENT)	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify) _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording			
b. Recommended Wording			
c. Reason/Rationale for Recommendation			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	