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MILITARY SPECIFICATION

SEALING, LUBRICATING, AND WICKING COMPOUNDS: THREAD-LOCKING, ANAEROBIC, 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 anaerobic compounds suitable for thread-locking and sealing. The compounds cure on all metal surfaces without the aid of a primer when applied at temperatures above 40°F, (4.4°C) and cure on plastic, plated and glass surfaces with the aid of a primer (see 6.15 and 6.16).

1.2 Classification.

1.2.1 Thread-locking compounds. The thread-locking compounds shall be of the following types and grades as specified (see 6.1 and 6.2):

Type I	- Sealing - Standard Viscosity	Grades J,K,L
Type II	- Lubricating - Thixotropic	Grades M,N,O
Type III	- Wicking - Fast Curing - Low Viscosity	Grades P,Q,R

Grades are based on viscosity and locking torque.

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.

FSC 8030

1.2.2 Surface primer. The surface primer-cleaner shall be compatible with the compound specified (see 3.5.2) and unless otherwise specified (see 6.2) shall be Grade F, Primer-Normal (ready to use) compound, green color.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified see (6.2), 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 - Anti-freeze/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)
QQ-Z-325 - Zinc Coating, Electrodeposited, Requirements For
TT-S-735 - Standard Test Fluids, Hydrocarbon
TT-T-548 - Toluene, Technical
PPP-P-566 - Boxes, Folding Paperboard
PPP-B-636 - Box, Shipping, Fiberboard
PPP-B-676 - Boxes, Setup
PPP-B-601 - Boxes, Wood, Cleated-Plywood

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
MIL-STD-1188- Commercial Packaging of Supplies and Equipment

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific aquisition 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 100-199 - Department of Transportation Rules and Regulations for the Transportation of Hazardous Materials by Air, Motor, Rail and Water.

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

2.2 Other publications. The following document(s) 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)

A109 - Steel, Carbon, Cold-Rolled Strip
A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
A568 - Steel, Carbon and High-Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet, General Requirements.
A568M - Steel, Carbon and High-Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet, General Requirements (Metric).
A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
A570 - Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
A611 - Steel, Cold-Rolled Sheet, Carbon, Structural
A619 - Steel Sheet, Carbon, Cold-Rolled, Drawing Quality.
A620 - Steel Sheet, Carbon, Cold-Rolled, Drawing Quality, Special Killed.
A621 - Steel Sheet and Strip, Carbon, Hot Rolled, Drawing Quality.
A622 - Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality. Special Killed.
A635 - Hot-Rolled Carbon Steel Sheet and Strip, Commercial Quality, Heavy-Thickness Coils (Formerly Plate).
D304 - Normal Butyl Alcohol (Butanol).
D445 - Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Viscosities).
D1084 - Consistency of Adhesives.
D1310 - Flash Point of Volatile, Flammable Materials by Tag Open-Cup Apparatus.

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

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent:

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(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 (see 4.3.1) and at regular intervals (see 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 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).

TABLE I - Color of unpolymerized sealing compounds

Type and Grade	Color Code
Type I	
Grade J	Blue
Grade K	Red
Grade L	Red
Type II	
Grade M	Purple
Grade N	Blue
Grade O	Red
Type III	
Grade P	Blue
Grade Q	Blue
Grade R	Green

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, specified in Table II, (as applicable) when tested as specified in 4.6.1.2.

TABLE II - Viscosity of unpolymerized sealing compounds

Type and grade	Viscosity, centipoises (pascal - seconds)	
Type I		
Grade J	115-135	(0.115-0.135)
Grade K	450-550	(0.45 -0.55)
Grade L	6000-8000	(6.0 -8.0)
Type II		
Grade M	900-5000	(0.90 -5.0)
Grade N	900-5000	(0.90 -5.0)
Grade O	1600-5500	(1.60 -5.5)
Type III		
Grade P	10-25	(0.01 -0.025)
Grade Q	10-25	(0.01 -0.025)
Grade R	10-25	(0.01 -0.025)

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.

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 and stored for 4 weeks at 120° ± 3°F (49°C ± 1.7°C) shall meet the breakaway and prevailing torque requirements of Table III. Also the compound shall not show an increase in viscosity in excess of 50 percent of that specified in Table II. Tests shall be as specified in 4.6.1.7.

3.3.8 Toxicity. The compound 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).

3.3.9 Lubricity (Type II). Type II compounds shall show lubricity on the thread flanks to within ± 10 percent of an as received phosphate and oil 3/8-16 grade 5 bolt when tested as specified in 4.6.1.9.

3.4 Polymerized compound.

3.4.1 Locking torque after normal curing. The compound shall have an average breakaway and prevailing torque within the range specified in Table III when tested as specified in 4.6.2.1.2.

3.4.2 Speed of cure. For types I, II, and III the average breakaway and prevailing torque for steel shall be not less than that specified in Table III after 24 hours exposure. Also the breakaway and prevailing torque for steel shall be not less than 50 percent of that specified in Table III after 90 minutes for Type I; 60 minutes for Type II; and 15 minutes for Type III. Tests shall be as specified in 4.6.2.1.3.

3.4.3 Locking torque after immersion in solvents. The breakaway and prevailing torque of each grade of compound shall be not less than 50 percent of the minimum value for steel as specified in Table III 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 4.6.2.1.4.

3.4.4 Hot strength. The hot-strength breakaway and prevailing torque shall be not less than 50 percent of the minimum required as specified in Table III for steel (see 4.6.2.1.5).

3.4.5 Heat aging. The breakaway and prevailing torque after heat aging shall be not less than 50 percent of minimum required in Table III for steel (see 4.6.2.1.6).

3.4.6 Low temperature torque. The average breakaway and prevailing torque shall be not less than 50 percent of the minimum values specified in Table III for steel when tested as specified in 4.6.2.1.7.

3.4.7 Wicking Type III. The average breakaway and prevailing torque for Type III products shall be not less than 50 percent of the minimum required (see Table III)) when tested as specified in 4.6.2.1.8.

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

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

3.5 Primer. (See 6.3 and 6.9.1.)

3.5.1 Corrosivity (primer). The primer shall not be corrosive to steel, aluminum alloy, or brass, or to cadmium or zinc-plated surfaces when tested as specified in 4.6.1.6.1.

TABLE III - Locking torque of unpolymerized sealing compounds

Type and Grade	Locking torque a/, inch-pounds (newton-metres)			
	Steel		Plated	
	Breakaway	Prevail	Breakaway	Prevail
Type I				
Grade J	100-200 (11.3- 22.6)	50-150 (5.65-16.9)	50-100 (5.65-11.3)	50-150 (5.65-16.9)
Grade K	200-300 (22.6- 33.9)	250-350 (28.2 -39.5)	50-100 (5.65-11.3)	200-300 (22.6 -33.9)
Grade L	250-350 (28.2- 39.5)	200-300 (22.6 -33.9)	50-100 (5.65-11.3)	100-200 (11.3 -22.6)
Type II				
Grade M	50-100 (5.65-11.3)	20- 50 (2.26- 5.65)	10- 40 (1.13- 4.52)	10- 40 (1.13- 4.52)
Grade N	100-200 (11.3 -22.6)	30- 60 (3.39- 6.78)	20-120 (2.26-13.6)	20- 50 (2.26- 5.65)
Grade O	150-250 (16.9 -28.2)	50-150 (5.65-16.9)	50-150 (5.65-16.9)	50-150 (5.65-16.9)
Type III				
Grade P	20-100 (2.26-11.3)	20-100 (2.26-11.3)	20-100 (2.26-11.3)	10- 50 (1.13-5.65)
Grade Q	20-100 (2.26-11.3)	100-200 (11.3 -22.6)	20-100 (2.26-11.3)	20-100 (22.6-11.3)
Grade R	20-100 (2.26-11.3)	200-350 (22.6 -39.5)	10- 50 (1.13- 5.65)	120-300 (13.6-33.9)

a/ 3/8-inch (9.525-mm) bolt (see 4.6.2.1.2)

3.5.2 Torque (after priming). The primer used in conjunction with Types I, II and III compounds on cadmium and zinc-plated surfaces shall be compatible to the compounds and shall provide a breakaway and prevailing torque of not less than 50 percent of the minimum specified in Table III after 15 minutes; and not less than 100 percent of the minimum specified in Table III after 4 hours when tested as specified in 4.6.3.1.

3.5.3 Storage stability (primer). The primer, packaged in original containers shall meet the requirements of this specification when conditioned for 4 weeks at 120°F (49°C) and tested as specified in 4.6.3.2.

3.5.4 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).

3.6 Workmanship. The unpolymerized compound shall be smooth and homogeneous after shaking, 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 thread-locking compound of the same type and grade, or all primer of the same grade manufactured as one batch and offered for inspection at one time.

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

a. Preproduction tests (see 4.3.1)
b. Quality conformance tests (see 4.3.2)

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 (see 4.3.2.1)
b. Individual lot tests (see 4.3.2.2)

4.3.2.1 Comparison tests. The procuring activity may require that the subsequent lots of the thread-locking 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:

a. Viscosity (see Table II and 4.6.1.2)
b. Locking torque after normal curing (see 3.4.1 and 4.6.2.1.2)
c. Speed of cure (see 3.4.2 and 4.6.2.1.3)
d. Torque (after priming) (when primer is required see 6.2) (see 3.5.2 and 4.6.3.1)
e. Lubricity (Type II only) (see 3.3.9 and 4.6.1.9)
f. Wicking (Type III only) (see 3.4.7 and 4.6.2.1.8)

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 specified as in Table IV.

4.4.2 For preproduction tests. A 250-cc sample of thread locking compound and a 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 or cans of each grade of compound and 5 representative cans of primer (when required) shall be selected from the preproduction batch (lot).

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 thread-locking compound and a 6-ounce (170-g) can of primer (if required) which are representative of the lot shall be selected from each lot for the individual lot tests of 4.3.2.2.

4.5 Examination. Sample units selected in accordance with 4.4.1 should be examined for color (1.2.2 and 3.3.1) workmanship (3.6) and preparation for delivery (see section 5) at the acceptable quality levels shown in Table IV.

TABLE I. Methods of Examination

Material	Inspection level and AQL	Classification of defect Critical	Defect None defined	Method of inspection
Thread locking 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]	Visual
		Major 106	Wrong grade	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 5.4)	Level I 1.0 AQL	Major 110	Improper size	Visual
		Major 111	Improper type	Approved scale[3]
Cans of primer (see 5.1.1.2 or 5.1.2.2 and 5.4	Level I 1.0 AQL	Major 112	Improper closure or leakage	Visual
		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 5.4)	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, 5.3 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.

[3] Approved by procuring activity.

4.6 Test methods. Samples of thread-locking 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 V.

TABLE V. 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	1/
Flash point	3.3.3	4.6.1.3	1/
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
*Lubricity (Type II only)	3.3.9	4.6.1.9	5
Polymerized Compound			
Locking torque			
*after nominal curing	3.4.1	4.6.2.1.2	5
*speed of cure	3.4.2	4.6.2.1.3	5
after immersion in solvents	3.4.3	4.6.2.1.4	5 for each test fluid
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
*Wicking (type III only)	3.4.7	4.6.2.1.8	2/
Fluid tightness	3.4.8	4.6.2.2	3
Fungus resistance	3.4.9	4.6.2.3	5
Primer			
Corrosivity	3.5.1	4.6.1.6.1	1
*Torque (after priming	3.5.2	4.6.3.1	3/
Storage stability	3.5.3	4.6.3.2	1

*Individual lot tests.

1/Duplicate determinations shall agree within the tolerance 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 assemblies with zinc-plated threads and 5 assemblies with uncoated steel threads, using fluids as required from 1 sample of primer and 1 sample of the sealant.

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 6.8).

4.6.1.2 Viscosity. The viscosity shall be determined by ASTM D 445 or by method B of ASTM D 1084. For ASTM D 445, a 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 Open-Cup flashpoint tester as specified in ASTM D 1310.

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, or A635; QQ-A-250/4; and QQ-B-613, copper alloy no 268, respectively, shall be degreased and cleaned, followed by buffing with clean number 400 emery cloth. A few drops of compound (approximately 0.03 cc) shall be applied to the prepared surfaces of each of the metals. The compound shall be considered as having wetted the metal if there is clear evidence of the migration of the compound to cover an area greater than that initially wet by the drops.

4.6.1.6 Corrosivity of compound. 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 wetted 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.

4.6.1.6.1 Corrosivity of primer. When a primer is required (see 6.3 and 6.9.1), tests for corrosivity shall be made as specified in 4.6.1.6 except that the specimens shall first be primed in accordance with instructions (see 5.1.1.4). Additional specimens with cadmium or zinc surfaces plated in accordance with QQ-P-416 and QQ-Z-325 shall also be tested in the same manner.

4.6.1.7 Storage stability. Five bottles of each size container shall be conditioned for 4 weeks at 120° ± 3°F (49° ± 1.7°C). After cooling to room temperature, the viscosity (see 4.6.1.2) and average breakaway and prevail torque after nominal curing (see 4.6.2.1.2) shall be determined. An increase in viscosity in excess of 50 percent, or failure of the compound to meet torque requirements specified in Table III shall constitute cause for rejection.

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 thread-locking compound or primer (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.

4.6.1.9 Lubricity (Type II). Type II compounds shall exhibit lubricity on the thread flanks to within 10 percent of the tension generated on an as-received phosphate and oil-treated 3/8-16 grade 5 bolt and an as-received steel nut when applied to the assembly and tested as follows: The bolt shall be inserted in a load measuring device which indicates tension in pounds (newtons) at various torques. A hardened steel washer shall be placed between the nut and the bearing surface of the device. During the complete performance test, the nut is turned and the washer and bolt are restrained from turning. Type II compounds shall be applied to the exposed threads of the bolt and the threads of the nut, and the nut assembled onto the bolt. Tensions, not exceeding 75 percent of the bolt proof load, shall be recorded at 10, 20, 30, 40 ft. lbs. (13.6, 27.1, 40.7 54.2 Nm) torque.

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 test shall be 3/8 inch size, 16 threads per inch, unified national coarse thread series, Class 2 fit (3/8-16 UNC) grade 5 bolts. Nuts shall conform to FF-N-836. The bolt shall have a minimum length of 1 inch (25.4 mm) with hexagonal head. The nut shall be style 1 (nominally 21/64 inch (8.3 mm) thick), heavy. All steel nuts and bolts shall be vapor degreased, stored in an atmosphere of low humidity and kept clean. Plated nuts and bolts conforming to QQ-Z-325 and QQ-P-416 Class 2, Type II do not require any special cleaning prior to assembly. Before use, test specimens shall be examined for damaged threads and any damaged bolts or nuts shall not be used. During assembly, any bolt-nut pair 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 a file, tap or die. All test specimens used in one series of tests shall be taken from one lot. Assembly of the test specimen is accomplished by applying

the liquid compound to the threads of both the nut and bolt, then assembling them, allowing at least 3 threads to protrude.

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 from 70 to 77°F (21 to 25°C) for 24 to 26 hours. The nuts shall then be unscrewed with a torque measuring device of suitable capacity and sensitivity. Torque reading shall be taken at breakaway, 1/4, 1/2, 3/4 and 1 full turn. The average of the last four readings shall be considered the average prevailing torque of the specimens. The breakaway and average prevail shall be within the range specified in Table III, as applicable.

4.6.2.1.3 Speed of cure. The speed of cure shall be determined by the method of 4.6.2.1.2. Also, the breakaway and prevailing torque for steel shall be not less than 50 percent of that specified in Table III after 90 minutes for Type I, after 60 minutes for Type II, and after 15 minutes for Type III.

4.6.2.1.4 Locking torque after immersion. The coated steel 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 24 to 26 hours. After aging, 5 specimens of each grade shall be immersed for 168 hours at 188 ± 5°F (87 ± 3.0°C) (in a flask equipped with a reflux condenser) in each of the test fluids conforming to specifications as follows:

Liquid	Application Specification
a. Distilled water	-
b. Normal butyl alcohol	ASTM D304
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 breakaway and prevailing torque shall be determined in accordance with 4.6.2.1.2 and shall be not less than 50 percent of the minimum required as specified in Table III for steel.

4.6.2.1.5 Hot strength. Steel 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 K, O, and R shall be 300°F (149°C); and for Grades J, L, M, P and Q shall be 250°F (121°C); for Grade N the heating temperature shall be 200°F (93°C). Within 30 seconds after removal of the assembly from the oven, the specimens shall be tested and shall be not less than 50 percent of the minimum strength required as specified in Table III.

4.6.2.1.6 Heat aging. Steel specimens prepared and tested as specified in 4.6.2.1.2 shall be aged in an air oven for 1000 hours at the following

temperatures: Grades K, C, and R heat aged at 300°F (149°C); Grades J, L, M, P and Q heat aged at 250°F (121°C); and Grade N heat aged at 200°F (93°C). The specimens shall be removed and cooled to room temperature after 1000 hours and the breakaway and prevail torque determined. The torque shall not be less than 50 percent of the minimum required as specified in Table III.

4.6.2.1.7 Low-temperature torque. Steel specimens prepared and tested as specified in 4.6.2.1.2 shall be placed in a container having a temperature of -65° ± 2°F (-54 ± 1°C) and conditioned at this temperature for 2 hours. The specimens shall then be removed and tested within 30 seconds for breakaway and prevail torque and shall be not less than 50 percent of the minimum torque required as specified in Table III.

4.6.2.1.8 Wicking (Type III). Steel and plated specimens prepared in accordance with 4.6.2.1.1 shall be assembled without the liquid compound and one set of test specimens pretorqued to 30 ft. lbs. (40.7 Nm) using a hardened steel washer and spacer. The other set of test specimens shall be assembled without any pretorque. In both cases, at least 3 threads shall protrude. Type III liquid compound shall then be applied to the assemblies by allowing several drops to fall on the threads adjacent to the nut and cured for 24 hours. The assemblies shall then be tested in accordance with 4.6.2.1.2. The average prevailing torque shall be not less than 50 percent of that specified in Table III for both pretorqued and non-pretorqued assemblies, and the breakaway for the non-pretorqued assemblies not less than 50 percent of that specified in Table III.

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 1/2-inch (12.7mm) thick drilled with a 3/8-inch (9.5mm) hole at its approximate center ((b) is welded to (A)); (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 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), and the "O" ring and the specimen (consisting of a nut and bolt assembly treated with compound under test), are set in place. Plate (D) is swiveled over the top nut which only acts as a pressure surface and the nut of the specimen forced against the "O" ring by the tightening of the nuts (F).

The assembled apparatus is then repositioned so that the fluid level is above the treated nut and bolt assembly. The apparatus level is above the treated nut and bolt assembly. 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, grade 5 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 3/8-16 UNC2, 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.

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 ± 5 psi (345 ± 34.5 kPa) shall be applied to the water and maintained for one minute. Any leakage through the thread between the bolt and the nut shall constitute a failure. All 3 specimens of each compound must pass this test.

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 Torque (after priming). Primer shall be tested for conformity to 3.5.2. Test specimens, cadmium plated, and zinc plated fasteners only, shall be prepared as specified in 4.6.2.1.1. The primer shall be applied by dipping the fastener components therein and allowing to dry in air (see 6.4). The test shall be made as specified in 4.6.2.1.2.

4.6.3.2 Storage stability (primer). Five containers of primer shall be conditioned for 4 weeks at 120° ± 3°F (49° ± 1.7°C). After cooling to room temperature, the primer shall be examined for conformity to 3.6 and the torque of the specimens determined after priming (see 4.6.3.1). Each of the 5 specimens must pass.

5. PACKAGING

5.1 Packaging. Packaging shall be level A or C as specified (see 5.4 and 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), or 250-cc (8-1/3 fluid ounces) plastic squeeze bottles, as specified (see 6.2). Bottles of 10-cc, 50-cc and 250-cc 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 products during extended storage.

5.1.1.2 Cans (primer). Unless otherwise specified, when primer is required (see 6.2), it shall be packaged in one of the cans as specified in Table VI.

TABLE VI. Primer Containers

Primer containers	Grade F (Green) Ready to use
6 oz. (170 g) aerosol can	X
1 gallon (0.0038 m^3) can	X

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

5.1.1.4 Instructions. 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 thread locking 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 Commercial.

5.1.2.1 Thread-locking compound. The thread locking compound bottles in the size and quantities specified (see 6.2) and with the type of dispenser specified (see 6.6) shall be packaged in accordance with the contractors commercial practice.

5.1.2.2 Primer. When primer is required it shall be packaged in the size and quantities specified (see 6.2 and 6.6) and 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 instruction sheet shall be provided for every twelve or less, units of compound within each separate container.

5.2 Packing. Packing shall be level A, B or Commercial as specified (see 5.4 and 6.2).

5.2.1 Level A. Containers, preserved as specified (see 5.1), shall be packed in boxes conforming to PPP-B-601, overseas type, style I. Weight of contents shall not exceed 200 pounds (91 Kg).

5.2.2 Level B. Containers preserved as specified (see 5.1) shall be packed in fiberboard 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 Commercial. Packing shall be in accordance with MIL-STD-1188.

5.3 Department of Transportation Regulations. In addition to requirements specified in 5.1 and 5.2, the material shall be packaged and packed in accordance with 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 for Level A and B shall be marked in accordance with MIL-STD-129 and shall include date of manufacture. Marking for Commercial packages shall be in accordance with MIL-STD-1188. All containers shall be marked 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 thread-locking compounds are liquid and in use, are converted to an infusible, insoluble state by confinement between closely fitting metal surfaces (under anaerobic conditions). All three types (I, II, III) are designed to lock threaded assemblies against working loose under shock and vibration. Specifically, Type I compounds are intended for use in sealing threaded fasteners, plugs, and other threaded fittings against fluid pressure. Type II compounds, having excellent lubricity, allow a minimum of metal to metal friction, thus reducing galling on the thread flanks. Type III compounds, which have a low viscosity, are intended for use in closely fitting joints or for application to the outside of an assembled joint into which the compound flows by capillary action and cures. The user should be aware that if using Type III compound as a wicking agent from the outside of a threaded assembly, the breakaway and prevailing torque to be expected may be only 50 percent of that specified in Table III (see 4.6.2.1.8).

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 oversize.

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 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. To seal hydraulic fittings against loosening, to prevent leakage of hydraulic fluids, and to seal other types of fittings against loosening to prevent the leakage of lubricating oils and fuels.

i. To seal threaded joints against leakage in pneumatic control systems and cylinder gas systems, and steam lines where temperature requirements permit.

j. The very viscous Grades L, M, N, and O are designed to fill larger clearances. Uses to be considered for pipe thread sealing up to 6 inches (152 mm) of 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).

6.2 Ordering data.

6.2.1 Acquisition Requirements Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Type and grade of thread-locking compound required (see 1.2.1).
c. Grade of primer if required (see 1.2.2, 6.3 and 6.9.1).
d. Quantities of thread-locking 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 of compound and primer, if other than that of 1.2.2 and 3.3.1.
g. Size of bottles or cans required (see 5.1.1.1, 5.1.1.2 or 5.1.2.1 and 5.1.2.2 and 6.6).
h. Selection of applicable levels of packaging and packing (see 5.1 and 5.2).
i. When Level C packaging specifies type of dispenser (see 6.6).
j. Special marking (if required) (see 5.3).

6.3 Temperature effects. Continued satisfactory service of the materials specified herein may be expected within the temperature range specified in (4.6.2.1.5) and (4.6.2.1.7). 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 F primer.

6.4 Application method. It is recommended that the product selected be applied to clean surfaces free of heavy oil, rust, scale or other foreign material which would interfere with the adhesion of the compound to the metal substrate. The liquid thread-locking compound should be applied to the engagement area of the bolt and also to the nut for maximum effectiveness. Materials should be allowed to flow around the bolt surface before engagement of the nut and bolt. (This flow is critical with the heavier viscosity products such as Grade L). The nut should then be run up on to the final engagement point on the bolt and allowed to cure in an undisturbed condition for at least 30 minutes.

6.4.1 If it is necessary to accelerate the cure, or if a cleaning compound is necessary, the Grade F primer-cleaner can be used by spraying upon the surface to be engaged and on to the nut. Allow the solvent to flash off before application of the compound. The parts should be engaged rapidly to prevent polymerization prior to final assembly. If the application method of primer is other than spray, such as dip, the parts can be dipped up to six months previous to use and allowed to stand in a low-humidity room prior to assembly. When dipping is used, rust preventative coatings are removed and care should be taken to avoid corrosion during long storage periods.

6.4.2 In the case of a wicking compound (Type III), it is suggested that the parts be assembled loosely, the product applied to the rear end of the nut

and allowed to wick in prior to final tightening. The wicking compound can be applied directly to completely assembled structures where pre-torque has been applied to the bolted assembly by applying several drops on the thread adjacent to the nut and curing for 24 hours.

6.5 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 Table III. The treated 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 6.7) and retreated prior to assembly.

6.6 Bottles. The thread-locking compound is usually containerized in accordance with 5.1.1.1 and primer in accordance with 5.1.1.2.

6.7 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.

6.8 Ultraviolet fluorescence. Fluorescence under ultraviolet illumination required in 3.3.1.1 is essential to facilitate detection of thread-locking compound when disassembled parts are inspected.

6.9 Application. Clean parts of the common metals will require no particular surface treatments. Where 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 chromium platings should be slightly roughened; otherwise, relatively weak bonding will result.

6.9.1 Primers for inert surfaces. Cleaner primers are available fom 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, glass and plastic parts require the use of a primer in order to meet the curing rate requirement of 3.5.2.

6.9.1.1 The parts are dipped into primer F and allowed to drain and dry before application of the compound. The primer solution may be used separately until too dirty to degrease efficiently. Parts thus treated with Grade F primer may be expected to keep their activation capacity up to 30 days after treatment.

6.10 Handling. Containers used in handling the thread-locking 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.

6.11 Application to fastener components prior to assembly. Surfaces to be joined should be wetted with the applicable grade of thread-locking compound by brushing, dipping, or tumbling, etc. Where brushing is employed, a camels 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 square centimeters) depending on the viscosity. For the very viscous grades use about 1 cc to cover approximately 20 to 50 square inches (129 to 323 square centimeters).

6.12 Application to assembled fastenings. The thread-locking 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 form 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.

6.13 Application by tumbling. Where small fasteners are used in containers containing the compound quantity, the thread-locking compound may be applied economically by tumbling. Information relative to the best methods of tumbling can be obtained from the producers of the compounds.

6.14 Storage to prevent contamination and polymerization. The storage life of anaerobic compounds 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 compound while it is in the storage container, as this will result in severe contamination and destroy the usefulness of the thread-locking compound in a very short time.

6.15 Caution. Certain plastic materials and varnishes may be adversely affected in contact with compound covered by this specification.

6.16 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.

6.17 Definition Anaerobic compounds: Compounds that harden or set in the absence of air.

6.18 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

Review Interest:

Army - AR, CR, ER, MI, MD
Navy - AS

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Army - MR

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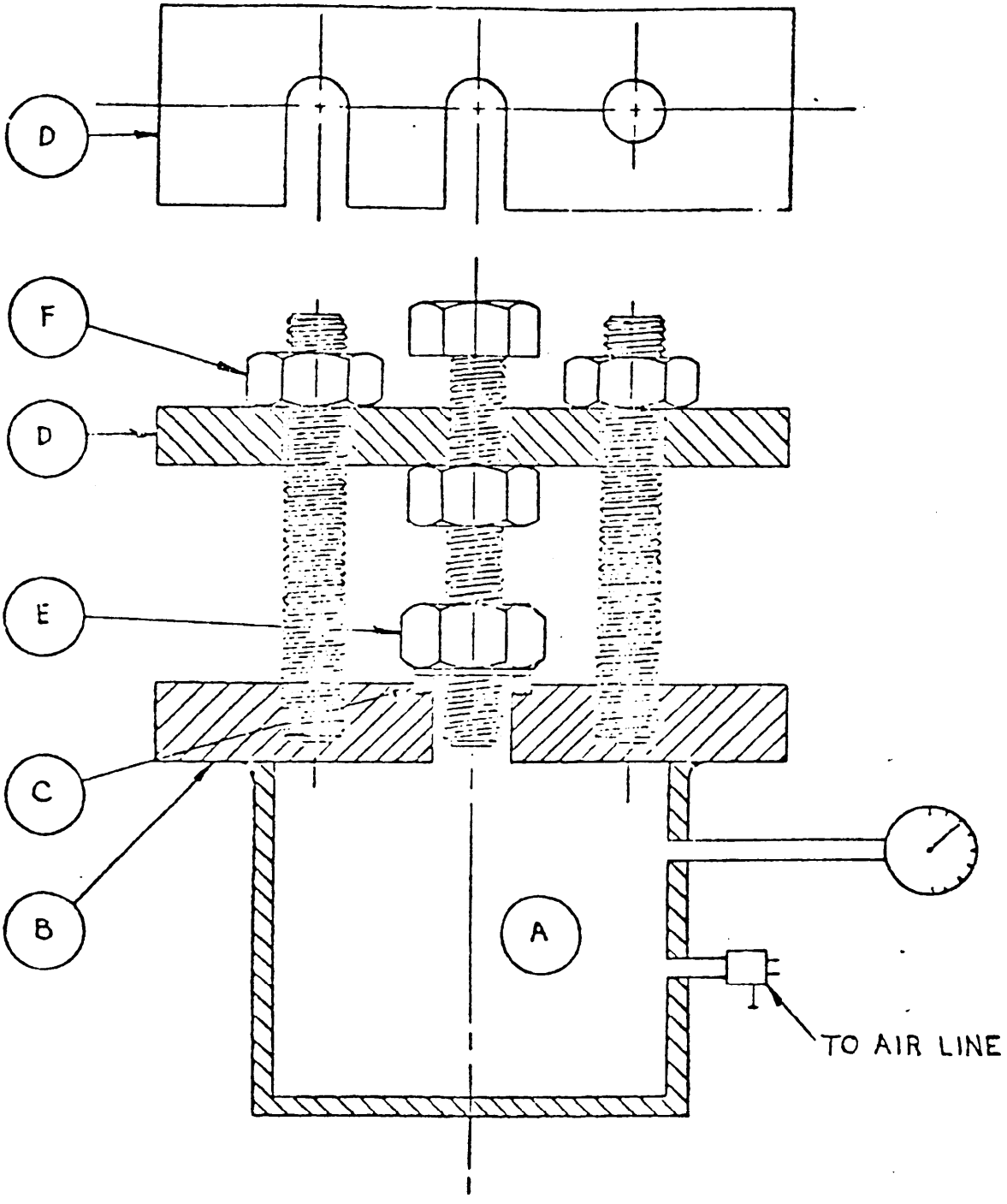

FLUID TIGHTNESS TEST JIG
FIGURE 1

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-S--46163A	SEALING, LUBRICATING, AND WICKING COMPOUNDS THREAD-LOCKING, ANAEROBIC, SINGLE-COMPONENT

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ 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

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