

MIL-S-81733C
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SUPERSEDING
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MILITARY SPECIFICATION

SEALING AND COATING COMPOUND, CORROSION INHIBITIVE

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

1. SCOPE

1.1 Scope. This specification covers accelerated, room temperature curing synthetic rubber compounds used in the sealing and coating of metal components on weapons and aircraft systems for protection against corrosion. The sealant is effective over a continuous operating temperature range of -54° to +93°C (-65° to +200°F).

1.2 Classification. The sealing compound shall be of the following types as specified (see 6.2):

- Type I - For brush or dip applications
- Type II - For extrusion application, gun or spatula
- Type III - For spray gun application
- Type IV - For faying surface application, gun or spatula

1.2.1 Dash numbers. The following dash numbers shall be used to designate the minimum application time in hours.

- Type I - Dash numbers shall be -1/2 and -2
- Type II - Dash numbers shall be -1/2, -2 and -4
- Type III - Dash number shall be -1
- Type IV - Dash numbers shall be -12, -24, -40 and -48

Example - Type I- $\frac{1}{2}$ shall designate a brushable material having an application time of $\frac{1}{2}$ hour. Type I-2 shall designate an application time of 2 hours. All other types and dash numbers shall be designated in a similar manner.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, 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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2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-378	-Plastic Sheet and Strip, Thin Gauge, Polyolefin
QQ-A-250/12	-Aluminum Alloy 7075, Plate and Sheet
QQ-M-44	-Magnesium Alloy, Plate and Sheet (AZ31B)
QQ-P-416	-Plating, Cadmium (Electrodeposited)
TT-E-751	-Ethyl Acetate, Technical
TT-I-735	-Isopropyl Alcohol
TT-M-261	-Methyl-Ethyl-Ketone, Technical
TT-N-97	-Naphtha, Aromatic
CCC-C-419	-Cloth Duck, Cotton, Unbleached, Piled Yarns, Army and Numbered
PPP-B-585	-Box, Wood, Wirebound
PPP-B-601	-Box, Wood, Cleated, Plywood
PPP-B-621	-Box, Wood, Nailed and Lock Corner
PPP-B-636	-Box, Shipping, Fiberboard
PPP-C-96	-Can, Metal, 28 Gauge and Lighter

MILITARY

MIL-S-5002	-Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
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MILITARY (Continued)

MIL-C-5541	-Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-H-5606	-Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-T-5624	-Turbine Fuel, Aviation Grades JP-4 and JP-5
MIL-L-7808	-Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-S-7839	-Screw, Structural, Aircraft
MIL-A-8625	-Anodic Coatings for Aluminum and Aluminum Alloys
MIL-T-9046	-Titanium and Titanium Alloy, Sheet, Strip and Plate
MIL-F-18264	-Finishes, Organic, Weapons System, Application and Control of
MIL-L-23699	-Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-P-38714	-Packaging and Packing of Two-Component Materials in Semkits
MIL-C-81706	-Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-C-87962	-Cloths, Cleaning, for Aircraft Fuel Tanks

STANDARDS

MILITARY

MIL-STD-105	-Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	-Marking for Shipment and Storage

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MS24694

-Screw, Machine, Flat Countersunk Head,
100 Deg, Structural, Cross Recessed,
UNC-3A and UNF-3A

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM A108

-Steel Bars, Carbon, Cold Finished,
Standard Quality

ASTM B117

-Salt Spray (Fog) Testing

ASTM D412

-Tension Testing of Vulcanized Rubber

ASTM D2240

-Indentation Hardness of Rubber and
Plastics by Means of a Durometer, Test
for

ASTM D3182

-Rubber - Materials, Equipment, and
Procedures for Mixing Standard Compounds
and Preparing Standard Vulcanized Sheets.

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

UNIFORM CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Rules

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

3. REQUIREMENTS

3.1 Qualification. The corrosion inhibitive sealing compounds furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

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3.2 Material. The basic ingredient used in the manufacture of the sealing compound shall be synthetic rubber of the polysulfide type. The sealing compound shall cure by the addition of a separate curing agent to the base compound.

3.2.1 Soluble chromate compound. Soluble chromate compounds may be formulated as an integral part of the base compound, the curing system or both. Any soluble chromate compound shall be permitted, provided the base compound, curing agent, and cured compound meet all the requirements contained herein.

3.3 Performance characteristics.

3.3.1 Properties before cure.

3.3.1.1 Appearance. The base compound and curing agent shall be of uniform blend and shall be free of skins, lumps, and jelled or coarse particles. There shall be no separation of ingredients which cannot be readily dispersed by mechanical agitation or mixing by hand.

3.3.1.2 Color. Unless otherwise specified in the contract or order, the color of the sealing compound shall be as furnished by the manufacturer (see 6.2). The curing agent, if furnished separately, shall be of contrasting color to facilitate mixing.

3.3.1.3 Nonvolatile content. The minimum percent nonvolatile content of the freshly mixed compound, when tested as specified in 4.8.2, shall be as follows:

Type I	- 84 percent
Type II	- 92 percent
Type III	- 65 percent
Type IV	- 90 percent

3.3.1.4 Flow (type II only). The sealing compound shall flow within the limits of 0.1 and 0.75 inch when tested as specified in 4.8.3.

3.3.1.5 Application life. Application life shall consist of the initial viscosity of the base compound and an application time measurement of the mixed compound (see 4.8.4).

3.3.1.5.1 Initial viscosity. The initial viscosity of the base compound shall conform to Table I when tested as specified in 4.8.4.1.

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TABLE I. Initial viscosity.

Type	Application suitability	Viscosity
		Poises
I	Brush or dip	100-500
II	Extrusion or injection gun or spatula	6,000-16,000
III	Spray	50-150
IV	Extrusion or injection gun or spatula	1,500-4,000

3.3.1.5.2 Application time. The compound prepared in accordance with the manufacturer's instructions shall have an application time of not less than the time in hours specified in table II. The end of the application time shall be considered as 2,500 poises (maximum) for Type I, 15 grams per minute (minimum) for Type II, 300 poises (maximum) for Type III, and 50 grams per minute (minimum) for Type IV. Testing shall be in accordance with 4.8.4.2.

TABLE II. Application time.

Type I	Hours	Type II	Hours	Type III	Hours	Type IV	Hours
-1/2	1/2	-1/2	1/2	-1	1	-12	12
-2	2	-2	2				
		-4	4			-24	24
						-40	40
						-48	48

3.3.1.6 Tack-free time. The material shall cure to a tack-free condition within the time specified in table III (see 4.8.5).

TABLE III. Tack-free time.

Type I	Hours	Type II	Hours	Type III	Hours
-1/2	16	-1/2	16	-1	8
-2	24	-2	24		
		-4	32		

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3.3.2 Properties after cure. Unless otherwise specified, curing of all specimens shall be in accordance with 4.7.

3.3.2.1 Hardness. When tested as specified in 4.8.6, the minimum shore A-2 hardness for Types I, II and III shall be 35; Type IV shall be 30.

3.3.2.2 Soluble chromate content. The cured sealing compound shall have a soluble chromate range of 3 to 7 percent when tested as specified in 4.8.7.

3.3.2.3 Specific gravity. The specific gravity of the cured sealing compound shall not exceed 1.65 when tested as specified in 4.8.8.

3.3.2.4 Corrosion. When tested as specified in 4.8.9, the sealing compound shall not in itself induce corrosion and shall be capable of protecting the substrate metal. There shall be no visible evidence of corrosion at the metal-sealant interface.

3.3.2.5 Low-temperature flexibility. The compound shall withstand the bend test as specified in 4.8.10 without cracking, checking, or separation from the panel.

3.3.2.6 Thermal stability. When tested in accordance with 4.8.11, the cured compound shall not blister, crack, or show evidence of "blowing" at rest or when wrapped 180° on a mandrel. The hardness, after exposure, shall be within -5 to +15 points of the original "as cured" hardness.

3.3.2.7 Tensile strength (Type II only). Type II minimum tensile strength (4.8.12) shall be 200 pounds per square inch (psi).

3.3.2.8 Elongation (Type II only). The Type II minimum elongation shall be 150 percent (4.8.12).

3.3.2.9 Peel strength (Types I, II & IV). The peel strength of the compound, when tested as specified in 4.8.13, shall be a minimum 15 pounds per inch width, as received and after immersion. All specimens shall exhibit 100% cohesive failure.

3.3.2.10 Anchorage (tape test, Type III only). When tested as specified in 4.8.14, the sealant under test shall show no more than a slight widening of the scratch. No more than 1/8 inch shall be considered acceptable.

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3.3.2.11 Reparability. The sealing compound shall be suitable for repairing minor breaks in itself and other materials qualified to this specification (see 4.3.2.2). A second coat of the sealing compound applied over a freshly cured film of the material shall show satisfactory bonding, no lifting, blistering, loss of adhesion, or other film irregularities and shall have a minimum adhesion strength value of 10 pounds per inch of width for Types I, II, and IV when tested as specified in 4.8.15. Type III reparability shall conform to 3.3.2.10 when tested in accordance with 4.8.15.2.

3.3.3 Long-term storage. The base compound and curing agent, after 6 months storage, shall show no hardening, separation, or settling of material when tested as specified in 4.8.16. After the storage period, the mixed sealing compound shall meet the requirements for flow (3.3.1.4), application life (3.3.1.5), tack free time (3.3.1.6), and hardness (3.3.2.1).

3.4 Workmanship. Workmanship shall be in accordance with high grade practice for this type of material. It shall be suitable for its intended purpose and free of defects which may affect its performance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of 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.

4.1.1 Source inspection. Materials procured by the Government under this specification must be source inspected, so that there is assurance that the material meets the quality conformance inspection (4.4) when it leaves the manufacturer's plant. Note that 4.4.2.2 requires that the samples for quality conformance tests be packaged and mixed as much as practical in the same containers that are being procured.

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

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

4.3 Qualification inspection. Qualification inspection shall consist of all the tests specified in table VIII.

4.3.1 Qualification sampling. Qualification samples shall consist of 5 quarts of Type I material, 8 quarts of Type II, 8 pints of

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Type III, and 5 quarts of Type IV base compound material together with sufficient curing agent for each type for which qualification is requested. The samples, in containers of the type used in filling contracts or orders, shall be forwarded to the Commander, Naval Air Development Center, Warminster, Pennsylvania 18974, Attention: ACSTD (Code 60621). The samples shall be durably and plainly marked with the following information:

SAMPLE FOR QUALIFICATION TEST
SEALING AND COATING COMPOUND, CORROSION INHIBITIVE

TYPE AND APPLICATION TIME

Name and address of manufacturer
Plant address and date sample produced
Manufacturer's part number or designation
Submitted by (name and date) for qualification in
accordance with the requirements of MIL-S-81733
under authorization (reference authorizing letter)

4.3.2 Manufacturer's data.

4.3.2.1 Test reports. Two copies of the manufacturer's test report showing the material submitted conforms to all the requirements of this specification shall be submitted along with the qualification samples. The test report shall reference the specific test methods of this specification.

4.3.2.2 Certification. The manufacturer shall certify that the material submitted conforms to the reparability requirement (3.3.2.11) as it pertains to other similar materials.

4.3.2.3 Instructions for use. Two copies of the manufacturer's instructions for preparation, mixing and application of the sealing compound shall be submitted.

4.3.3 Retention of qualification. In order to retain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that his product complies with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by certification shall be in two-year intervals from the date of original qualification.

4.4 Quality conformance inspection.

4.4.1 Lot formation. Unless otherwise specified in the contract, a lot shall consist of all the sealing compound of the same type, processed at one time from one batch, forming a part of one contract or order, and submitted for inspection at one time.

4.4.2 Sampling.

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4.4.2.1 Physical properties. A 1-quart container or sufficient containers to prepare test specimens in 4.4.3.1 shall be randomly selected from each lot and tested as specified in 4.4.3.1.

4.4.2.2 Packaging.

4.4.2.2.1 Unit containers. A random sample of filled unit containers (base compound and curing agent) shall be selected from each lot in accordance with Inspection Level I of MIL-STD-105 and examined as specified in 4.4.3.2. The lot size shall be the total number of unit containers of the same type.

4.4.2.2.2 Shipping containers. Shipping containers, just prior to closure, shall be randomly selected from each lot in accordance with Inspection Level I of MIL-STD-105 for examination as specified in 4.4.3.2. Lot size shall be the number of shipping containers.

4.4.3 Examination of quality conformance samples.

4.4.3.1 Physical properties. The sample selected in 4.4.2.1 shall be tested to the requirements specified in table IV. In addition, the sample may be subjected to any other tests specified herein when considered necessary by the procuring activity. Nonconformance of a test specimen to a single requirement (table IV) shall be cause for rejection of the lot represented by the sample.

TABLE IV. Quality conformance physical properties.

Test	Applicable type	Test paragraph
Nonvolatile content	I, II, III, IV	4.8.2
Flow	II	4.8.3
Application life	I, II, III, IV	4.8.4
Hardness	I, II, III, IV	4.8.6
Chromate content	I, II, III, IV	4.8.7
Specific gravity	I, II, III, IV	4.8.8
Thermal stability	I, II, III, IV	4.8.11
Peel strength, initial (adherend #1)	I, II, IV	4.8.13
Anchorage	III	4.8.14

4.4.3.2 Packaging. Samples selected in accordance with 4.4.2.2.1 and 4.4.2.2.2 shall be visually examined to the requirements in table V and all other applicable requirements to determine conformance to Section 5

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of this specification. The Acceptable Quality Level (AQL) for this inspection shall be 2.5 percent defective except that unit containers with "fill" defects may be corrected. In addition, shipping containers fully prepared for delivery shall be inspected for closure defects.

TABLE V. Packaging examination.

Examination	Defect
<u>Unit container</u>	
Fill	Not volume specified in contract or order
Packaging	Wrong size cans or kits Material or construction not as specified Components damaged or missing Unit package closure incomplete or damaged Not level required by contract or purchase order Base compound and accelerator not properly separated
<u>Shipping container</u>	
Packing	Not level required by contract or purchase order Any nonconforming component, incomplete closures Bulged or damaged shipping containers
Count	Less than specified or indicated quantity per shipping container
Markings	Unit package and packing--omitted, illegible, incorrect, incomplete or not in accordance with contract requirements

4.5 Test conditions.

4.5.1 Temperature and humidity. Unless otherwise specified, all mixing, curing, conditioning of panels and tests of the sealing compound shall be conducted at a temperature of $25^{\circ} \pm 1^{\circ}\text{C}$ ($77^{\circ} \pm 2^{\circ}\text{F}$) and a relative humidity of 50 ± 5 percent. These conditions shall be considered standard conditions.

4.6 Preparation of test specimens.

4.6.1 Cleaning of test panels. Except where otherwise specified herein, metal panels shall be cleaned with lint-free cheesecloth conforming to MIL-C-87962, using solvent formulated in accordance with table VI. Immediately after rinsing, the panels shall be wiped dry with a clean, lint-free cloth.

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TABLE VI. Formulation of cleaner.

Ingredient	Specification	Percent by volume
Aromatic petroleum naphtha	TT-N-97, Type I, Grade B	50 \pm 2.5
Ethyl Acetate	TT-E-751	20 \pm 1.0
Methyl-Ethyl-Ketone	TT-M-261	20 \pm 1.0
Isopropyl Alcohol	TT-I-735	10 \pm 0.5

4.6.2 Mixing. The base compound and accelerator, both in their original unopened containers, together with the required mixing equipment shall be held at $25^{\circ} \pm 1^{\circ}\text{C}$ ($77^{\circ} \pm 2^{\circ}\text{F}$) for a minimum of 24 \pm 1 hours. The base compound and accelerator shall be proportioned, mixed, and prepared in accordance with the recommendation of the manufacturer, taking care to avoid incorporation of air by too rapid stirring or folding action. The mixing and curing of the compound shall be conducted in accordance with 4.5.1. Where applicable (Type II), the sealant, immediately after mixing, shall be placed into cartridges for extrusion from the Semco No. 250 gun, or equal, having a Semco 440 nozzle with an orifice of 0.125 ± 0.005 inch.

4.6.3 Application of sealing compound. Unless otherwise specified herein, test panels shall be given an application of sealing compound to produce a coating having a thickness of 0.125 ± 0.005 inch when cured for Types I, II, and IV. For Type III, the coating thickness shall be 0.005 to 0.007 inch.

4.7 Curing. Unless otherwise specified, all test specimens shall be cured as specified in table VII. All molded specimens shall be removed from the mold following the first 24 hours of cure. When specified by the manufacturer, Type IV materials shall be completely covered with polyethylene film conforming to L-P-378 during the entire cure period. For Qualification purposes, all test specimens shall be cured at standard conditions (see 4.5.1).

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TABLE VII. Cure cycle.

Type	Cure
Type I and III	7 days at standard conditions or 24 hours at standard conditions plus 24 hours at 49° ±1°C (120° ±2°F)
Type II	14 days at standard conditions or 48 hours at standard conditions plus 24 hours at 49° ±1°C (120° ±2°F)
Type IV	
-12 hour application time	14 days at standard conditions or 24 hours at standard conditions plus 48 hours at 49° ±1°C (120° ±2°F)
-24 hour application time	21 days at standard conditions or 24 hours at standard conditions plus 96 hours at 49° ±1°C (120° ±2°F)
-40 hour application time	49 days at standard conditions or 24 hours at standard conditions plus 7 days at 49° ±1°C (120° ±2°F)
-48 hour application time	56 days at standard conditions or 24 hours at standard conditions plus 9 days at 49° ±1°C (120° ±2°F)

4.8 Test methods.

4.8.1 Visual examination. The sealing compound and curing agent shall be visually examined for conformance to 3.3.1.1 and 3.3.1.2.

4.8.2 Nonvolatile content. Five to ten grams of the mixed sealing compound shall be transferred as soon as possible to a dish about 8 centimeters in diameter. A tight fitting cover shall immediately be placed over the dish and the weight determined to the nearest milligram. The cover shall then be removed and the sealing compound heated for 72 ±1 hours at 70° ±1°C (158° ±2°F), and the compound transferred to a desiccator and cooled to room temperature, the cover replaced, and the weight determined to the nearest milligram. The percent nonvolatile content shall be calculated as follows:

$$\text{Percent nonvolatile content} = \frac{\text{Final weight}}{\text{Initial weight}} \times 100$$

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TABLE VIII. Qualification tests.

Test	Test method	Requirement paragraph	Test paragraph
Appearance	-	3.3.1.1	4.8.1
Color	-	3.3.1.2	4.8.1
Nonvolatile content	-	3.3.1.3	4.8.2
Flow	-	3.3.1.4	4.8.3
Application life	-	3.3.1.5	4.8.4
Tack-free time	-	3.3.1.6	4.8.5
Hardness	ASTM D2240	3.3.2.1	4.8.6
Soluble chromate	-	3.3.2.2	4.8.7
Specific gravity	-	3.3.2.3	4.8.8
Corrosion	-	3.3.2.4	4.8.9
Low temperature flex	-	3.3.2.5	4.8.10
Thermal stability	-	3.3.2.6	4.8.11
Tensile strength	ASTM D412	3.3.2.7	4.8.12
Elongation	ASTM D412	3.3.2.8	4.8.12
Peel strength	-	3.3.2.9	4.8.13
Anchorage (wet tape)	-	3.3.2.10	4.8.14
Reparability	-	3.3.2.11	4.8.15
Long term storage	-	3.3.3	4.8.16

4.8.3 Flow (Type II only). A 250 gram lot of Type II compound shall be mixed and prepared for testing in accordance with 4.6.2. The test shall be conducted with a flow-test fixture as shown in figure 1. Depth of plunger tolerance is critical and shall be controlled as specified (See Figure 1). The test fixture temperature shall be maintained at $25^{\circ} \pm 1.1^{\circ}\text{C}$ ($77^{\circ} \pm 2^{\circ}\text{F}$).

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4.8.3.1 Procedure. The flow-test fixture shall be placed on a table with the front face upward and the plunger depressed to the limit of its travel. Within 15 minutes after the beginning of mixing, the mixed sealant shall be added to the recessed cavity of the fixture and leveled off even with the block. Within 10 seconds after the leveling operation, the fixture shall be placed on its end and the plunger immediately advanced to the limit of its forward travel. The flow measurement shall be taken directly from the fixture exactly 30 minutes after the sealing compound has been applied to the cavity. Conformance to 3.3.1.4 shall be noted.

4.8.4 Application life.

4.8.4.1 Initial viscosity. The viscosity shall be determined with the sample of base compound in a 1-quart can. The can shall be filled with base compound to within 1/2 inch of the top, covered, and stored at standard conditions for a minimum of 8 hours. The base compound shall be thoroughly mixed by stirring for 3 minutes. The container shall be closed and the material allowed to stand for 1 hour. The Brookfield Model RVF Viscometer or equivalent shall be used with the reading being reported as poises. Spindle identification and speed shall be as follows:

Type I Compound	- No. 6 spindle at 10 rpm
Type II Compound	- No. 7 spindle at 2 rpm
Type III Compound	- No. 5 spindle at 10 rpm
Type IV Compound	- No. 6 spindle at 2 rpm

4.8.4.2 Application time.

4.8.4.2.1 Types I and III. An amount of base compound and curing agent, sufficient to fill a standard 1/2-pint can (2-7/8 inches in diameter by 2-7/8 inches high) to within 1/2 inch of the top, shall be prepared and mixed at standard conditions in accordance with 4.6.2. This can shall be tightly covered except when testing the viscosity. At the end of the rated application time (see 3.3.1.5.1) measured from the beginning of the mixing period, the viscosity of the sealing compound shall be determined as follows:

Type I Compound	- No. 7 spindle at 10 rpm
Type III Compound	- No. 5 spindle at 10 rpm

4.8.4.2.2 Types II and IV. The Type II flow test sample shall be used for application time. The Type IV sample shall be mixed and prepared as specified in 4.6.2. From 2 to 3 inches of sealing compound shall be extruded initially to clear trapped air. At the end of the rated application time, measured from the beginning of the mixing period, the sealing compound shall be extruded through a Semco 440 nozzle or equal (0.125 ± 0.005 inch orifice at 90 ± 5 psig air pressure) onto a suitable receptacle for 1 minute and the weight in grams of sealing compound determined.

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4.8.5 Tack-free time. An aluminum test panel 7075-T6, conforming to QQ-A-250/12 and measuring approximately 0.040 by 2-3/4 by 6 inches in size shall be cleaned in accordance with 4.6.1 and covered with freshly mixed sealing compound to a depth of 0.125 inch for Types I and II (5 to 7 mil for Type III). The sealing compound shall be cured as specified in 4.7. At the end of the specified tack-free time, two 1-inch by 6-inch pieces of clean polyethylene film conforming to L-P-378, 0.004 \pm 0.002 inch thick shall be applied to the sealing compound and held in place at a pressure of 1/2 ounce per square inch for 2 minutes. The strips or cover, as applicable, shall be slowly and evenly withdrawn at right angles to the sealing compound surface. The polyethylene shall come away clean and free of sealing compound.

4.8.6 Hardness. Hardness specimens shall be prepared and cured in accordance with 4.7 and ASTM D2240. Hardness, instantaneous, shall be determined on a 0.25 inch (approximate) thick specimen using an A-2 durometer. Type III specimens shall be cut from a cured ASTM D3182 standard sheet, or equivalent, and plied to the required thickness.

4.8.7 Soluble chromate content. The soluble chromate content in the compound shall be determined by the following procedure:

4.8.7.1 Sample preparation. A minimum of 25 grams of sample cured in accordance with 4.8.4 shall be filed off such that all of the sealant will pass an ASTM No. 40 sieve (0.165 inch screen size) or equivalent. A small portion shall be sifted. A 5-gram sample of filed material shall be placed into a 250 milliliter (ml.) Erlenmeyer flask and 100 ml. of distilled water added. The sample shall then be covered with a watchglass, placed on a hot plate, and boiled for 1 hour. After boiling for the time specified, the flask shall be removed from the heat and the liquid decanted into a 500 ml. flask. The flask and sealant shall be rinsed with 5 to 10 ml. of distilled water. This procedure shall be repeated three times; a total of 4 extractions.

4.8.7.2 Titration. After the filtrate collected in 4.8.7.1 has cooled to ambient temperature, 10 ml. of concentrated hydrochloric acid and 2 grams of potassium iodide shall be added to this solution; the solution shall be covered immediately and allowed to stand for a minimum of 5 minutes. The solution shall then be titrated with 0.1 N sodium thiosulfate until the brown color of iodide is almost gone; then add 2 ml. of freshly prepared starch solution. The titration shall be continued until the dark blue color of iodine-starch solution is gone. Do not mistake the green color of Cr+3 for the blue color of the iodine-starch complex. The volume in ml. of sodium thiosulfate required for titration shall be recorded.

4.8.7.3 Calculation. The percentage of soluble chromate, for purposes of this specification, shall be calculated as magnesium chromate pentahydrate as follows:

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$$\frac{(\text{ml. Na}_2\text{S}_2\text{O}_3) \times (N \text{ Na}_2\text{S}_2\text{O}_3) \times (0.0768)}{\text{Wt. of sample in grams}} \times 117.6 = \% \text{MgCrO}_4 \cdot 5\text{H}_2\text{O}$$

(Results shall be reported to the nearest whole number.)

4.8.8 Specific gravity. Three specimens, approximately 1 by 2 by 0.030 inch thickness, shall be prepared and cured as specified in 4.7. The specimens shall be weighed in air and then in water by means of an analytical or Jolly balance. The specific gravity shall be computed by means of the following formulas:

$$\frac{\text{Specific gravity}}{\text{(Analytical balance)}} = \frac{\text{Weight in air}}{\text{Weight in air} - \text{weight in water}}$$

$$\frac{\text{Specific gravity}}{\text{(Jolly balance)}} = \frac{\text{Weight in air}}{\text{Weight in water}}$$

4.8.9 Corrosion. Corrosion testing shall consist of stressed aluminum assemblies (4.8.9.1) and mixed metal panels (4.8.9.2) undergoing exposure to a corrosive environment.

4.8.9.1 Preparation of test assembly. Sufficient 7075-T6 panels conforming to QQ-A-250/12 and chemically treated with Class 1A materials conforming to MIL-C-81706 to produce coatings conforming to MIL-C-5541, shall be prepared to produce aluminum assemblies in accordance with figure 2. All surface treatment shall be in accordance with MIL-S-5002. All sealants shall be mixed in accordance with 4.6.2 and the manufacturer's instructions. Two assemblies shall be used for the corrosion test. Each corrosion assembly shall be prepared using all four types of sealing compound in accordance with the procedures of table IX. The prepared assemblies shall be exposed as specified in 4.8.9.3.

TABLE IX. Preparation sequence of corrosion test assemblies.

Sequence Step	Assembly preparation
	Two assemblies shall be prepared as follows:
1	Approximately 5 mils of Type IV sealing compound shall be applied to one side of each panel by spatula. After 1 to 2 hours the coated sides of the panels shall be mated.
2	Threaded fasteners conforming to MIL-S-7839 shall be dipped into Type I compound, then inserted into the freshly mated panels and torqued to 40 inch pounds.
3	Type II compound shall be applied by gun to the butt joint. Using a spatula, cover over and around the fastener head, backs (nuts) and all edges.

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TABLE IX. Preparation sequence of corrosion test assemblies.
(Continued)

Sequence step	Assembly preparation
4	Spray Type III compound over the entire assembly to a thickness of 5 to 7 mils.
5	Cure the assembly in accordance with 4.7 (use the longest cure time based on material used)
6	After curing, scribe one half of the front side of each assembly as shown in figure 2. Assemblies are now ready to be tested in accordance with 4.8.9.3.

4.8.9.2 Mixed metals. All types shall be subjected to mixed metal corrosion testing. Two assemblies, as indicated in table X and configured as shown in figure 3, shall be used for each sealant.

4.8.9.2.1 Assembly preparation. 5 to 7 mils of sealant shall be applied to one side of each metal (see figure 3). The coated portions shall be mated using inert non-metal fasteners (e.g., nylon) tightened to produce a total sealant thickness of approximately 7 mils. Excess sealant shall be carefully removed from the panel surface. Type IV sealant shall not be mated until 1 to 2 hours after panels are coated.

TABLE X. Mixed metal assemblies.

Assembly	Metal B (figure 3)	Metal A (figure 3)
1	Aluminum <u>1/</u>	Titanium <u>2/</u>
2	Aluminum <u>1/</u>	Magnesium <u>3/</u>

1/ 7075-T6 conforming to QQ-A-250/12 treated with Class 1A materials conforming to MIL-C-81706.

2/ MIL-T-9046, Type III composition C (6 Al - 4V).

3/ QQ-M-44, treated with Class 1A materials conforming to MIL-C-81706.

4.8.9.2.2 Exposure. Mixed metal assemblies shall be exposed as specified in 4.8.9.3.2 and evaluated as specified in 4.8.9.3.3.

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4.8.9.3 Stress cycling, exposure, and evaluation of assemblies.

4.8.9.3.1 Cyclic loading. Assemblies prepared in 4.8.9.1 shall be installed vertically in the jaws of a machine capable of cycling between 0 and 5000 pounds for 250 cycles with a loading rate of 10 inches per minute. The assembly shall be subjected to 250 cycles at a temperature of $-54^{\circ} \pm 1^{\circ}\text{C}$ ($-65^{\circ} \pm 2^{\circ}\text{F}$) after a 30 minute soak time at $-54^{\circ} \pm 1^{\circ}\text{C}$ ($-65^{\circ} \pm 2^{\circ}\text{F}$) under no load.

4.8.9.3.2 Exposure. The prestressed or mixed metal assembly shall be exposed for a period of 4 weeks in a salt- SO_2 spray cabinet meeting the requirements of ASTM B117 Appendix 1. The butt joints of Type III and Type IV assemblies shall be masked with wax prior to salt- SO_2 exposure. The test shall be conducted under the following conditions:

Salt solution ...5% by weight sodium chloride

Cabinet temperature ... $35^{\circ} \pm 1^{\circ}\text{C}$ ($95^{\circ} \pm 2^{\circ}\text{F}$)

Saturator Tower Temperature ... $46^{\circ} \pm 1^{\circ}\text{C}$ ($115^{\circ}\text{F} \pm 2^{\circ}\text{F}$)

Cycle: Continuous spray; sulfur dioxide injected for one hour in every 6 hours (4 X daily) at a flow rate of lcc/min/ft³ of box.

NOTE: The collected solution in the cabinet shall be tested weekly and shall conform to the following conditions:

(1) 1 to 2 mls/hr collection rate

(2) pH of 2.5 to 3.2

(3) Specific gravity 1.02 to 1.04

4.8.9.3.3 Evaluation. When removed from the exposure cabinet, each assembly shall be disassembled. After the sealant has been carefully stripped from all surfaces, the assembly shall be evaluated for corrosion with respect to sealant function (Type I-fasteners, etc.). Countersinks as well as adjacent areas, and faying surfaces shall be examined under a zoom microscope up to 30X magnification. All surfaces shall be examined for compliance to 3.3.2.4.

4.8.10 Low-temperature flexibility. Sealing compound shall be applied to one side of each of three 7075-T6 aluminum panels conforming to QQ-A-250/12, treated with MIL-A-8625, Type I, measuring 1 inch by 6 inches by 0.032 inch in a manner which shall produce a thickness of approximately 0.075 inch (5 to 7 mils for Type III) leaving 1 inch at each end of the panels uncoated. Upon completion of the curing time (4.7), the panels

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shall be placed in an air-circulating oven and conditioned for 48 ± 1 hours at $93^\circ \pm 2^\circ\text{C}$ ($200^\circ \pm 5^\circ\text{F}$). The panels shall then be placed in a flexibility fixture as shown in figures 4 and 5 so that the uncoated side will contact the contour block and the weight will contact only the uncoated end of the panel. The flexibility fixture and panels shall be subjected to a conditioning temperature of $-54^\circ \pm 1^\circ\text{C}$ ($-65^\circ \pm 2^\circ\text{F}$) for 4 hours. After the specified conditioning, the specimens shall then be bent around the curved portions of the flexibility fixture by releasing the fastening hook. The panels shall be removed and examined for conformance to 3.3.2.5.

4.8.11 Thermal stability. Cured specimens approximately 1 by 2 by 0.25 inch (for Type III, a 0.007 inch cured coating on a 0.020 by 1 by 6 inch panel conforming to QQ-A-250/12 shall be used) shall be placed in an air circulating oven for 48 ± 1 hours at $93^\circ \pm 2^\circ\text{C}$ ($200^\circ \pm 5^\circ\text{F}$). Specimens shall be removed from the oven and allowed to recover to standard conditions (4.5.1). Hardness shall be determined as specified in 4.8.6 (Type III panels shall not undergo hardness testing). The specimen (including the panel for Type III) shall then be bent through 180° on a 0.25 inch diameter mandrel and examined while on the mandrel (0.125 Mandrel for Type III) and examined for conformance to 3.3.2.6.

4.8.12 Tensile strength and elongation (Type II). Molded sheets approximately 0.075 inch in thickness shall be cured in accordance with 4.7. Tensile strength and elongation determinations shall be made in accordance with ASTM D412 using die C.

4.8.13 Peel strength.

4.8.13.1 Adherends, cleaning, surface treatment, and immersion media. The following adherends, cleaning and surface treatment methods, and immersion media shall be used:

<u>Adherends</u>	<u>No. of specimens</u>
1. Aluminum alloy, 7075-T6 conforming to QQ-A-250/12, chemically treated with materials conforming to MIL-C-81706 Class 1A.	6
2. Aluminum alloy, 7075-T6 conforming to QQ-A-250/12, chemically treated in accordance with MIL-A-8625, Type II.	6

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<u>Adherends (continued)</u>	<u>No. of specimens</u>
3. Cadmium-plated steel (4130), ASTM A108 treated in accordance with QQ-P-416, Class 1, Type II.	6
4. Magnesium alloy, QQ-M-44, treated with materials conforming to MIL-C-81706, Class 1A.	6
5. Titanium, MIL-T-9046, Type III Composition C (6 Al - 4V).	6

Cleaning and surface treatment: The panels shall be cleaned and surface treated in accordance with MIL-S-5002.

Immersion media:

1. Hydraulic fluid, MIL-H-5606
2. Lubricating oil, MIL-L-7808
3. Lubricating oil, MIL-L-23699
4. Aqueous sodium chloride solution, 3 percent
5. Turbine fuel, JP-4, MIL-T-5624

4.8.13.2 Specimen preparation. Adherends, 3 by 6 by .064 inch, shall be coated respectively with a 0.125 ± 0.005 inch thickness of Types I, II, and IV sealant. A 3 inch by 6 inch area of 3 inch by 12 inch strip of cotton duck conforming to Type III of CCC-C-419 shall be impregnated with the respective types of sealing compounds. The sealant must be worked well into the fabric. The sealant impregnated end of the fabric shall be placed on the sealant coated panel and smoothed down on the layer of the sealant taking care not to trap air beneath the fabric. An additional 0.031 inch thick coating of Types I, II and IV sealing compound shall be applied over the fabric. Curing shall be as specified in 4.7.

4.8.13.3 Test procedure. After cure, one specimen of each adherend shall be tested at standard conditions and one specimen of each adherend shall be completely immersed for 48 ± 1 hours at $60^\circ \pm 1^\circ\text{C}$ ($140^\circ \pm 2^\circ\text{F}$) for each of the five immersion test fluids above. After expiration of the test period, the fluids shall be cooled to standard conditions. The specimens shall then be removed and adhesion determined within 10 minutes after removal from the fluids. Two 1-inch wide strips shall be cut lengthwise through the fabric and sealing compound to the panel surface and

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extended the full length of the loose end of the fabric. The edges of the panel shall not be used as one edge of the test strip. The panels shall be individually tested in an autographic testing machine whose capacity shall be such that the tension at failure is not more than 85 percent nor less than 15 percent of the full scale load. If the machine is of the pendulum type, the weight shall swing as a free pendulum without engagement of the pawls. The rate of separation of the jaws shall be 2 inches per minute. Specimens shall be mounted in the machine so that the loose end of the 1-inch wide fabric strip will be folded 180 degrees as it is pulled from the panel. Each strip shall be pulled as follows: A cut through the sealant to the panel at the junction of separation shall be at an angle of 45 degrees in the direction of the separation. If the sealant separates from the fabric, similar 45-degree cuts shall be made to promote separation of the sealant from the panel. A minimum of five cuts shall be made. The adhesion in pounds shall be automatically recorded on a chart as a continuous curve. The adhesion value shall be calculated by averaging the maximum forces required to separate the sealant from the panel. If cohesive failure occurs, the adhesion value shall be reported as greater than the observed value.

4.8.14 Anchorage (wet tape test) (Type III only). A 3 by 6 inch aluminum panel, 7075-T6, conforming to QQ-A-250/12, shall be prepared as in 4.6 and tested for wet tape adhesion in accordance with MIL-F-18264.

4.8.15 Reparability.

4.8.15.1 Types I and II. A 3 by 6 by 0.064 inch aluminum alloy panel, 7075-T6 conforming to QQ-A-250/12, treated with Class 1A materials conforming to MIL-C-81706, shall be coated with a 1/8 inch thickness of sealant for Types I, II, or IV. Curing shall be as specified in 4.7. The panel shall be placed in an air-circulating oven and conditioned for 48 ± 1 hours at $60^\circ \pm 1^\circ\text{C}$ ($140^\circ \pm 5^\circ\text{F}$). The specimen shall be removed from the oven and returned to standard conditions. The sealant shall be cleaned with isopropyl alcohol or solvent formulated in accordance with table VI, air dried for 2 hours, and another coating of newly mixed sealant shall be applied as above over the previously conditioned sealant. A 3 inch by 6 inch deep area of a 3 inch by 12 inch strip of cotton duck conforming to Type III of CCC-C-419 shall be impregnated with the sealing compound. The sealant must be worked well into the fabric. The sealant impregnated end of the fabric shall be placed on the sealant-coated panel and smoothed down on the layer of the sealant taking care not to trap air beneath the fabric. An additional 1/8 inch thick coating of sealing compound shall be applied over the fabric. After the standard cure (4.7), the specimen shall be tested for peel strength in accordance with 4.8.13.

4.8.15.2 Type III. A 3 by 6 inch aluminum panel, 7075-T6 conforming to QQ-A-250/12, shall be prepared and coated to a thickness of 0.005 to 0.007 inch as in 4.6. Curing shall be as specified in 4.7. The

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panel shall be placed in an air-circulating oven and conditioned for 48 ± 1 hours at $60^\circ \pm 1^\circ\text{C}$ ($140^\circ \pm 2^\circ\text{F}$). The sealant shall be cleaned with isopropyl alcohol or solvent formulated in accordance with table VI, air dried for 2 hours, and another coating of newly mixed sealant shall be applied as above over the conditioned sealant. After the standard cure, (4.7), the specimen shall be tested for wet tape adhesion as specified in 4.8.14.

4.8.16 Long-term storage. A 1-quart sample of sealing compound and the specified amount of curing agent shall be conditioned at $25^\circ \pm 2.8^\circ\text{C}$ ($77^\circ \pm 5^\circ\text{F}$) for 6 months. If the curing agent shows signs of settling or hardening, it shall be stirred. Failure of the curing agent to return to a smooth workable consistency shall be construed as a failure. The stirred curing agent and the base shall be mixed and tested for conformance with 3.3.3.

5. PACKAGING

5.1 Preservation-packaging. Packaging shall be Level A or Commercial as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Unit protection. The base compound and curing agent shall each be packaged in their own containers. Each curing agent container shall be packaged with one base compound container with a suitable separator between the two containers in a manner which will prevent accidental separation but which will permit easy separation for mixing purposes. The ratio of the quantity contained in the base compound container to the quantity contained in the attached curing agent container shall be the same as the recommended mixing ratio of the base compound and curing agent.

5.1.1.2 Unit package. The base compound shall be furnished in 1/2 pint, 1 pint, 1 quart, or 1 gallon multiple friction top cans conforming to Type V, Class 2 of PPP-C-96. The base compound contained in each size container shall be as follows:

<u>Size of container</u>	<u>Amount of base compound</u>	<u>Volume tolerance</u>
1/2 pint	6 fluid ounces	$\pm 1/8$ fluid ounce
1 pint	12 fluid ounces	$\pm 1/4$ fluid ounce
1 quart	24 fluid ounces	$\pm 1/2$ fluid ounce
1 gallon	96 fluid ounces	± 2 fluid ounces

The air in the unfilled space of the container shall be replaced with Nitrogen gas or carbon dioxide gas immediately prior to closing the container. The proper amount of curing agent shall be furnished in glass or plastic jars; or a suitable plastic container approved by the procuring activity.

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The containers shall have smooth inside walls with projections or lips not exceeding 1/16 inch. The inside bottom shall be approximately horizontal. The jars shall have one rolled thread such that the cap will turn a minimum of 1/4 revolution to fully secure. The jars shall be provided with enameled metal or plastic screw type caps.

5.1.1.3 Sectional-type containers (Types I, II, and IV only). The base compound and curing agent shall be furnished in sectional-type 2-1/2-ounce or 6-ounce non-metal containers conforming to MIL-P-38714 as specified in the contract or order. The total content of base compound and curing agent contained in each sectional-type container shall be as follows:

<u>Size of container</u>	<u>Total content</u> (base and curing agent)	<u>Volume tolerances</u>
2-1/2 ounce	2 fluid ounces	±1/8 fluid ounce
6 ounce	3-1/2 fluid ounces	±1/8 fluid ounce

5.1.2 Commercial. The base compound and curing agent shall be packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be Level A, B, or commercial as specified (see 6.2).

5.2.1 Level A. Base compound and curing agent packaged in accordance with 5.1.1 shall be packed in an overseas exterior type container conforming to PPP-B-585, PPP-B-601, PPP-B-621, or PPP-B-636. Weight of the contents shall conform to the weight limitations of the applicable box specification and shall not exceed a total weight of 200 pounds. Containers shall be closed and strapped in accordance with Appendix to PPP-C-96.

5.2.2 Level B. The base compound and curing agent packaged as specified in 5.1.1 shall be packed in exterior domestic type containers conforming to PPP-B-585, PPP-B-601, or PPP-B-636. Weight of contents shall conform to the limitations of the applicable box specification.

5.2.3 Commercial. Base compound and curing agent packaged in accordance with 5.1.1, shall be packed to afford protection against damage during direct shipment from the source of supply to the first receiving activity for immediate use. Containers shall comply to the Uniform Freight Classification Rules or other regulations applicable to the mode of transportation.

5.3 Marking and labeling.

5.3.1 Packages.

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5.3.1.1 Base compound container. Each base compound container shall be durably and legibly marked as specified in MIL-STD-129 and include the following information:

SEALING AND COATING COMPOUND, CORROSION INHIBITIVE
 Specification MIL-S-81733C
 Type and dash number
 Date of manufacture (month and year)
 Manufacturer's name and address
 Manufacturer's product designation
 Manufacturer's batch identification
 Contract number
 Storage Life
 Manufacturer's recommended storage temperature
 Weight ratio for mixing (base/curing agent)
 Stock number

5.3.1.2 Exterior shipping containers. Each exterior shipping container shall be marked as required for interior containers and in accordance with MIL-STD-129.

5.4 Instructions for use. The supplier of the sealing compound shall furnish with each shipment 2 copies of complete instructions which shall contain complete and clearly stated mixing instructions, including the proper ratios for mixing on a weight basis.

6. NOTES AND CONCLUDING MATERIAL

6.1 Intended use. The sealing compound covered by this specification is intended for sealing interior and exterior areas on weapons and aircraft systems for protection of metal components against corrosion within a service temperature range of -54°C to 93°C (-65°F to 200°F). MIL-S-81733 materials are not intended for use as integral fuel tank sealants.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification
- (b) Type of sealing compound and dash number (see 1.2).
- (c) Quantity desired.
- (d) Size of container.
- (e) Level of packaging and packing required.
- (f) Any special marking required.

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for openings of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have been so listed by that date. The attention of suppliers is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they might be eligible to be awarded contracts or orders. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Washington, DC 20361; however, information pertaining to qualification of products may be obtained from the Commander, Naval Air Development Center, Warminster, PA 18974, Attn: ACSTD (Code 60621).

6.4 Curing time. The time and temperature specified as the cure time in 4.7 are for laboratory preparations. These conditions may be considered as the optimum for curing each class of compound. In actual field use, the application time, tack free time and cure time will be affected by changes in temperature/humidity. Approximate times for these properties will be halved/doubled when a 10°F increase/decrease, respectively, from the standard temperature (77°F) is experienced.

6.5 Toxicity. The sealing 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 adviser to the preparing activity.

6.5.1 Skin contact warning labels, as necessary, shall be added by the manufacturer.

6.6 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

Review activities:

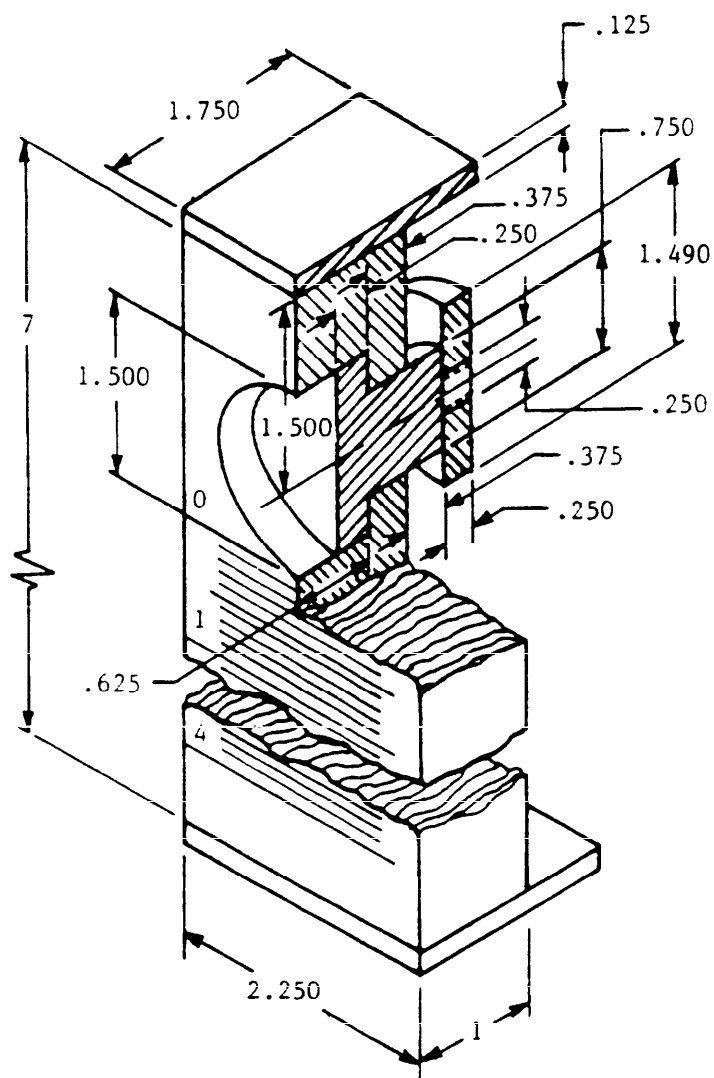
Army - AV, MI
Air Force - 99

User Activities:

Army - ME
Navy - MC

Preparing Activity:

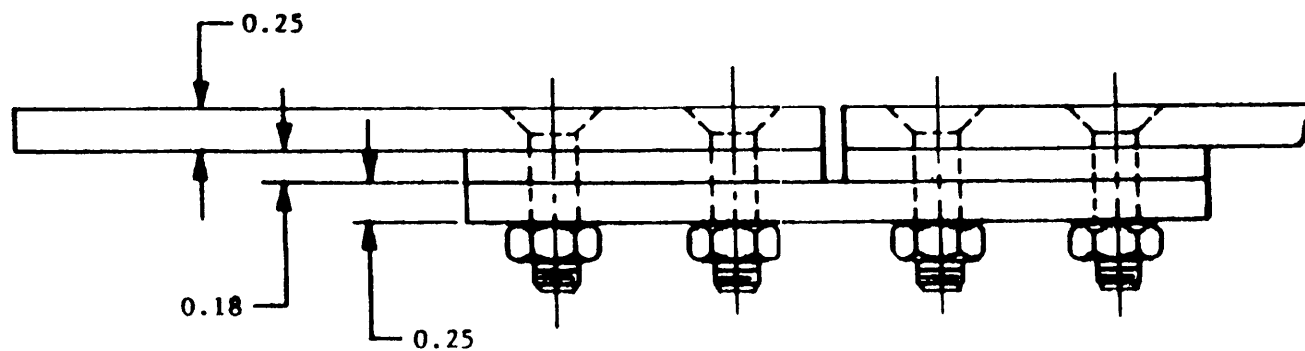
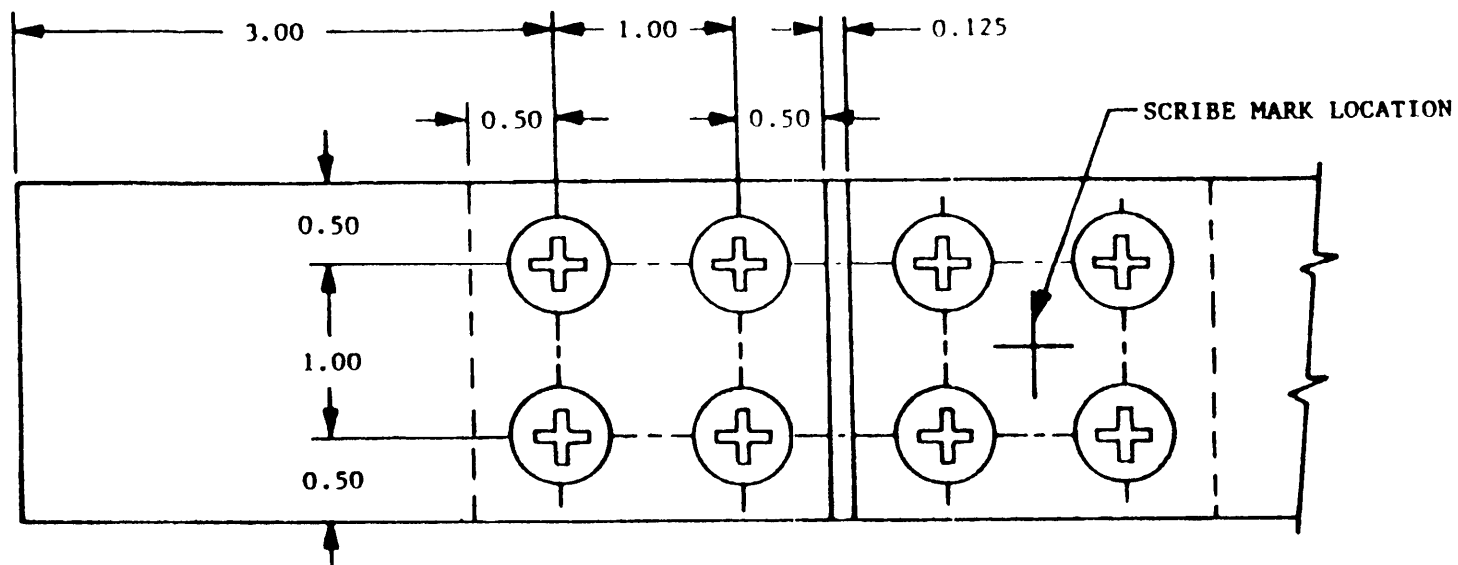
Navy - AS
(Project No. 8030-0457)



MATERIAL: 4130 STEEL, CHROMIUM PLATED
DIMENSIONS IN INCHES.
TOLERANCES: DECIMALS $\pm .016$

FIGURE 1. Flow-test fixture

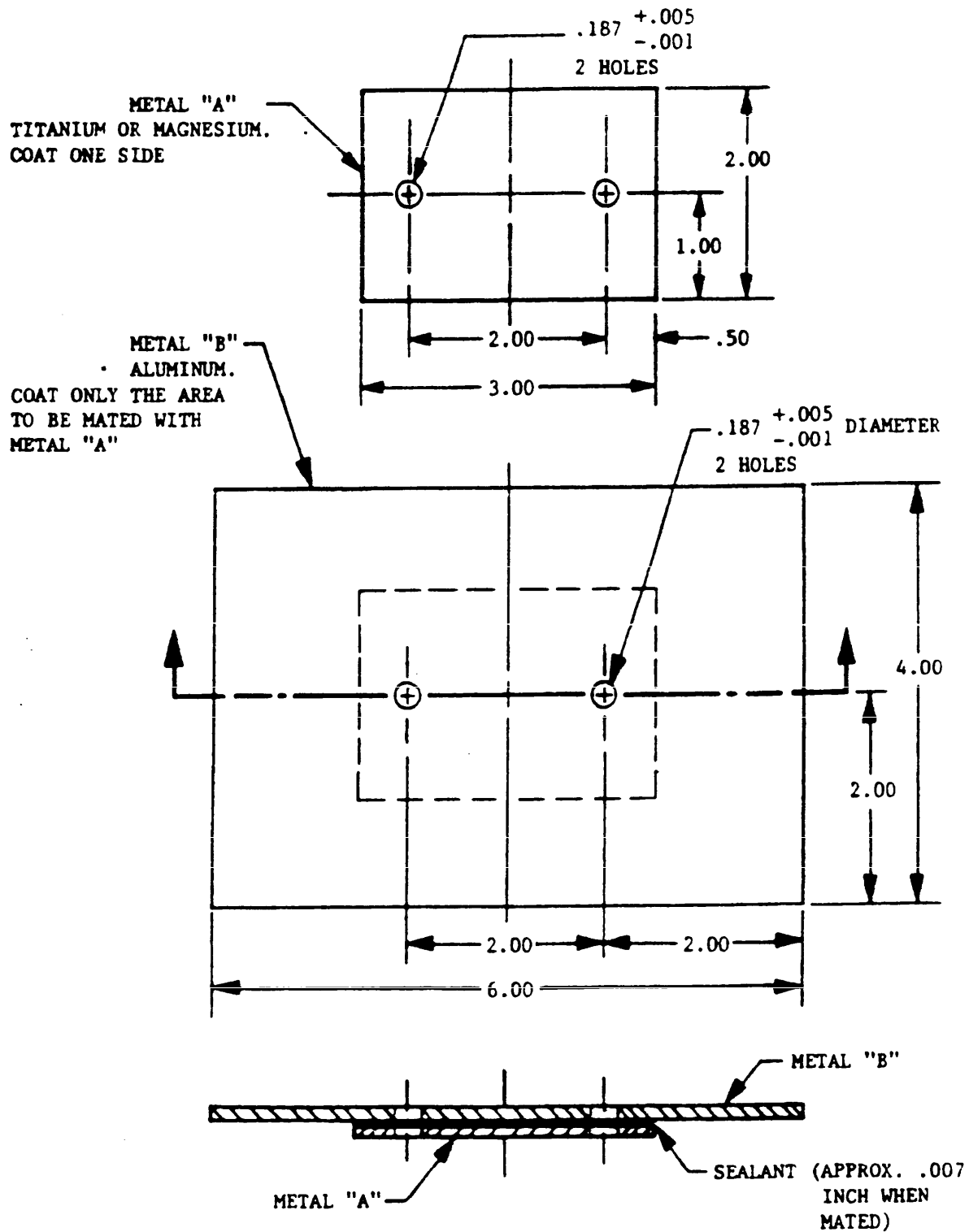
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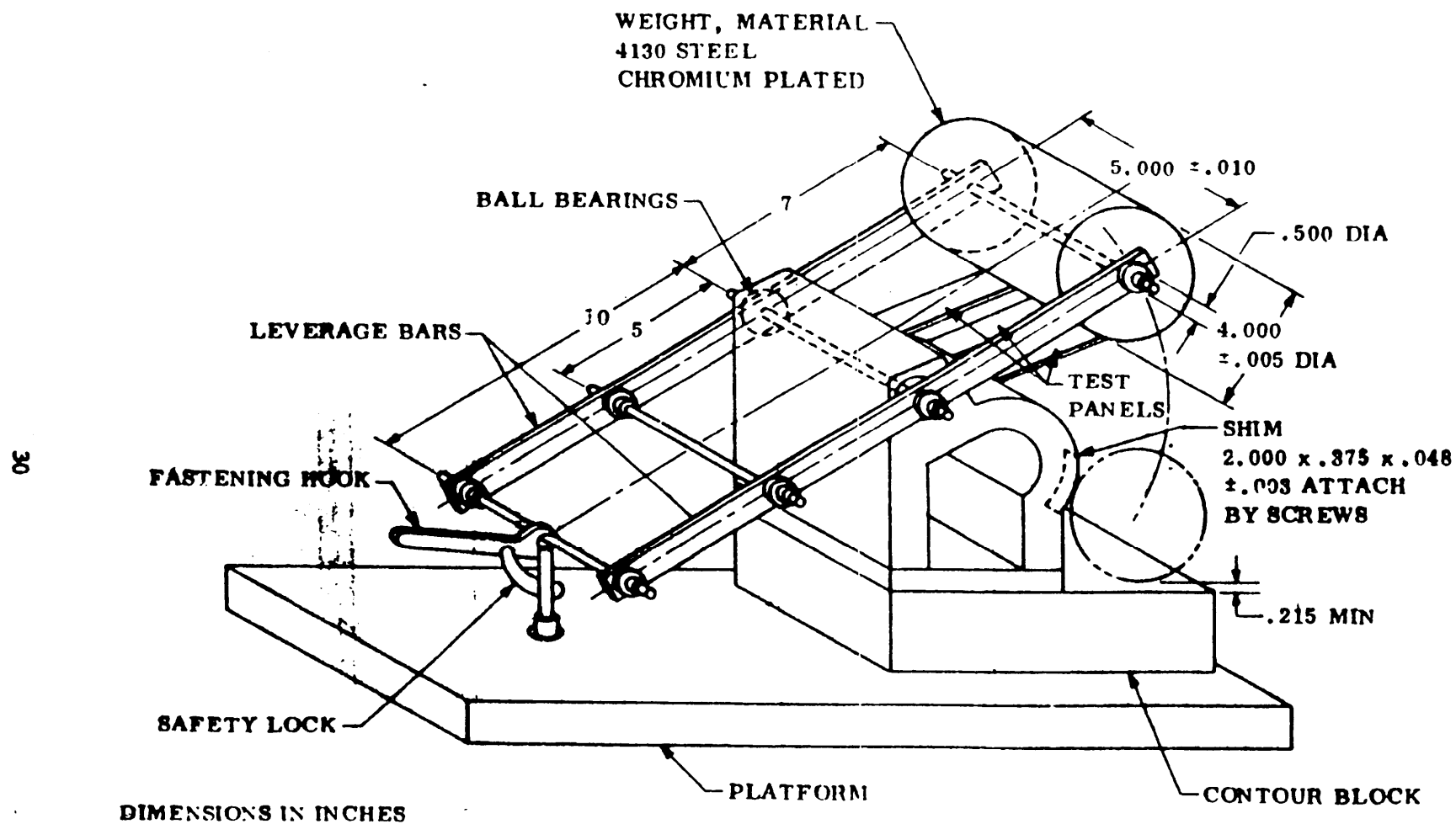
MATERIAL: 7075-T6 Al BARE
 FASTENER: MS24694 IN ACCORDANCE WITH
 MIL-S-7839 TORQUE TO 40 INCH POUNDS

FIGURE 2. Assembly configuration for cyclic loading and exposure

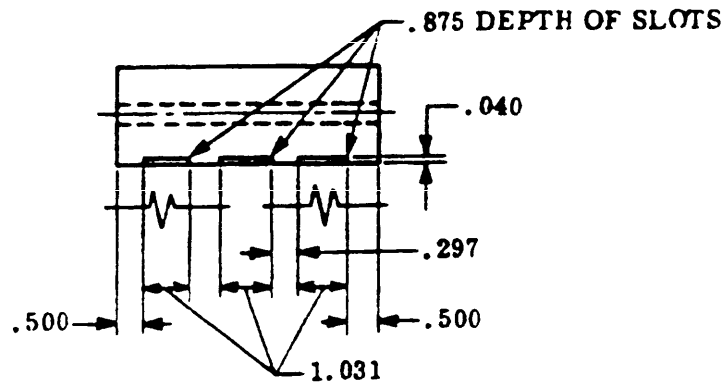
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FIGURE 3. Mixed metal assembly

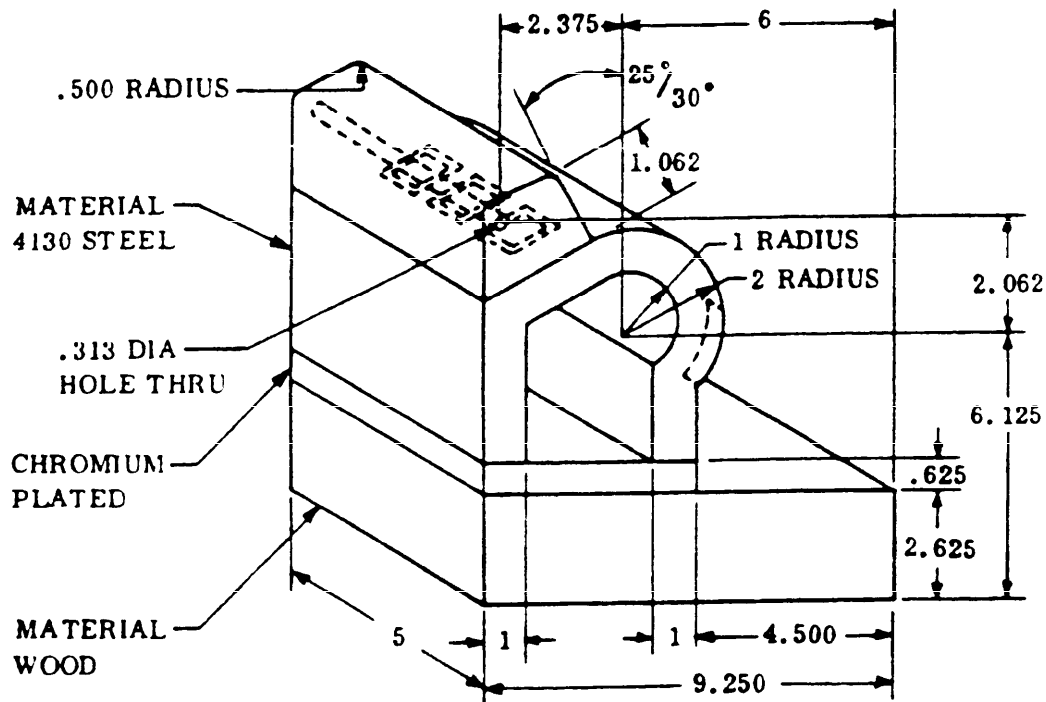
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FIGURE 4. Low Temperature Flexibility Apparatus

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VIEW SHOWING SLOTS FOR PANELS



DIMENSIONS IN INCHES

FIGURE 5. Contour Block

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b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
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