

MIL-S-38249(USAF)

18 AUGUST 1964

MILITARY SPECIFICATION**SEALING COMPOUND, FIREWALL****1. SCOPE**

1.1 This specification covers flame-resistant, synthetic rubber compounds for sealing firewall structures.

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

Type I—For applications at service operating temperatures of -65° to $+400^{\circ}$ F, and flash temperatures up to 2000° F.

Type II—For applications at service operating temperatures of -65° to $+400^{\circ}$ F, and flash temperatures up to 3500° F.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS**FEDERAL**

QQ-A-355—Aluminum Alloy Plate and Sheet 2024

TT-E-751—Ethyl Acetate, Technical, Organic Coatings Use

TT-M-261—Methyl-Ethyl-Ketone (For Use in Organic Coatings)

TT-N-97 —Naphtha; Aromatic

PPP-C-96—Cans, Metal, 28 Gage and Lighter

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MIL-S-4388 —Sealing Compound, Topcoat, Fuel Tank, Buna-N Type

MIL-S-5059 —Steel, Corrosion-Resistant (18-8), Plate, Sheet and Strip

MIL-F-5566 —Fluid; Anti-Icing (Isopropyl Alcohol)

STANDARDS**FEDERAL****Federal Test**

Method No. 601—Rubber: Sampling and Testing

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MIL-STD-129—Marking for Shipment and Storage

3. REQUIREMENTS

3.1 **Preproduction.** This specification makes provisions for preproduction testing.

3.2 **Materials.** The sealing compound material covered by this specification shall be formulated from synthetic rubber and curing composition of such ingredients as may be necessary to produce a product of high quality.

3.2.1 **Appearance.** The base compound and the curing agent shall each be of uniform blend and shall be free of skins, excess air, lumps and gelled or coarse particles. There shall be no separation of ingredients which cannot be readily mixed by normal agitation.

3.2.2 **Toxic products and formulations.** The material shall have no adverse effect on the health of personnel when used according to provided instructions and for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to

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the appropriate department medical service who will act as an advisor to the procuring agency.

3.3 Properties.

3.3.1 Color. The base compound and curing agent shall possess sufficient color contrast to permit easy identification of an unmixed or incompletely mixed sealing compound.

3.3.2 Specific gravity. The specific gravity of the cured sealing compound shall not exceed 1.15.

3.3.3 Nonvolatile content. The nonvolatile content of the freshly mixed sealing compound shall not be less than the amount specified below:

Type I —65 percent by weight.

Type II—98 percent by weight.

3.3.4 Flow. Freshly mixed sealing compound shall exhibit an initial flow within the limits of 0.1 to 1½ inches when a cylindrical section formed in the flow-test jig is allowed to flow under its own weight on a vertical surface. In addition, the sealing compound shall retain a flow within the limits of 0.1 to 1½ inches throughout the entire application time.

3.3.5 Application time. The mixed sealing compound shall have an application time of not less than 1½ hours after addition of the curing agent, and shall remain suitable for application during that period. The end of the application time shall be when the extrusion rate diminishes to 15 grams per minute.

3.3.6 Tack-free time. Type I sealing compound shall cure to a tack-free condition in not more than 24 hours and type II shall cure to a tack-free condition in not more than 6 hours after addition of the curing agent.

3.3.7 Curing rate. The sealing compound shall have an instantaneous Rex durometer hardness of not less than 30 within 48 hours after curing under standard conditions (see 4.5).

3.3.8 Resistance to thermal rupture. The sealing compound shall retain pressure of 5 psi with no more than 1/8 inch deformation.

3.3.9 Low temperature flexibility. The sealing compound shall withstand the low temperature flexing through 150 cycles at $-65^{\circ} \pm 2^{\circ}$ F without cracking, checking, or loss of adhesion.

3.3.10 Peel strength. The cured sealing compound shall have a peel strength of 10 pounds per inch minimum to aluminum alloy conforming to Specification QQ-A-355 and stainless steel conforming to Specification MIL-S-5059, composition 302.

3.3.11 Corrosion resistance. There shall be no evidence of loss of adhesion, softening, blistering and leaching of the sealing compound or corrosion of the panel under the sealant at $140^{\circ} \pm 2^{\circ}$ F.

3.3.12 Flame resistance. The sealing compound shall not burn through to the panel, and shall extinguish itself within seconds after a flame exposure of 15 minutes.

3.3.13 Oil resistance. There shall be no evidence of loss of adhesion, softening or blistering of the sealing compound, when tested in accordance with 4.7.12.

3.3.14 Accelerated storage stability. When stored at $120^{\circ} + 2^{\circ}$ F, the base compound shall show no skinning, hardening, separation, or settling of the material. The aged curing agent shall not be adversely affected and shall be capable of restoration by normal agitation to a condition suitable for use. The aged base compound and aged curing agent, when mixed, shall meet the requirements for flow, application time and tack-free time (3.3.4, 3.3.5 and 3.3.6).

3.4 Workmanship. The workmanship shall be in accordance with high grade manufacturing practice covering this type of material. It shall be suitable for its intended use and free of defects which may affect its functionality.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for

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the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 Classification of tests. The inspection and testing of the sealing compound shall be classified as follows:

- a. Preproduction tests.
- b. Quality conformance tests.

4.3 Preproduction tests. Preproduction tests shall consist of all the tests specified in 4.7.

4.3.1 Sampling. The preproduction samples shall consist of a sufficient quantity of the sealing compound to perform the tests specified in 4.7. Samples shall be tested in a laboratory designated by the procuring activity, or, when so stated in the contract or order, at the contractor's plant under the inspection of the procuring activity (see 6.2).

4.3.2 Previous approval. At the discretion of the procuring activity preproduction testing may be waived for sealing compound which has been accepted under a previous contract.

4.4 Quality conformance tests. The quality conformance tests shall consist of the tests specified in 4.7.1 through 4.7.7.

4.4.1 Sampling.

4.4.1.1 Lot. Unless otherwise specified a lot shall consist of all sealing compound manufactured at one time from one batch, forming part of one contract or order for delivery. A batch is defined as the end product of all raw material mixed or blended in a single operation.

4.4.1.2 Tests. A 1-quart sample, representative of each lot of sealing compound on order, shall be selected from each lot and subjected to the tests listed below.

Specific gravity	(4.7.1)
Nonvolatile content	(4.7.2)
Flow	(4.7.3)
Application time	(4.7.4)
Tack-free time	(4.7.5)
Curing rate	(4.7.6)
Resistance to thermal rupture	(4.7.7)

4.5 Test conditions. Standard laboratory testing conditions shall be $77^{\circ} \pm 2^{\circ}$ F and 50 ± 5 percent relative humidity. Except as otherwise specified herein, all test specimens shall be prepared, cured and tested under these standard conditions.

4.6 Preparation of test specimens.

4.6.1 Cleaning of test panels. All test panels shall be cleaned by scrubbing and rinsing with soap-free and grease-free rags or paper towels, using solvent formulation in accordance with table I. Immediately after rinsing, the panels shall be wiped dry with a clean, lint-free cloth.

TABLE I. Formulation of Cleaner.

Ingredient	Specification	Percent by volume
Aromatic petroleum naphtha	TT-N-97 type I, grade B	50
Ethyl acetate	TT-E-751	20
Methyl-ethyl-ketone	TT-M-261	20
Isopropyl alcohol	MIL-F-556G	10

4.6.2 Preparation of sealing compound. The quantity of sealing compound required for the tests specified in 4.7 shall be mixed in accordance with the manufacturer's recommended procedure. A Semco Model SP-1350 mixer, or equal, shall be used. The mixed sealing compound shall have a minimum inclusion of air. When applicable, the sealing compound, immediately after mixing, shall be placed into cartridges for extrusion from the Semco No. 250 gun, or equal.

4.7 Test methods

4.7.1 Specific gravity. Three specimens approximately $\frac{1}{8}$ by 1 by 1 inch in size shall be cut with a sharp razor blade from a sheet of the sealing compound that has been cured for 14 days. The specimen shall be weighed

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to 3 decimal places after which it shall be dipped in methyl alcohol and then, while wet, immediately suspended in distilled water at standard conditions and reweighed. The specific gravity shall be computed from the following formula:

$$\frac{\text{Weight in air}}{\text{Weight in air minus weight in water}} = \text{Specific gravity}$$

4.7.2 Nonvolatile content. Five to ten grams of the freshly mixed sealing compound shall be transferred as rapidly as possible to a cup approximately 3 inches in diameter and $\frac{3}{4}$ inch in depth. A fitted cover shall immediately be placed over the cup and the weight determined to a 3-place accuracy. The weight of the cup and cover shall be determined prior to using, and subtracted from the initial and final weights in order to calculate the new sample weights. The cover shall then be removed and the sealing compound heated in an oven for 7 days at $160^{\circ} \pm 2^{\circ}$ F. It shall be cooled to room temperature in a desiccator, the cover replaced, and the weight determined. The percentage of total nonvolatile content shall be calculated as follows:

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

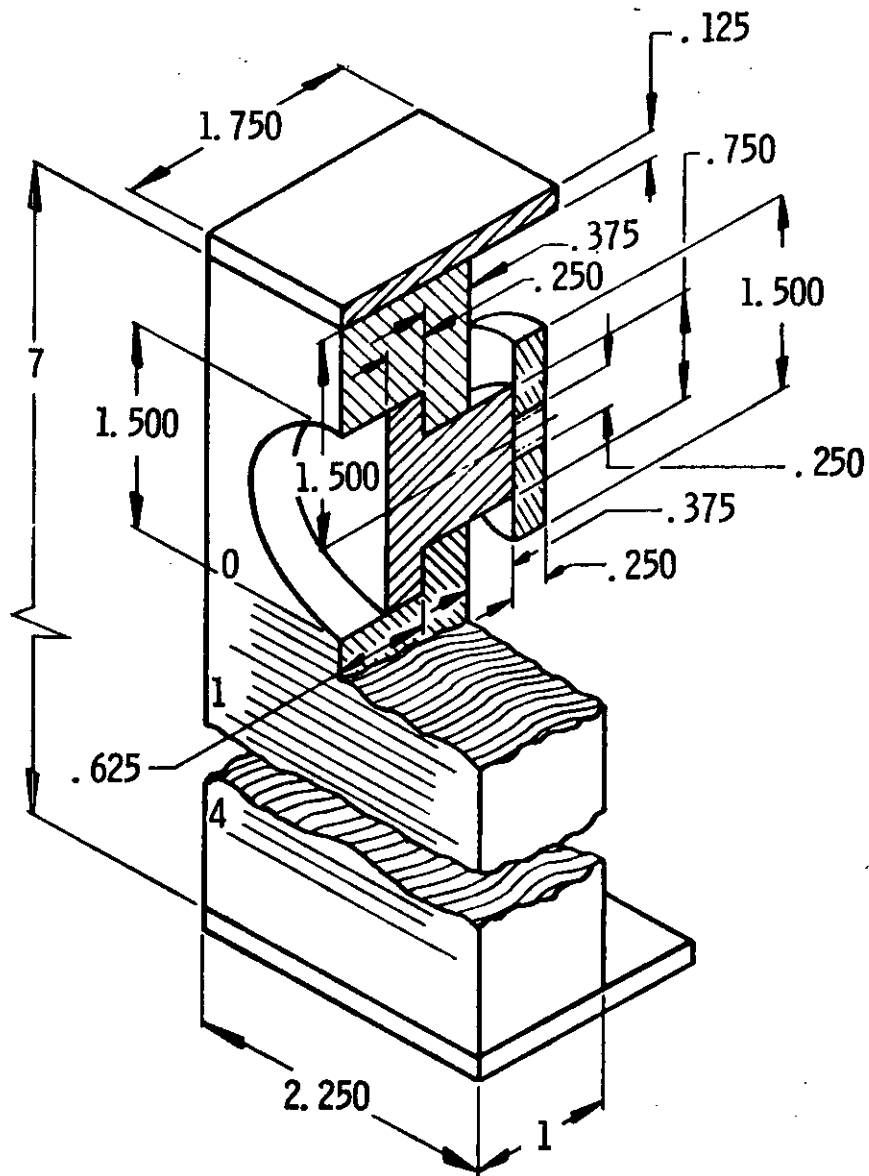
4.7.3 Flow. The base compound, curing agent, application gun and flow-test jig shall be stabilized at standard conditions for at least 8 hours before a minimum of 250 grams of base compound are mixed with the proper amount of curing agent. The mixed sealing compound shall be promptly used to fill a standard Semco sealant gun cartridge with a Semco 440 nozzle, or equal. The gun and sealing compound shall be maintained at standard conditions throughout the test. The test shall be conducted with a flow-test jig as shown in figure 1 and under flow conditions specified in 3.3.4. Depth of plunger is critical and shall be controlled within the tolerance during the test. The flow-test jig 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 begin-

ning of mixing, enough of the mixed sealing compound shall be extruded from the application gun to fill the recess cavity of the jig and leveled off even with the block. Within 10 seconds after leveling operation, the jig shall be placed on its end and the plunger immediately advanced to the limit of its forward travel. The flow measurement shall be taken exactly 30 minutes after the sealing compound has been applied to the test jig. The flow shall be measured from tangent to the lower edge of the plunger to the farthest point to which flow has advanced.

4.7.4 Application time. The base compound, curing agent, and application gun shall be stabilized at standard conditions for at least 8 hours before a minimum of 250 grams of base compound are mixed with the proper amount of curing agent. The mixed sealing compound shall be promptly used to fill a standard Semco sealant gun cartridge, or equal, having a Semco 440 nozzle with an orifice chamber of 0.125 ± 0.005 inch. The gun and sealing compound shall be maintained at standard conditions throughout the test. The gun shall be attached to a constant air supply of 90 ± 5 psig for line variation or gage error. 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 onto a suitable receptacle for 1 minute. The amount of extruded sealing compound shall not be less than 15 grams.

4.7.5 Tack-free time. An aluminum test panel conforming to QQ-A-355, measuring 0.040 by $2\frac{3}{4}$ 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 $\frac{1}{8} \pm \frac{1}{16}$ inch. The sealing compound shall be allowed to cure at standard conditions and as specified in 3.3.6. At the end of the specified tack-free time, two 1-inch pieces of polyethylene film 0.004 ± 0.002 inch thick shall be applied to the sealing compound and held in place at a pressure of $\frac{1}{2}$ ounce per square inch for 2 minutes. The

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MATERIAL: ALUMINUM ALLOY

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES:
DECIMALS ± 0.016

FIGURE 1. FLOW - TEST JIG

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strips 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.

4.7.6 Curing rate. The hardness shall be determined with a Rex instrument in accordance with method 3021 of Federal Test Method Standard No. 601, and cured under standard conditions for 48 hours. The reading shall be taken on a doubled back-to-back, 0.125-inch thick specimen.

4.7.7 Resistance to thermal rupture. Four test specimens shall be prepared, each having a fillet $\frac{1}{8}$ inch thick by 2 inches in diameter applied to a test panel. The test panels shall be steel conforming to MIL-S-5059. They shall be 0.040 by $3\frac{1}{2}$ by $3\frac{1}{2}$ inches in size with a hole $\frac{1}{4}$ inch in diameter in the center of the panel. The sealing compound fillets shall be given a 14-day cure. After curing, each panel in turn shall be placed on the test fixture, figure 2, with the sealant on the interior or pressure side. The test fixture with the test panel shall be subjected to 5 ± 0.5 psi in an air oven for 15 minutes at $400^\circ \pm 10^\circ$ F. Tests shall also be conducted at room temperature ($75^\circ \pm 5^\circ$ F) on panels which have been subjected to flame tests of 2000° F and 3500° F (see 4.7.11).

4.7.8 Low temperature flexibility. Two test panels 0.040 by $2\frac{3}{4}$ by 6 inches in size shall be prepared from aluminum alloy conforming to Specification QQ-A-355. The sealing compound 0.094 inch thick by $1\frac{1}{2}$ inches wide by 4 inches long shall be applied to the center of each of the 2 panels. Care shall be taken to maintain an accurate sample thickness of 0.094 inch. Panels shall be cured for 14 days. Both panels shall then be immediately placed in a low temperature flexibility jig consisting of a clamp support that will grip both sides of both 6-inch edges of the panel for a distance of 3 inches from 1 end without touching the sealant. The jig shall be capable of flexing the panel through a 30-degree arc (15 degrees each side of the center) at a constant speed of 1 cycle per 5 seconds (see figure 3). The temperature shall be reduced to $-65^\circ \pm 2^\circ$ F, stabilized at this temperature for 2

hours, and the panels flexed through 130 consecutive cycles.

4.7.9 Peel strength. Four 0.040 by $2\frac{3}{4}$ by 6 inches aluminum alloy test panels conforming to QQ-A-355 and four 0.025 to 0.040 by $2\frac{3}{4}$ by 6 inches stainless steel panels conforming to composition 302, finish 2D of Specification MIL-S-5059 shall be coated with a $\frac{1}{8} \pm \frac{1}{64}$ inch thickness of sealing compound. After the sealing compound has immobilized, 1 end of a 3- by 12-inch strip of wire screen (20- to 40-mesh aluminum or monel wire fabric) shall be placed on each panel, leaving a loose end 6 inches in length. An additional $\frac{1}{32}$ inch thick coating of sealing compound shall be applied over the screen strips and the panels allowed to cure 14 days. Two of the aluminum panels and 2 panels of the stainless steel panels shall be aged for 72 hours at $400^\circ \pm 5^\circ$ F. A 1-inch wide section shall be cut through the strip and sealing compound on each test panel to provide the center inch for the peel test. The specimens shall be stripped back at an angle of 180 degrees to the metal panel in a suitable tensile testing machine having a jaw separation of 2 inches per minute. The results shall be the numerical average of the peak loads.

4.7.10 Corrosion resistance. One aluminum panel conforming to Specification QQ-A-355 and one stainless steel panel conforming to composition 302, finish 2D of Specification MIL-S-5059, measuring 0.040 by $2\frac{3}{4}$ by 6 inches in size, shall be prepared with 2 parallel sealing compound fillets approximately 1 inch apart. The fillets shall be applied $\frac{3}{16}$ inch thick by $\frac{3}{4}$ inch wide by 5 inches long and shall extend to within $\frac{1}{2}$ inch of the edges of the panel. The panels shall have a 14-day cure. At least 48 hours before the cure time has expired, the panel shall be dipped in a sealing compound topcoat conforming to Specification MIL-S-4383 and the cure allowed to continue. At the end of the 14-day curing period, the fillets shall be cut down to $\frac{1}{16}$ inch and the panels immersed vertically for 20 days in a covered glass vessel containing a 3 percent solution of sodium chloride in distilled water. One

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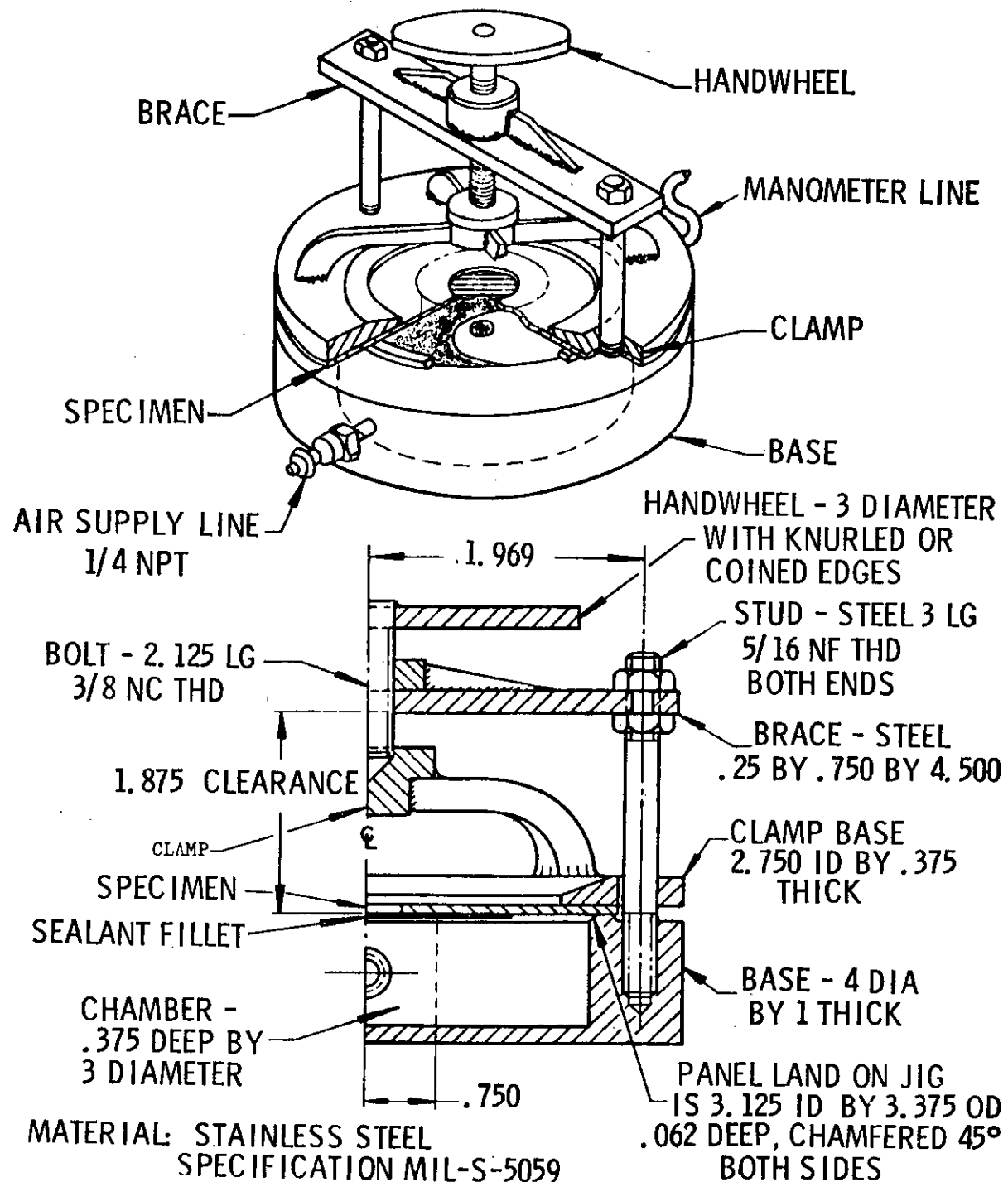


FIGURE 2. THERMAL RUPTURE JIG

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half of the panel shall be immersed in the liquid and the other half exposed to air vapor mixture. The temperature during the test shall be maintained at $140^{\circ} \pm 2^{\circ}$ F. Immediately upon removal from the liquid, the panels shall be examined for compliance with the requirements of 3.3.11.

4.7.11 Flame resistance. Two panels 0.040 by $2\frac{7}{8}$ by 6 inches of stainless steel shall be coated with sealing compound $\frac{1}{8}$ inch thick and cured for 14 days. Type I material shall be subjected to a Bunsen burner flame at temperatures of $2000^{\circ} \pm 100^{\circ}$ F for 15 minutes (figure 4). Type II material shall be subjected to an oxyacetylene flame at temperatures of $3500^{\circ} \pm 100^{\circ}$ F for 15 minutes. The flame shall be directed at the center of the coated side at a 45-degree angle.

4.7.12 Oil resistance. Two aluminum panels conforming to Specification QQ-A-355, measuring 0.040 by $2\frac{3}{4}$ by 6 inches shall be prepared with 2 parallel sealing compound fillets approximately 1 inch apart. The fillets shall be applied $\frac{3}{8}$ inch thick by $\frac{3}{4}$ inch wide by 5 inches long and shall extend to within $\frac{1}{2}$ inch of the edge of the panel. The panels shall have a 14-day cure. At the end of the 14-day curing period the panels shall be immersed vertically for 72 hours in Di-2-ethylhexyl sebacate with $\frac{1}{2}$ percent phenothiazine at 140° F.

4.7.13 Accelerated storage. An unopened container of base compound and an unopened container of the curing agent shall be stored for 14 days at $120^{\circ} \pm 2^{\circ}$ F in a suitably ventilated oven. After cooling at standard conditions for at least 24 hours, tests shall be conducted in accordance with 4.7.3, 4.7.4 and 4.7.5.

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

4.7.15 Packaging, packing and marking. Preparation for delivery shall be examined for conformance with section 5.

5. PREPARATION FOR DELIVERY

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

5.1.1 Level A.

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

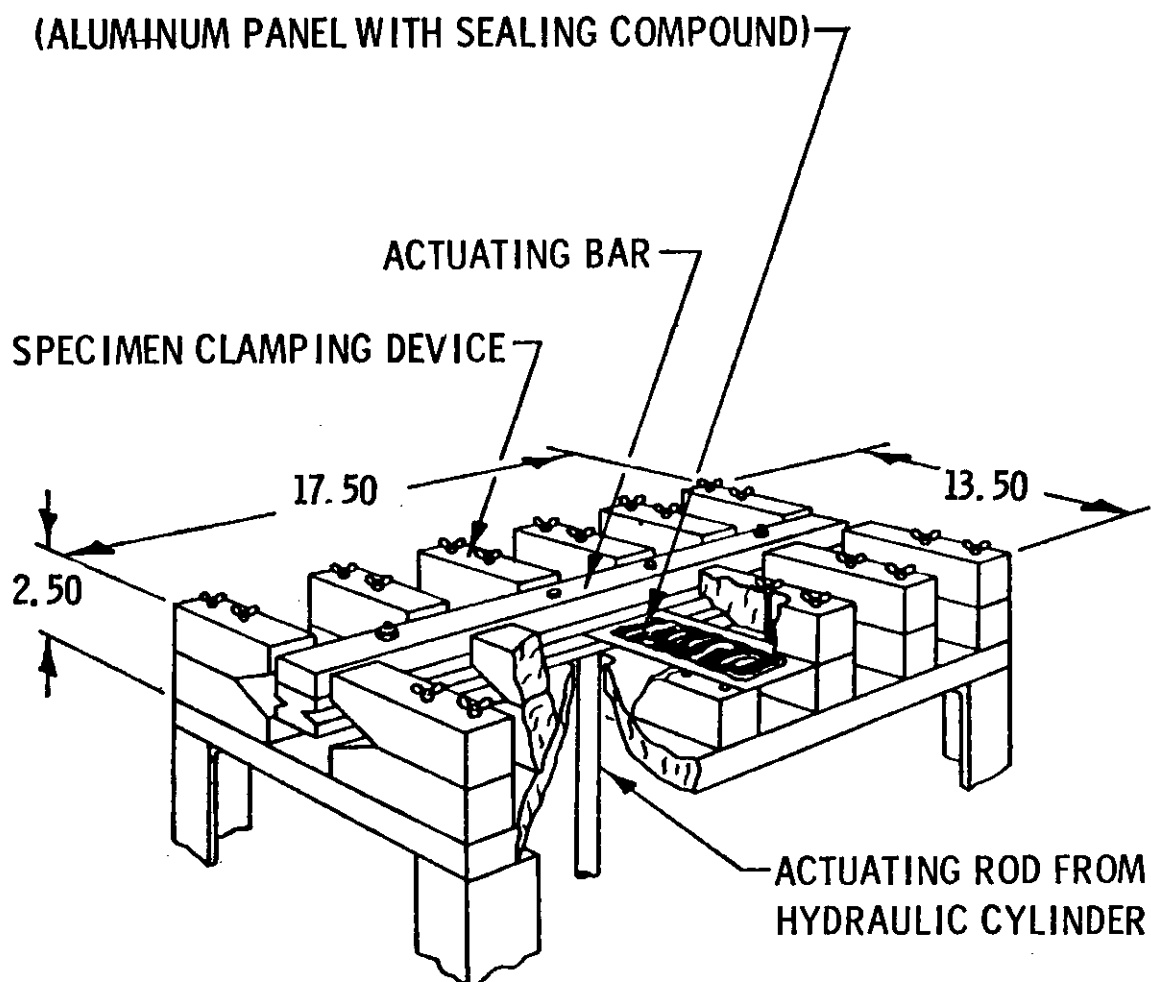
5.1.1.1.1 Individual containers. The base compound shall be furnished in $\frac{1}{2}$ -pint, 1-pint, 1-quart, or 1-gallon metal cans, as specified in the contract or order. Metal cans shall conform to type V, class 2 of Specification PPP-C-96, except that tinplate cans with paper labels may be used, unless specifically prohibited. The base compound contained in each size container shall be as follows:

Size of container	Amount of base compound	Volume tolerance
$\frac{1}{2}$ pint	6 fluid ounces..	$\pm \frac{1}{8}$ fluid ounce
1 pint	12 fluid ounces..	$\pm \frac{1}{4}$ fluid ounce
1 quart	24 fluid ounces..	$\pm \frac{1}{2}$ fluid ounce
1 gallon	96 fluid ounces..	± 2 fluid ounces

The curing agent shall be furnished in glass jars or bottles, cans, or in suitable plastic containers approved by the procuring activity. The jars or plastic containers, as applicable, shall have vertical, smooth inside walls, and no internal projections nor internal lips exceeding $\frac{1}{16}$ inch. The glass jars and bottles shall be closed with enameled metal or plastic continuous thread screw caps having a non-absorbent lining material. Cans for the curing agent shall conform to type V, class 2 of Specification PPP-C-96, except that tinplate cans with paper labels may be used, unless specifically prohibited.

5.1.1.1.2 Sectional-type containers. The base compound and curing agent shall be furnished in sectional-type $2\frac{1}{2}$ - or 6-ounce

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DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED,
TOLERANCES: $\pm .015$

FIGURE 3. LOW TEMPERATURE FLEXIBILITY JIG

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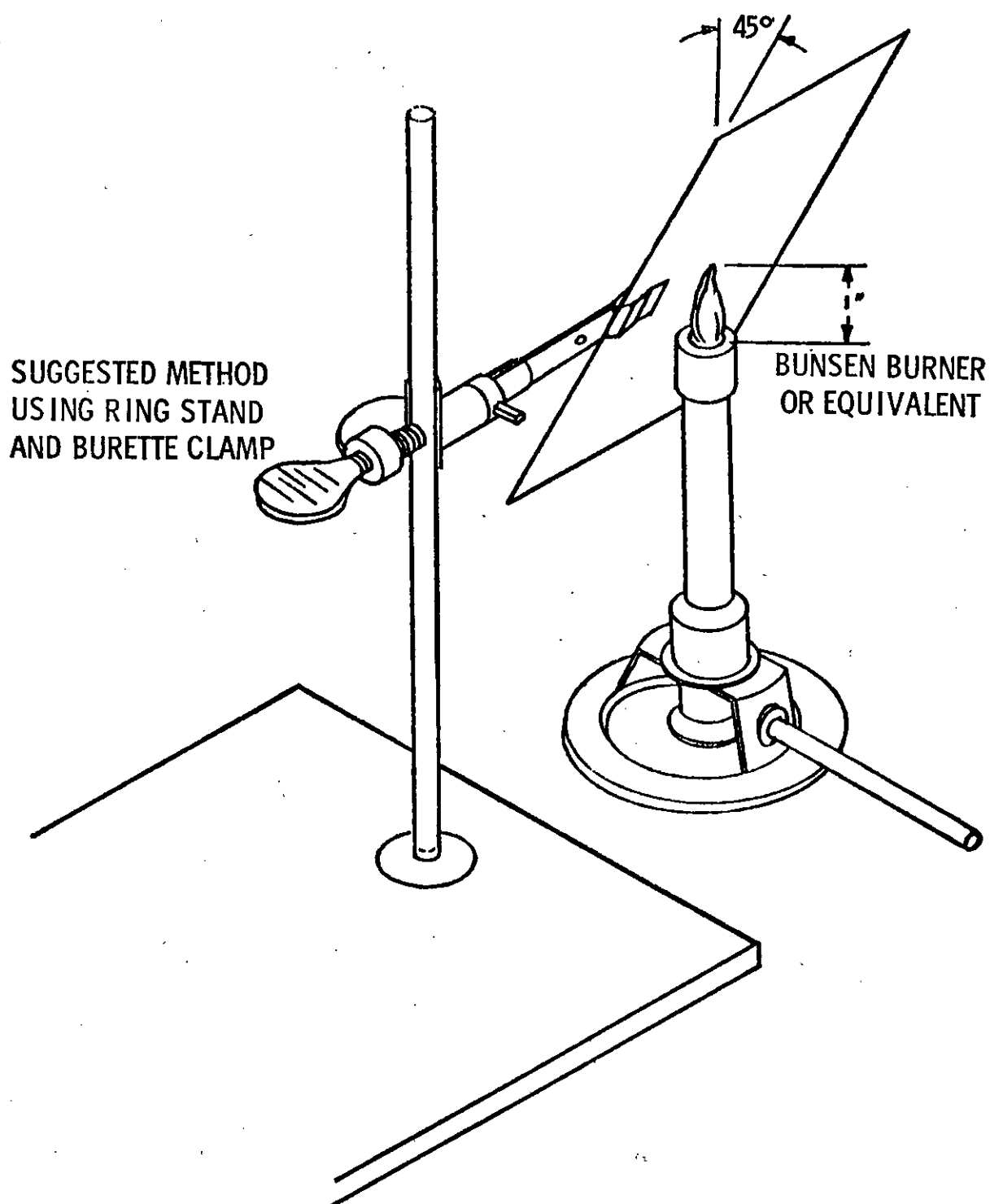


FIGURE 4. FLAME RESISTANCE TEST

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nominal containers, as specified in the contract or order. The total content of base compound and curing agent container in each sectional-type container shall be as follows:

Size of container	Total content (base and curing)	Volume tolerance
2½ ounces ..	2 fluid ounces..	± ¼ fluid ounce
6 ounces ..	3½ fluid ounces..	± ¼ fluid ounce

5.1.2 *Level C.* Packaging shall be in accordance with the manufacturer's commercial practice.

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

5.2.1 *Level A.* The sealing compound shall be packed in overseas-type shipping containers in accordance with the requirements of the appendix to Specification PPP-C-96.

5.2.2 *Level B.* The sealing compound shall be packed in domestic-type shipping containers in accordance with the requirements of the appendix to Specification PPP-C-96.

5.2.3 *Level C.* The sealing compound shall be packed in a manner to insure carrier acceptance and safe delivery at destination. Containers shall be in accordance with Uniform Freight Classification Rules or regulations of other carriers applicable to the mode of transportation.

5.3 *Marking for shipment.* In addition to special marking specified herein and that required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. Marking shall include specification

number, applicable type, name of manufacturer, date of manufacture (month and year), and recommended storage temperature.

5.3.1 *Labeling.* Labeling shall be required in accordance with the requirements of appropriate Federal Statutes and Regulations, e.g., Federal Hazardous Substance Labeling Act, etc, or as prescribed by the processing agency upon advice and recommendations of the departmental medical services.

6. NOTES

6.1 *Intended use.* The sealing compound covered by this specification is intended for sealing firewall structures. Types I and II sealing compounds are suitable for use in a service temperature range from -65° to +400°F. Type I sealing compound is suitable for flash temperatures up to 2000° F; type II should only be used for missile applications when flash temperatures exceed 2000° F.

6.2 *Ordering data.* Procurement documents should specify the following:

- Title, number and date of this specification
- Type (see 1.2)
- Quantity desired
- Size of base compound container (see 5.1.1.1.1)
- Applicable levels of packaging and packing (see 5.1 and 5.2)
- Provisions for submission of preproduction samples (see 4.3.1).

Custodian:

Air Force—11

Reviewers:

Air Force—11, 69

User:

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Preparing Activity:

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