

INCH-POUND

MIL-DTL-47113E

15 May 2012

SUPERSEDING

MIL-DTL-47113D

25 September 2001

DETAIL SPECIFICATION

COMPOUND, HEAT SINK, SILICONE AND/OR NON-SILICONE

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a silicone or non-silicone heat sink compound which is applied to the base and mounting studs of transistors and diodes to provide a positive heat sink seal.

1.2 Classification. The heat sink compound will be of the following types and sizes (see [6.2](#)).

1.2.1 Types. The types of heat sink compound are as follows:

Type I - Silicone compound

Type II - Non-silicone compound

Comments, suggestions, or questions on this document should be addressed to Defense Logistics Agency Aviation-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at <https://assist.daps.dla.mil>.

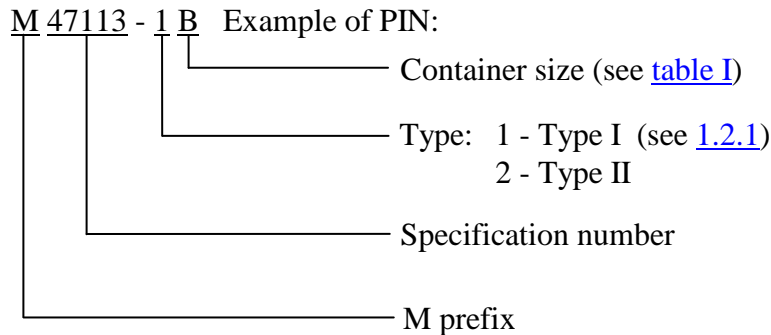
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1.2.2 Sizes. The heat sink container size should be one of the coded options listed in [table I](#).

TABLE I. Container size.

Size code	Container size
A	2 oz. jar
B	5 oz. tube
C	8 oz. jar
D	1 pint can
E	10 lb. can

1.3 Part or identifying number (PIN). The PIN to be used for heat sink compound acquired to this specification is created as follows:



M47113 - 1B indicates: type I silicone compound, 5 oz. tube.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

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2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

SPECIFICATIONS

FEDERAL

VV-D-1078 - Damping Fluid, Silicone Base (Dimethyl Polysiloxane)

(Copies of these documents are available online at <https://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D70 - Standard Test Method for Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method)
- ASTM D217 - Standard Test Methods for Cone Penetration of Lubricating Grease
- ASTM D6184 - Standard Test Method for Oil Separation from Lubricating Grease (Conical Sieve Method)

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Electronic copies of ASTM standards may be obtained from <http://www.astm.org/>.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this standard and the references cited herein, the text of this standard takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Toxic chemicals, hazardous substances, and ozone depleting substances (ODS). The use of toxic chemicals, hazardous substances, or ODS shall be avoided whenever feasible.

3.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided

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that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 First article. When specified (see [6.2](#)), a sample shall be subjected to first article inspection in accordance with 4.3.

3.4 Material. The compound shall be an opaque white grease-like compound and conform to the applicable chemical characteristics of [table II](#).

TABLE II. Chemical characteristics.

Chemical requirement	Type	
	Type I (silicone)	Type II (non-silicone)
Base fluid	Dimethyl polysiloxane ¹	Polyol ester
Filler/other materials	99% min., Zinc oxide	Zinc oxide, aluminum silicate
Specific gravity, 25 °C, min. ²	2.0	2.0
Penetration - consistency	250-320	250-320
Bleed, 24 hrs., %/wt., max.	1.0	1.0
Evaporation, 24 hrs., %/wt., max.	2.0	2.0
Thermal conductivity, g-cal(cm)/sec/cm ² /°C, min.	0.0005	0.0005

¹Dimethyl polysiloxane used in this silicone compound shall meet the requirements of VV-D-1078 with appropriate viscosity grade so that it shall meet the requirements of [table II](#).

² See note [6.3.1](#).

3.5 Workmanship. The compound, as packaged in containers, shall be a smooth, homogeneous mixture, free from lumps, coarse particles, and foreign material. There shall be no separation of filler that cannot be readily re-dispersed.

4. VERIFICATION

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

- a. First article inspection (see [4.3](#)).
- b. Conformance inspection (see [4.4](#)).

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4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the following test conditions:

- a. Temperature, room ambient $\pm 9^{\circ}\text{C}$ ($\pm 16^{\circ}\text{F}$).
- b. Altitude, facility ground.
- c. Humidity, facility ambient up to 95 percent relative humidity.

4.3 First article inspection. When specified in the contract or order, a sample shall be subjected to first article inspection. The sample size shall be specified in the contract or order (see [6.2](#)). If the first article sample does not meet the requirements of this specification, it shall be rejected. Subsequent units shall not be considered for acceptance until government approval of the first article sample has been obtained. Testing of this sample, to determine compliance with the characteristics shown in [3.4](#) and [3.5](#), shall be conducted in accordance with [4.5](#).

4.4 Conformance inspection. Conformance inspection shall be performed in accordance with inspection provisions set forth herein. The characteristics shown in [3.4](#) and [3.5](#), when tested in accordance with [4.5](#), shall constitute minimum inspections to be performed by the supplier prior to government acceptance or rejection. Failure of any test, by any sample, shall be cause for rejection. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the government for acceptance comply with all requirements of the contract.

4.5 Test methods.

4.5.1 Component and material inspection. In accordance with [4.4](#), components and materials shall be inspected in accordance with all of the requirements of referenced documents unless otherwise excluded, amended, modified, or qualified in this specification or applicable purchase document.

4.5.2 Tests.

4.5.2.1 Composition and workmanship. The supplier shall certify the composition of and visually determine that the condition of the heat sink compound in the container conforms to [3.4](#) and [3.5](#) (see [6.2](#)).

4.5.2.2 Specific gravity. Determine the specific gravity of the sample in accordance with ASTM D70 and verify the result with [table II](#).

4.5.2.3 Penetration. Determine the penetration of the sample in accordance with ASTM D217. The test shall be run one minute after working and the results shall conform to [table II](#).

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4.5.2.4 Bleed. Determine the bleed of the sample in accordance with ASTM D6184 with the following exceptions:

- a. The cone shall be suspended from a rod supported on the edges of the beaker without covering the beaker.
- b. The test shall be conducted at 200 ± 0.5 °C (392 ± 1 °F) for at least 24 hours.

Calculate the percent by weight as follows and verify the percent bleed with table II:

$$\text{Percent bleed} = \frac{\text{Gain in weight of beaker}}{\text{Weight of sample}} \times 100$$

4.5.2.5 Evaporation. Determine the evaporation of the sample via the procedure given in paragraph 4.5.2.4. Calculate the percent evaporation loss of the sample as follows:

$$\text{Percent evaporation loss} = \frac{(S - \text{wt.})}{S} \times 100$$

Where: S = initial weight of sample, gram
wt. = weight of sample after heating, gram

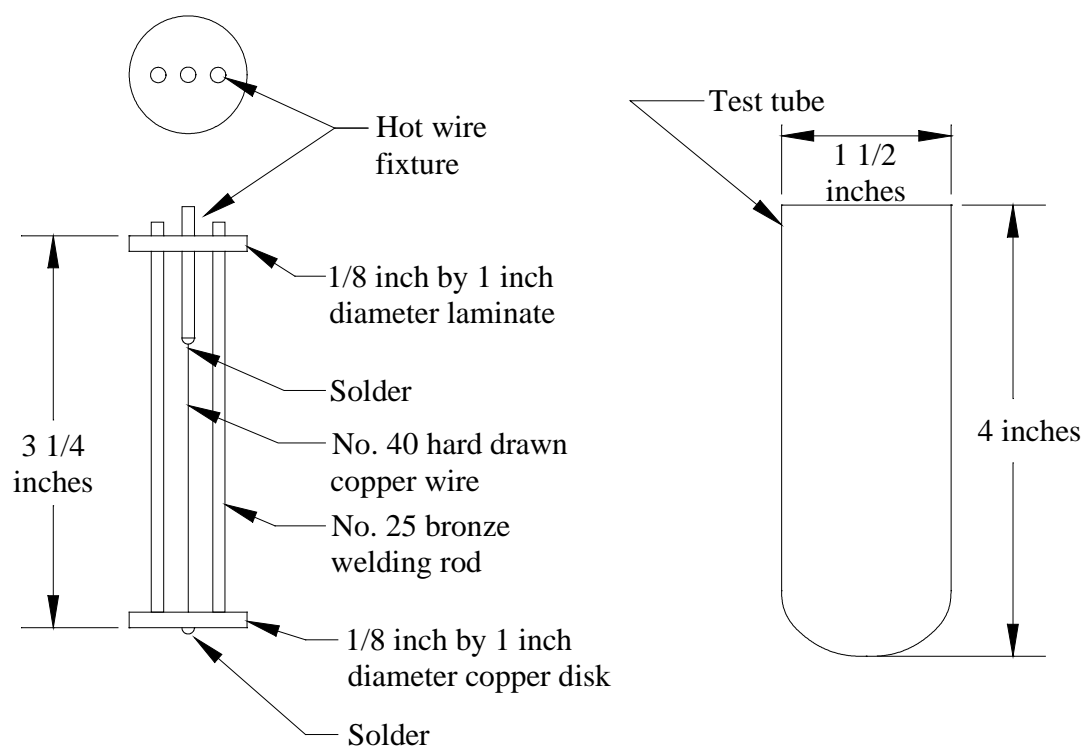
Verify the percent evaporation loss with [table II](#).

4.5.2.6 Thermal conductivity. Determine the thermal conductivity of the sample using the hot wire method as follows:

4.5.2.6.1 Equipment.

- a. Conductivity cell in accordance with [figure 1](#).
- b. Voltmeter 0-1.5 volts.
- c. Ammeter 0-5 amperes.

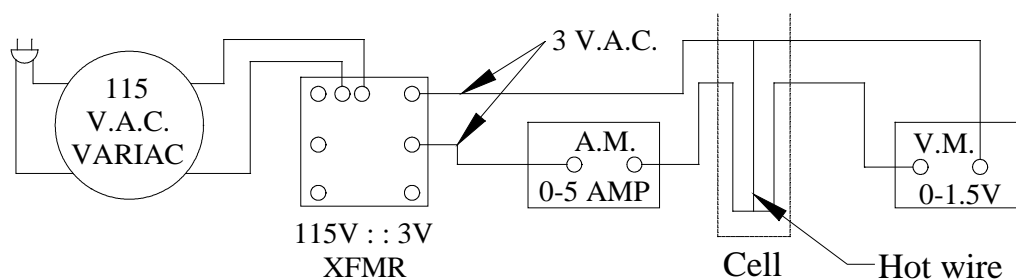
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FIGURE 1. Thermal conductivity tests - hot wire method.

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4.5.2.6.2 Hot wire method.

- a. Fill sample into a sample tube to within 0.75 inch of the top.
- b. Insert hot wire fixture into the sample tube until the level of the sample is at the same level as the top-insulating disc.
- c. Place the tube containing the sample and fixture into a 400 ml beaker containing water maintained at 23 ± 1 °C (73 ± 2 °F).
- d. When the tube and the sample reach 23 ± 1 °C (73 ± 2 °F), the voltage shall be raised to 1.3 volts provided current flow does not exceed 4 amperes.
- e. The voltage shall be allowed to continue until current is stabilized. Record the voltage and current readings using the diagram in [figure 2](#).

FIGURE 2. Thermal conductivity test diagram.

- f. Reduce the voltage by 0.1 volt and wait for 2 minutes. Record the current flow.
- g. Repeat step f until 0.5 volt is reached.
- h. Calculate the circuit resistance (R_C) as follows:

$$\text{Circuit resistance } (R_C) = \frac{E}{I}$$

Where: E = voltage (volts)

I = current (amperes)

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- i. Calculate the watts (W) as follows:

$$\text{Watts (W)} = EI$$

- j. Calculate the temperature (T) in Celcius as follows:

$$T = \frac{(R_c \times 257)}{R_e} - 234.5$$

Where: R = circuit resistance

Re = resistance of wire at 23 °C (73 °F).

Resistance shall be measured by means of a bridge. Resistance of test leads shall be subtracted when determining resistance of wire.

- k. Plot the temperature versus watts and calculate slope (W/T).

- l. Calculate the thermal conductivity (K) as follows:

$$\text{Thermal conductivity (K)} = \frac{0.00038}{0.022} \times \text{slope}$$

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When actual packaging of material is to be performed by DOD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory).

6.1 Intended use.

6.1.1 General. The material covered by this specification is intended for use in improving thermal conductivity at heat sink junctions.

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Caution: When this material is initially applied under devices which are torque set, the zinc oxide filler may not allow complete seating of the device. The following procedure should be used:

Apply a thin film of silicone/non-silicone grease, then torque to the pressure specified on the device detail drawing; after 20-30 minutes, re-torque to specified pressure.

6.1.2 Military unique. The silicone or non-silicone heat sink compound tests covered by this specification are not standard tests for commercial products in the market. In order to meet the requirements of this specification, the vendor may have to run additional tests on their product.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type required (see [1.2.1](#)) and container size required (see [1.2.2](#)).
- c. Specific issue of individual documents referenced (see [2.2](#) and [2.3](#)).
- d. First article sample, if required, sample size and pertinent details (see [3.3](#) and [4.3](#)).
- e. Requirement for certification of composition (see [4.5.2.1](#)).
- f. Packaging requirements (see [5.1](#)).

6.3 Definitions.

6.3.1 Specific gravity. Also called relative density. The ratio of the weight of a volume of material to the weight of an equivalent volume of water. ASTM D70 uses the term relative density.

6.4 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.hq.dla.mil/>.

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6.5 Subject term (key word) listing.

opaque white grease
polyol ester
thermal conductivity
zinc oxide

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:

Navy - SH

Air Force - 68

Preparing activity:

DLA - GS3

(Project 6850-2012-006)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST database at <https://assist.daps.dla.mil>.