INCH-POUND

MIL-DTL-47113D
25 September 2001
SUPERSEDING
MIL-DTL-47113C
12 April 1999

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this document should be addressed to: Defense Supply Center Richmond, ATTN: DSCR-VBD, Richmond, VA 23297-5610, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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

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.

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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS), and the supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

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

STANDARDS

FEDERAL

FED-STD-791 - Liquid Fuels and Related Products; Methods of Testing

(Unless otherwise indicated, copies of the above standards are available from the General Services Administration, Federal Supply Service, Specification Section, 470 East L'Enfant Plaza SW, Suite 8100, Washington, DC 20407. Electronic copies of federal specifications and standards may be obtained from http://astimage.daps.dla.mil/quicksearch/.

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 documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS are the issues of documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 70 - Standard Test Method for Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method) (DoD Adopted)
ASTM D 217 - Standard Test Methods for Cone Penetration of Lubricating Grease (DoD Adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 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. 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 standard, 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 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.	2.0	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

[1]Dimethyl 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.

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).

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

a. Temperature, room ambient ± 9 °C (± 48 °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 D 70 and verify the result with table II.

4.5.2.3 Penetration. Determine the penetration of the sample in accordance with ASTM D 217. The test shall be run one minute after working and the results shall conform to table II.

4.5.2.4 Bleed. Determine the bleed of the sample in accordance with FED-STD-791, Method 321 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.

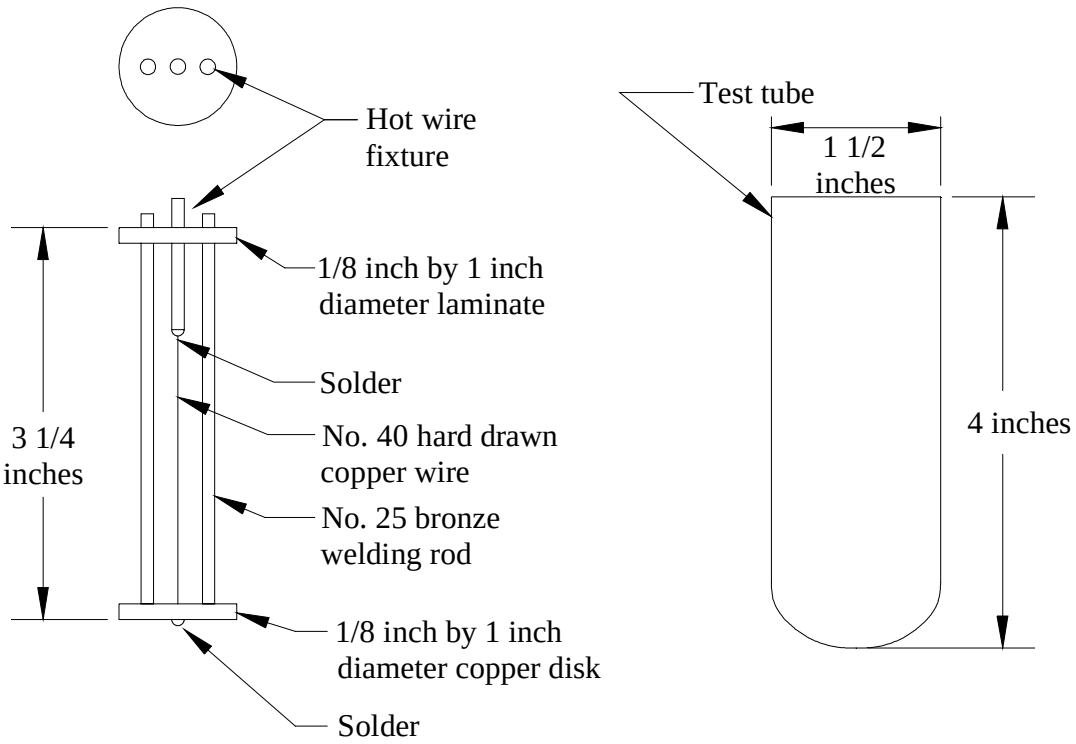


FIGURE 1. Thermal conductivity tests - hot wire method.

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.

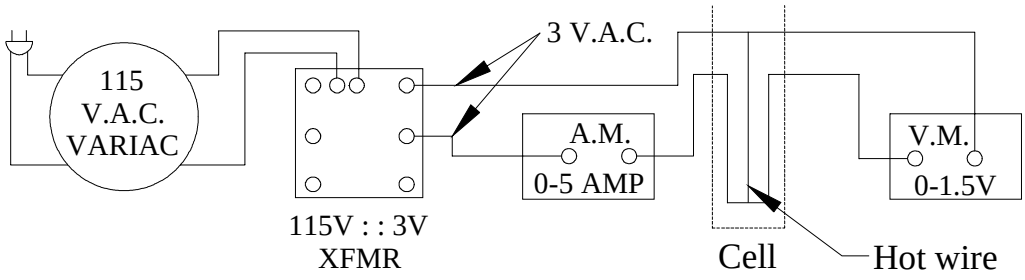


FIGURE 2. Thermal conductivity test diagram.

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)

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.

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:

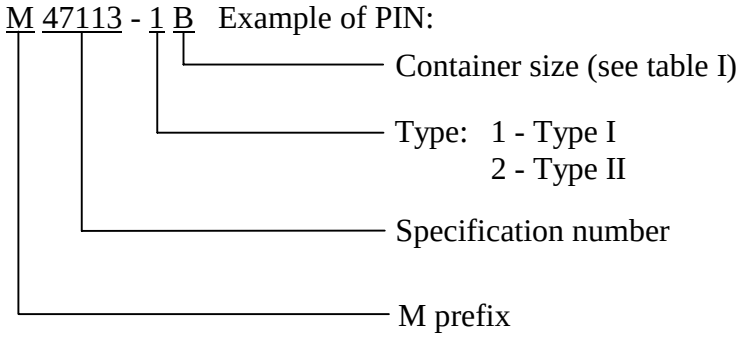
Apply a thin film of silicone/non-silicone grease, then torque to the pressure specified on the device detail drawing; after 20-30 minutes, re-torque to specified pressure.

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. Issue of DODISS to be cited in the solicitation, and if required, the 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 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.

6.4 Subject term (key word) listing.

opaque white grease
polyol ester
thermal conductivity
zinc oxide

6.5 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 6850-1453)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-DTL-47113D	**2. DOCUMENT DATE (YYYYMMDD)** 20010925

3. DOCUMENT TITLE

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

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) DSN *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Supply Center Richmond	b. TELEPHONE *Include Area Code)* (1) Commercial (804) 279-5019 (2) DSN 695-5019
c. ADDRESS *(Include Zip Code)* ATTN: DSCR-VBD (C. Hammond) 8000 Jefferson Davis Highway Richmond, VA 23297-5610	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** DEFENSE STANDARDIZATION PROGRAM OFFICE (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888