

## Resin Designs Thermally Conductive Gel Products

### 1.0 SCOPE

This specification covers the requirements for a family of thermally conductive gel products. These products are used to provide a thermally conductive interface between a heat sink and heat source utilizing low mounting pressures. Conductivity is provided through thermally conductive fillers in a silicone gel matrix.

### 2.0 APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issues of referenced documents apply. The following documents form a part of this specification to the extent specified herein.

#### 2.1 INTERNAL PROCEDURES

TUS-36-3009 Specific Gravity

TUS-36-3149 Shore 00 Hardness Procedure

TUS-36-3138 Standard Procedure For The Determination Of Adhesive Tack For Thin Fabric Based Strip Products Using the Texture Analyzer

TUS-36-3146 Procedure For The Determination Of Bulk Thermal Conductivity For Filled Thermal Gel Compounds using the Mathis TC-30.

#### 2.2 American Society for Testing and Materials (ASTM)

ASTM D 149-97a *Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies*

ASTM D 257-99 *Standard Test Methods for DC Resistance or Conductance of Insulating Materials*

ASTM D 412-98a *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers- Tension*

ASTM D 624-00 *Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers*

ASTM D 792-00 *Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.*

ASTM E 1530-99 *Standard Test Method for Evaluating the Resistance to Thermal Transmission of Thin Specimens of Materials by the Guarded Heat Flow Meter Technique*

ASTM D 2240-02a *Standard Test Method for Rubber Property- Durometer Hardness*

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, [www.astm.org](http://www.astm.org))

#### 2.3 Underwriters Laboratories, Incorporated

UL 94 (Fifth ed. Oct. 29, 1996) Test for Flammability of Plastic Materials for Parts in Devices and Appliances)

(Copies of UL publications may be obtained from the Underwriters Laboratories, Inc., [www.ul.com](http://www.ul.com))

### 3.0 REQUIREMENTS

3.1 Specification Control Drawings (SCD's). The requirements for the interface products furnished under this specification shall be as specified herein and on the applicable specification control drawing.

#### 3.2 SPECIFICATION SHEETS

The individual products shall be in accordance with the applicable specification sheet. In the event of conflict between the basic specification and the specification sheet, the requirements of the specification sheet shall prevail.

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**3.3 MATERIALS**

Thermally conductive gel products are fabricated from a soft silicone gel matrix which is filled with a thermally conductive filler. The product may be supported on a fiberglass fabric, reticulated foam, or other imbedded supporting carrier. The product is generally supplied on one or more release liners which protect the product during manufacture and transport.

**3.4 PROPERTIES**

The thermally conductive gel products shall meet the requirements of the appropriate Specification sheet.

**4.0 QUALITY ASSURANCE PROVISIONS****4.1 CLASSIFICATION OF TESTS****4.1.1 Qualification Tests**

Qualification tests are those performed on finished product or base material submitted for qualification as a satisfactory product and shall consist of all tests listed in the applicable specification sheet.

**4.1.2 Acceptance Tests**

Acceptance tests are those performed on product submitted for acceptance under contract. Acceptance tests are dimensions, specific gravity, and any other defined in the appropriate slash Sheet.

**4.2 SAMPLING INSTRUCTIONS****4.2.1 Qualification Test Samples**

Qualification test samples shall consist of 5m (16.5 feet) of continuous product for each qualification size. Qualification of any size within each size range specified below will qualify all sizes in the same range.

**Size Range**

.25 mm -.50 mm (Fabric)  
.75 mm -.2.0 mm (Fabric)  
2.2 mm – 3.0 mm (Foam)  
3.8 mm – 5.0 mm (Foam)

**4.2.2 Acceptance Test Samples**

Acceptance test samples shall consist of not less than .33 m (1 foot) of post-cured sheet product selected at random from each lot. A lot shall consist of all product of the same size from the same production run and offered for inspection at the same time.

**4.3 TEST PROCEDURES**

Unless otherwise specified, tests shall be performed on post-cured specimens which have been removed from the release liner. Prior to all testing, the test specimen (and measurement gauges, when applicable) shall be conditioned for 3 hours at  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}\text{F}$ ) and ambient laboratory relative humidity. All ovens shall be of the mechanical convection type in which air passes the specimens at a velocity of 30 - 60m (100 to 200 feet) per minute. See Table 1 for number of specimens per test.

**4.3.1 Dimensions**

Dimensions are measured on specimens with release liner in place using Mitutoyo Standup 10 gram load cell force thickness gauge. Check that measurement foot is on tight. Zero the gage

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with the release liner only. Allow gage measurement foot to contact product surface and record thickness within about 5 seconds of contact.

#### 4.3.2 Thermal Conductivity

4.3.2.1 Instrument. Materials are tested on a Guarded Heat Flow Instrument conforming to ASTM E1530. Refer to TUS-36-3146 using the Mathis TC-30.

4.3.2.2 Test Samples. For thermal conductivity only, specimens with thickness greater than or equal to 3 mm are used to qualify whole size range of foam products due to instrument limitation. Fabric products are qualified by casting a slab of the base filled gel 3.15mm +/- .25mm (.125" +/- .010") thick and curing it at 90°C for 1 hour.

#### 4.3.3 Density

Specimens of about 3-4 sq. cm. are cut from finished product and tested per ASTM D 792 Method A1 (by water displacement, hung on wire). Reference TUS-36-3009.

#### 4.3.4 Tensile Strength and Ultimate Elongation

The tensile strength and ultimate elongation of the gel product shall be determined in accordance with ASTM D 412 using a Die D specimen and 25mm (1-inch) bench marks and a 50-mm (2-inch) initial jaw separation. The speed of jaw separation shall be  $50 \pm 5$  mm ( $2 \pm .2$  inches) per minute.

#### 4.3.5 Shore OO Hardness

Foam products are tested as final product per ASTM D 2240. For samples of thickness less than 3mm two pieces 2" x 6" are stacked, taking care not to trap air between layers. For samples of thickness 3mm or greater, hardness is measured on single 2" x 6" specimen of final product. Reference TUS-36-3149.

#### 4.3.6 Compression Deflection

Sample disks of 25.4mm (1-inch) diameter are punched or die cut from final product. These are tested in an Instron using a 50kg compression load cell. The original sample thickness ( $T_0$ ) is recorded per 4.3.1. The specimen is then placed between compression plates and compression applied at the rate specified until sample is compressed to about 50%. Force at 20% compression is determined from the point on the chart corresponding to a crosshead travel distance of  $.2 \times T_0$ .

#### 4.3.7 Heat Resistance

Samples are placed on Teflon coated release paper and aged in convection oven for the specified time and temperature.

#### 4.3.8 Weight Loss

Samples (about 1 square inch or 6.5 square cm.) are cut from final product and release paper removed. Original weight is recorded to nearest .0001 g. Samples are placed on Teflon coated release paper and aged in convection oven for the specified time and temperature. After removal from oven samples are to be conditioned at ambient temperature and humidity for 3 hours minimum prior to weighing.

#### 4.3.9 Dielectric Breakdown

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The dielectric breakdown of the product shall be measured under oil in accordance with ASTM D 149. Five 3" x 5" specimens shall be tested using a 1/4" diameter brass electrode and a brass plate as electrodes. The test voltage shall be applied at a rate of rise of 500 volts per second. Average thickness measurement shall be used for calculating dielectric strength.

**4.3.10 Volume Resistivity**

Foam samples are tested in final product form. Thin fabric based products are qualified by using a cast slab prepared as described in 4.3.2.2. Three samples, at least 100mm x 100mm in size, with 2" (50.8mm) diameter circles of lead foil and brass plates as electrodes are tested per ASTM D 257. Silver filled epoxy paint is also allowed in place of the lead foil.

**4.3.11 Fluid Resistance**

Three approximately 2.54 cm x 2.54 cm specimens are cut from the final product and immersed for 24 hours in each of the test fluids listed in the specification sheet at the temperature specified. The volume of the fluid shall not be less than 20 times that of the specimens. After conditioning, all the specimens shall be lightly wiped and air dried for 30 to 60 minutes at  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}$ ). The specimens shall be weighed before and after immersion and the weight change calculated as a percentage.

**4.3.12 Flammability**

Samples of final product are die-cut and conditioned as described in the appropriate section of UL 94 (either Horizontal Burning Test 94HB or Vertical Burning Test 94V-0, 1, 2). For 94HB, a 45° wire support fixture 120mm long constructed of 2 mm diameter wires with 1 cm x 1 cm openings is used. Samples are tested per UL94 specified flame application times and locations.

**4.3.13 Tear Strength**

Specimens are cut with the long axis of the ASTM B-Die in the machine direction of the fabric. Tear strength is measured per ASTM D 624 using a crosshead speed of  $500 \pm 50$  mm/min.

**4.3.14 Adhesive Tack (fabric samples)**

Specimens with dimensions about 1" x 6" are cut transverse to the machine direction of the coating process. Tack is measured in 5 positions along the specimen using the appropriate procedure on the Texture Analyzer and a 7mm diameter stainless steel cylindrical probe. TUS-36-3138 reference. Two specimens are used and the average of 10 values is reported.

**4.3.15 Oil Bleed**

This test is loosely based on ASTM C772, Oil Migration or Plasticizer Bleed-Out of Preformed Tape Sealants. Three 1 cm x 4 cm strips are cut from the final product. The strips are then sandwiched in between two pieces of Whatman No. 1 filter paper. This sandwich is then placed into an oil bleed fixture. The specimens are then aged at the indicated temperature for the indicated time. Remove from the oven, allow them to cool, then measure the distance that the oil has absorbed into the filter paper beyond the edge of the original test specimen. Report this value for both sides of the sandwich.

**4.4 REJECTION AND RETEST**

Failure of any samples of product to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Product which has been rejected may be replaced or reworked to correct the defect and then resubmitted for acceptance. Before resubmitting, full particulars concerning the rejection and the action taken to correct the defect shall be furnished to the inspector.

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**5.0 PREPARATION FOR DELIVERY**

5.1 FORM

The product shall be supplied on spools or as sheets, unless otherwise specified.

5.2 PACKAGING

Packaging shall be in accordance with good commercial practice.

5.3 MARKING

Each container of product shall be permanently and legibly marked with the product description, quantity, manufacturer's identification, manufacturing date, and lot number.

TABLE 1

Test	Paragraph	Number of specimens
Dimensions	4.3.1	5
Thermal Conductivity	4.3.2	2
Density	4.3.3	3
Tensile Strength	4.3.4	5
Ultimate Elongation	4.3.4	5
Shore OO Hardness	4.3.5	3
Compression Deflection	4.3.6	3
Weight Loss	4.3.8	3
Dielectric Breakdown	4.3.9	5
Volume resistivity	4.3.10	3
Fluid Resistance	4.3.11	3
Flammability	4.3.12	10
Tear Strength	4.3.13	3
Adhesive Tack	4.3.14	2
Oil Bleed	4.3.15	3

Note: for all testing the average value is reported