

SMEX - FAST

ADHESIVE BONDING OF KAPTON THERMOFOIL HEATERS
TO SUBSTRATE SURFACES

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(PFS-HTRPROC)

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PROCEDURE FOR THE ADHESIVE BONDING OF KAPTON HEATERS TO SUBSTRATE SURFACES

1.0 OVERVIEW

Thermofoil heaters or Kapton flexible heaters, laminated between an insulating polymer film, are adhesively bonded to substrate surfaces. Heaters are employed on the FAST spacecraft to provide critically controlled heat for flight hardware designed to operate at specific temperatures. Heaters can be purchased with or without the adhesive already attached to the heater surface. The FAST spacecraft is using heaters without the adhesive already attached; therefore, this procedure will also cover that process

The reference document for this procedure is the "Materials Processing Document", S-313-022.

The heater bonding process on the FAST spacecraft structure and subsystem components shall be performed in the 100K Class clean tent in Building 5, GSFC.

2.0 HEATER BONDING ACCEPTANCE CRITERIA REQUIREMENTS

An adhesively bonded thermofoil heater shall meet the following requirements before it is acceptable for space flight use:

- a. There shall be no cracks, cavities, blisters, tears, burns, or discoloration anywhere on or within the thermofoil heater assembly.
- b. The thermofoil adhesive shall show continuous evidence of adhesive around the periphery of the heater edge.
- c. The thermofoil heater shall not have any internal separation or delamination from the substrate surface.
- d. The thermofoil heater and adjacent surfaces shall exhibit no cuts or scratches due to adhesive bonding process.
- e. There shall be no entrapped air bubbles in any direction between the thermofoil heater adhesive and the substrate surface.
- f. The thermofoil heater adhesive shall be free of any particulate contamination such as dirt, dust, hair, etc.

- g. There shall be no adhesive material on any of the exterior surfaces of the thermofoil heater nor the the adjacent substrate surfaces after completion of the adhesive bonding work
- h. A minimum 1/2 inch to 5/8 inch wide strip of Kapton tape shall overlap the heater periphery and adjacent substrate surface.

3.0 APPLICATION OF TRANSFER ADHESIVE TO THERMOFOIL HEATER

Prepare the thermofoil heater to accept the transfer adhesive as follows:

- a. Wipe both sides of the heater with a lint free cotton cloth and ethyl alcohol.
- b. Gently abrade the heater bonding surface (the side opposite the electrical lead wire attachment) with 400 grit aluminum oxide cloth to roughen and remove the high gloss from the thermofoil surface. Abrade this surface slowly to remove a maximum of 0.0005 inches of Kapton. BE CAREFUL NOT TO ABRAD E THROUGH THE KAPTON TO EXPOSE THE HEATER RESISTANCE ELEMENT. THE EXPOSURE OF THE RESISTANCE ELEMENT IS CAUSE FOR REJECTION.
- c. Clean the abraded surface with lint free cotton wipes and ethyl alcohol. Continue cleaning until no surface contamination is visible and no contamination appears on the cotton cloth after continued wipes.
- d. Use a hand held forced-air dryer to thoroughly dry the surface. Keep the dryer nozzle at least 12 inches from the thermofoil heater. Continue drying for 2 to 3 minutes.
- e. The cleaned heater is ready for adhesive bonding to the transfer adhesive.

Apply the transfer adhesive as follows:

- f. The transfer adhesive sheet will have a protective paper backing on both sides. Before removing either backing, use scissors or a razor blade to cut out a piece of the adhesive so that it is 1 to 2 inches longer on both ends than the length of the heater and 1 inch wider on both sides than the width of the heater.
- g. Using tweezers carefully remove the solid white side of the paper backing.
- h. Tape both ends of the adhesive sheet to a clean surface using Kapton tape.

- i. With one hand, grasp the heater by the electrical lead wire end. With the other hand, position the other end of the heater perpendicular to one end of the adhesive sheet. The heater should be aligned so that it is approximately equal distance from all edges of the adhesive sheet.
- j. Press the end opposite the electrical lead wire to the adhesive using finger pressure while maintaining the heater at approximately a 30 degree angle from horizontal. Press down firmly on the heater while working back and forth and toward the electrical lead wire end. Be careful not to entrap any air bubbles between the adhesive and the heater.
- k. Trim the excess adhesive away from the heater edges using a razor blade and straight edge, being careful not to damage the heater surface.
- l. The heater is now ready for bonding to a substrate surface.

4.0 THERMOFOIL HEATER AND SUBSTRATE PREPARATION & CLEANING PROCESS REQUIREMENTS

Thorough cleaning of the thermofoil heater and the substrate surface is mandatory to ensure there is maximum adhesion between the heater and its contact surfaces.

The substrate surface preparation and cleaning shall be as follows:

- a. Any surface coatings such as paints, iridite etc must be removed before the abrasion of the substrate can begin. The surface area to be cleared shall be 1/16 inch to 1/8 inch larger than the heater on all four sides.
- b. Using Kapton tape mask off the area as stated in step a.
- c. Lightly abrade this area with 320 grit aluminum oxide cloth until bare aluminum surface is exposed. (Use a clean room approved vacuum cleaner to collect debris from the abrasion process.)
- d. Clean the abraded area using a lint free cotton cloth and ethyl alcohol. Continue cleaning until no visible contamination remains on the surface and no contamination appears on the cotton cloth after continued wipes.

- e. Remove the Kapton tape and clean the taped surface area with a lint free cotton cloth and ethyl alcohol. All painted surfaces are to be cleaned by a representative from Code 724.5.
- f. Allow the cleaned area to air dry for 3-5 minutes before applying heater.

The heater surface cleaning shall be as follows:

- g. Prior to cleaning visually inspect the thermofoil heater for compliance to Acceptance Criteria as outlined in Section 2.0 a,b,c and d.
- h. Wipe the front and back surface (with protective backing paper) of the heater with a lint free cotton cloth dampened lightly with ethyl alcohol. The non-stick protective backing paper shall remain attached to the thermofoil heater until ready for final installation.
- i. Allow the heater to air dry for 3-5 minutes before applying to surface.

5.0 BONDING OF HEATERS TO SUBSTRATE SURFACE REQUIREMENTS

In the heater bonding process, the heater is positioned on a selected clean substrate surface, with pressure applied to the heater surface by finger to create good adhesion. The heater must not contain entrapped air bubbles between the heater and the substrate surface.

Each heater bonded to a substrate must have a record of location, manufacture, part number, and serial number.

- a. If more than 12 hours has passed since last cleaning of substrate area and heater, repeat cleaning process before continuing.
- b. Prepare the heater for bonding by placing on a clean surface with the protective backing paper side up.
- c. Determine the proper direction which the heater's electrical cable wires will flow and position heater in that direction so that the heater is centered in the designated area.

- d. Peel back approximately 3/8 inch of the heaters protective backing paper and make light contact with the substrate surface. When the heater is properly aligned apply finger pressure to the exposed adhesive area.
- e. Using tweezers slowly remove the protective backing paper and apply finger pressure back and forth over the heater surface for good adhesive contact with the substrate. Continue removing the paper backing and applying finger pressure until completely removed, being careful not to entrap air bubbles.
- f. Continue to apply finger pressure several more times to ensure good adhesion to the substrate.
- g. To help in preventing the heater from lifting, place Kapton tape over the entire heater overlapping the heater edge and substrate by 1/2 to 5/8 of an inch on all four sides.
- h. Wipe clean all surfaces with lint free cotton cloth and ethyl alcohol. All Painted surfaces are to be cleaned by a representative from Code 724.5.