



# Test Specifications

**Title:** Thermal Resistance

**ASTM Standard:** D5470

**Equipment:** Custom Built Tester

**Test Description:** Laird Technologies uses a modified ASTM D5470 to measure the thermal resistance. The test method involves placing a sample of known area between a hot plate and a cold plate, applying a known amount of heat, and measuring the temperature differential induced by the heat load. The thermal resistance is then calculated from those measurements.

$$R_{th} = \frac{\Delta T \times A}{Q}$$

Laird Technologies has designed automated, PC-controlled, flexible testing devices that allow us to run a variety of test conditions; power levels, pressures, & sample size.

## Test Device

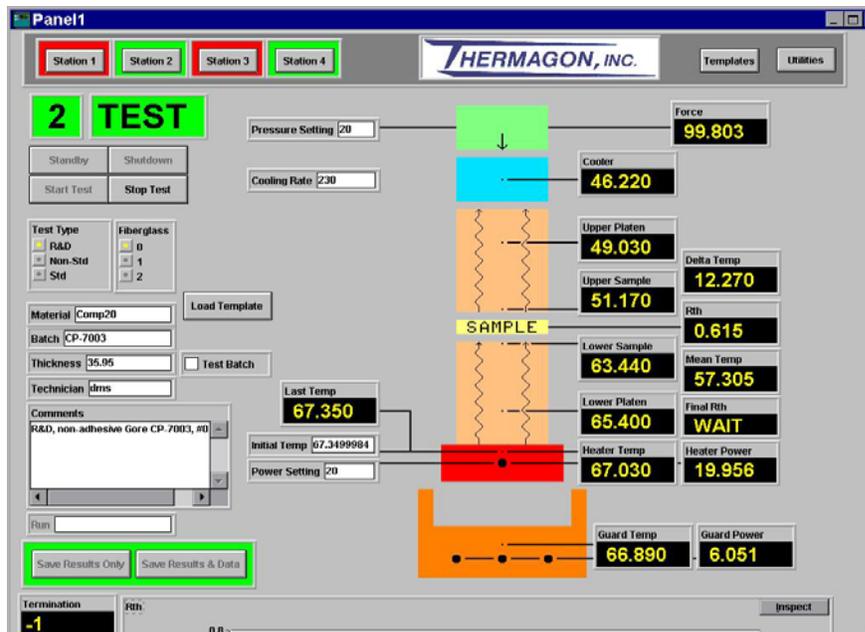
As mentioned above, Laird Technologies uses a modified form of the ASTM D5470 Test Device. Modifications will be noted below. Following are photos of the test fixture:



The test frame is made of steel to reduce the amount of flexing when pressure is applied to the sample. The bottom insulating block is made of furnace insulation (or other suitable material) to minimize conduction from the guard to the frame. The Guard is insulated from the Bottom Platen by a .125"-thick Teflon sheet (not shown). The Guard, Bottom Platen and Top Platen are nickel-coated copper, having very high thermal conductivity and high resistance to physical and chemical wear. The Bottom and Top Platen are each machined to 1 in<sup>2</sup> area, .0005" parallelism and flatness and less than a 16 μin surface finish.



The test system is primarily controlled and monitored by a custom thermal resistance program via an IBM-based PC (see below software “screen shot”). The PC is outfitted with control cards for the power supplies and data acquisition for all thermocouple and voltage inputs. The software also contains input fields for material, lot #, and other material and testing parameters. The pressure is manually set by a regulator and the actual pressure transmitted to the PC via a 0-10VDC pressure transducer.



There are a few keys to accurate measurement using this technique:

- 1) Surface conditions of test platens must be controlled and regularly maintained.
- 2) All heat applied must flow through sample.
- 3) Temperature differential that is measured must be well outside the range of error of the temperature measurement device.
- 4) Pressure must be precisely controlled.
- 5) The end condition of the test must be accurately specified and monitored.

*Surface conditions of test platens must be controlled and regularly maintained.* -- The platens are precisely machined, with the top platen being mounted using a free floating ball joint to ensure even pressure distribution across the sample. The test platens are visually inspected and reworked or replaced at regular intervals.

*All heat applied must flow through sample.* – Insulation is placed between the bottom platen and the guard. Furthermore, the software controls the guard temperature to within  $\pm 0.2$  °C of the platen temperature using a finely tuned control algorithm.

*Temperature differential that is measured must be well outside the range of error of the temperature measurement device.* -- Laird Technologies uses type T thermocouples and controls the test power to ensure that the measured temperature differential is above 5 °C, and preferably above 10 °C, depending on the material being tested.

*Pressure must be precisely controlled.* – The pressure is adjusted with a precision regulator. To verify the variability, the pressure is data-logged throughout the entire test. For description of relationship between pressure, thermal resistance, and thermal conductivity, see the “Reference Materials” section on the web page.

*The end condition of the test must be accurately specified and monitored.* – The test software is programmed to signal an end test condition when the temperature differential varies by no more than 0.2 °C over a 15-minute interval. This ensures that the test has come to equilibrium.

## **Notes:**

Every lot of material we produce is tested for thermal resistance to ensure product quality.

For further details not included in this overview consult the ASTM Test Method.