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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

10 May 1993

Telephone: 508-692-4764

Fax: 617-981-0590

To: Holographers

From: Alan E.E. Rogers

AEEOR

Subject: More information on panel expansion coefficient

1] Measurement using microscope

Figure 1 shows the differential expansion measurements between a small piece of panel and a strip of aluminum (6061) made using the z-axis readout of the measurement microscope. This microscope, which is normally used for recorder development has a z-axis readout precision of 1 micron (the readout being quantized to 1 micron) and is set by adjusting for best focus. The limits of this method (illustrated in Figure 2(a)) are measurement noise and thermal gradients. The result from this method is:

$$\begin{aligned} \text{panel - aluminum expansion coefficient} &= 2.6 \times 10^{-6} / ^\circ\text{C} \\ &= 12\% \text{ excess} \end{aligned}$$

2] Measurement using dial gauge

A 14" section of panel outfitted with a dial gauge (by John Cannon and Mike Gregory) as shown in Figure 2(b). The panel was inserted in hot and cold water (up to the dial gauge) and the differential expansion measured. A differential expansion of 1.0 ± 0.2 mils was measured for a change in temperature from 22 to 50°C. This corresponds to an expansion coefficient which is $10 \pm 2\%$ greater than aluminum. This method is limited by thermal gradients in the end piece (the gauge cannot be submerged). I attempted to correct for these by measuring the differential expansion with the bar clamped at the gauge rather than at the end.

3] Aluminum alloys

The panels and splice plate are made of various aluminum alloys. The variances of expansion coefficient among these alloys is small. For example, according to data sheets 6061 and 6063 are 13.1 and 13.0 ppm/°F respectively.

4] Summary

I am now fairly sure that the panels have a coefficient of thermal expansion of about 10% higher than the aluminum splice plate. Refining the accuracy of the measurement is not easy as most methods have difficulties. Measurements under the microscope are limited by precision while measurements on a large scale are limited by thermal gradients. Also, the panels may be somewhat variable if the epoxy thickness was not well controlled. For the present, I suggest we assume a coefficient 10% higher than aluminum.

Distribution:

J. Ball	J. Crowley	J. Salah
R. Barvainis	A. Haschick	P. Shute
R. Cady	R. Ingalls	A. Whitney
J. Cannon	C. Lonsdale	M. Zarghamee
J. Carter	S. Milner	
P. Charpentier	S. Murray	
B. Corey	A. Rogers	

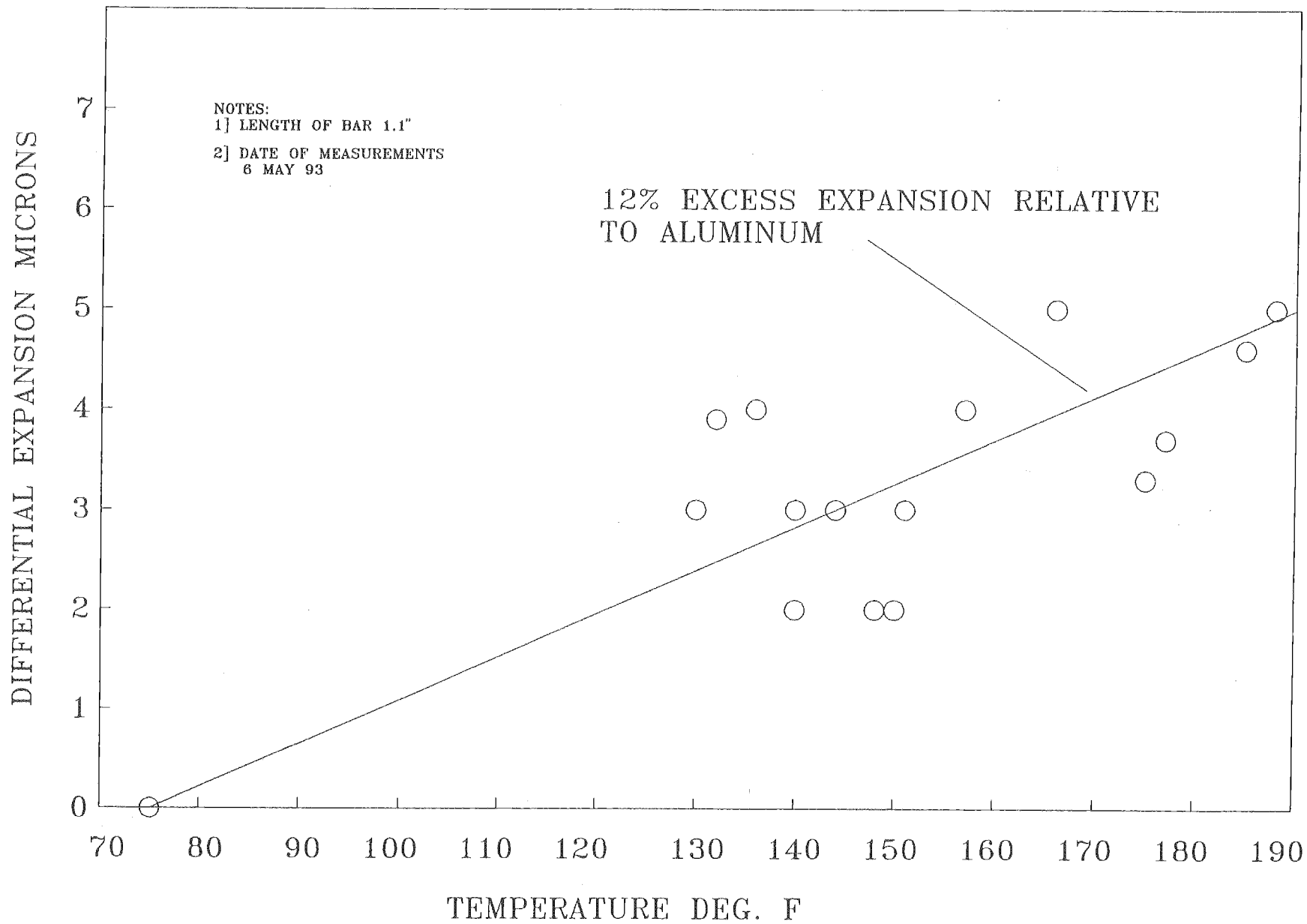


Fig. 1 Haystack surface panel expansion relative to aluminum

Notes: 1] In method (a) insulation was used around the panel sample - with hole for viewing with microscope.

2] In method (b) the panel was submerged in a water bath up to the gauge

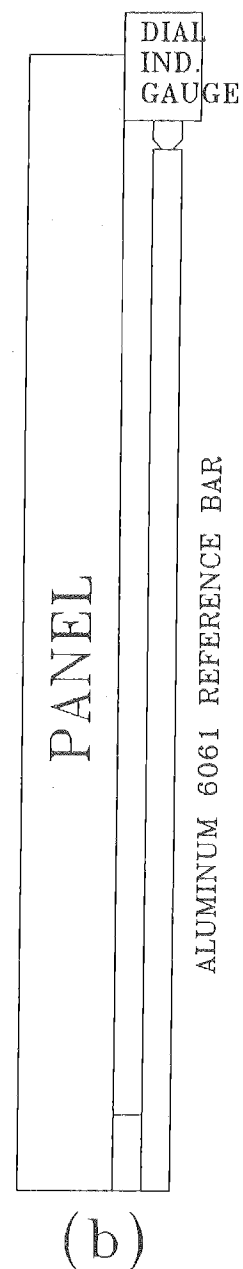
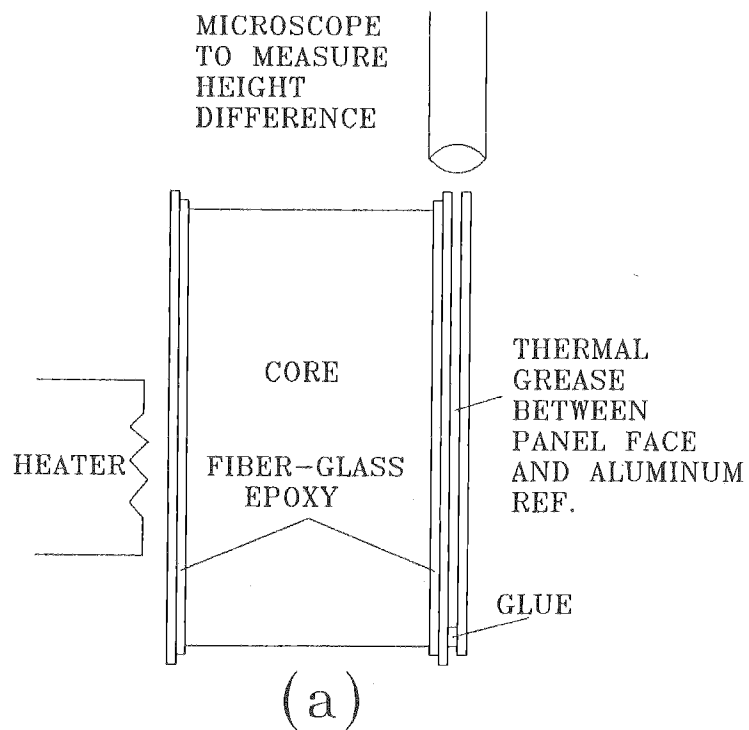


Fig. 2 Methods used to measure differential expansion coefficient