



# **TVH Results on LBNL Mockup #4 (UV Tacks)**

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## **Abstract**

This report summarizes the results from a series of TV Holography tests performed at HYTEC Inc. in March 1999, on the LBNL sector mockup #4 with UV tacks. The intent is to compare the performance of this mockup with the performance of mockup #3, which did not have UV tacks. Results seem to indicate similar thermal distortion levels for the mockup with and without UV tacks. Mockup #4 distortions ranged from 0.08 to 0.07  $\mu\text{m}/^\circ\text{C}$  as compared to 0.05  $\mu\text{m}/^\circ\text{C}$  for mockup #3 under similar test conditions.

## 1. Test Setup

The specimen under examination consists of two sandwiched coupons bonded to a carbon-carbon support bar. LBNL constructed the mockups by sandwiching a carbon-foam core between two carbon-carbon face sheets. The face sheets are attached to both the foam core and the support bar using a 0.002 in. toughened cyanate ester EO11899-2MU film from Bryte Technologies. The larger of the two mockup coupons has silicon bonded to both sides (but offset) using CGL (mockup #3 configuration). UV-curing tacks were then added to the silicon edges. The smaller coupon only has silicon mounted to the front face, Fig. 1. HYTEC mounted three RTDs to the mockup in order to monitor temperatures throughout the TV Holography testing. One RTD is centrally located on the back face of the larger coupon. The remaining two RTDs are centrally located on the front and back faces of the smaller coupon. The carbon-carbon support bar is clamped and cantilevered off a heavy steel support structure. HYTEC also attached a resistive heating element to the front surface of the carbon-carbon bar in order to alter the temperature of the mockup.

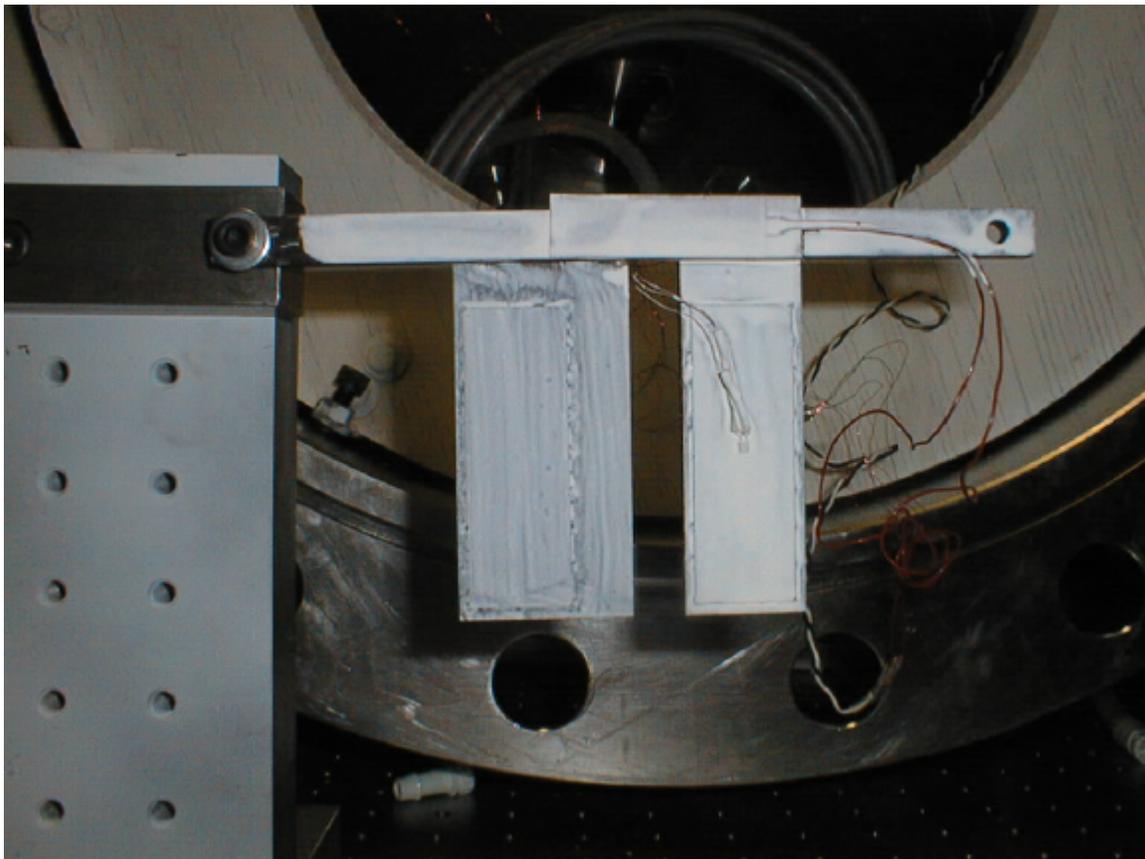
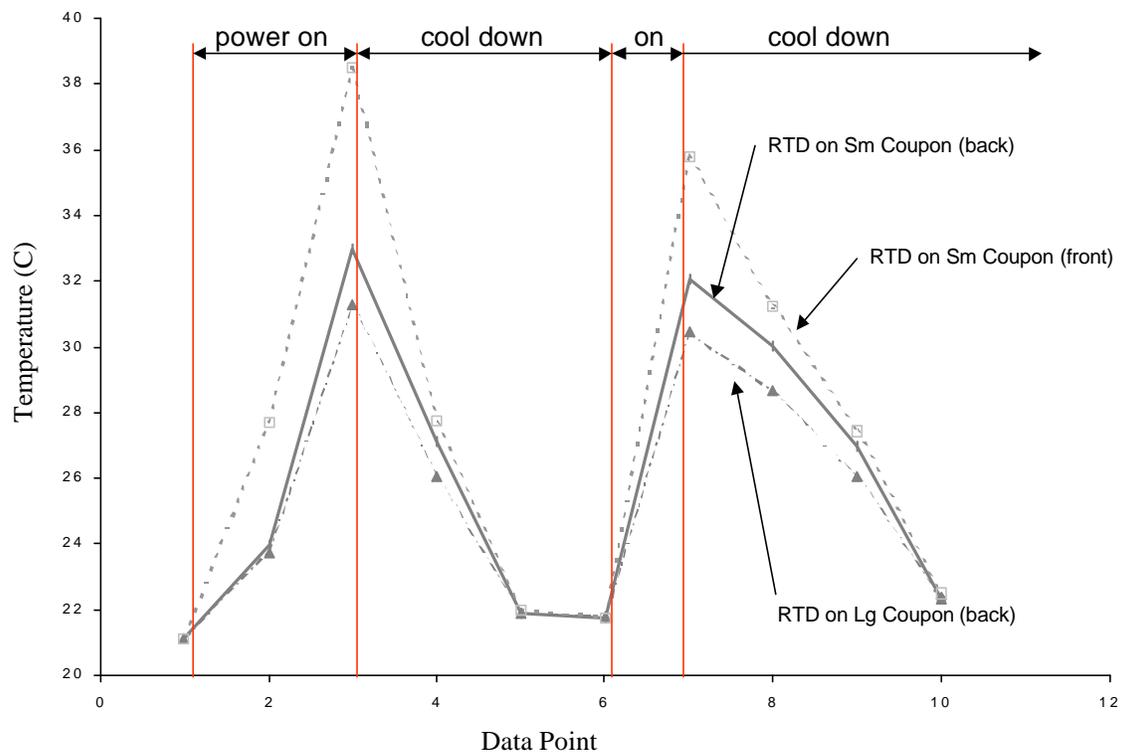


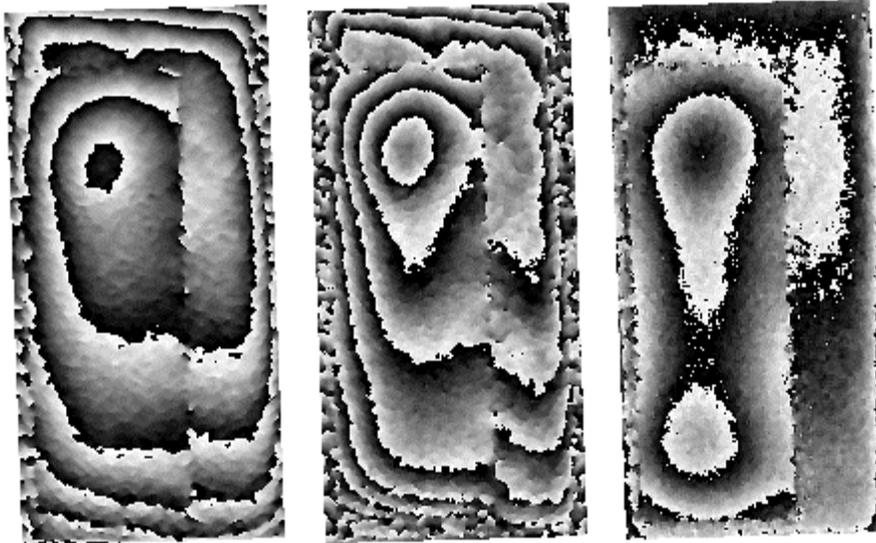
Figure 1. Test configuration for LBNL mockup #4.

## 2. Test Results

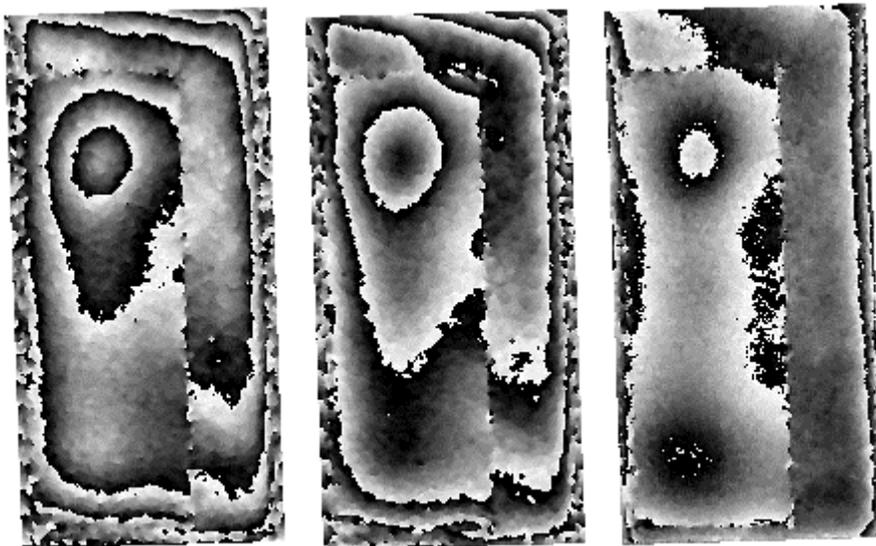
HYTEC raised the mockup temperature by applying power to the resistive heating element located on the front surface of the carbon-carbon support bar, Fig. 1. HYTEC captured RTD and TVH data during both the heating and cooling periods, corresponding to power on and power off of the heater element, Fig. 2. Throughout the heating process and also during a portion of the cooling process, a significant thermal gradient existed through the mockup, Fig. 1. Looking at the TVH results we see larger distortions per °C during these high gradient periods than during the later part of the cooldown events, Figures 3, 4. The difference in results between the first power cycle and the second power cycle may be partly due to more rapid heating during the first power cycle, as evidenced in Fig. 2 by the larger RTD temperature differences for data point #3 as opposed to data point #7.



**Figure 2. RTD responses during power-cycling of the resistive heating element. Large temperature gradients occurred during the heating process, leading to larger mockup distortions over this portion of the test.**

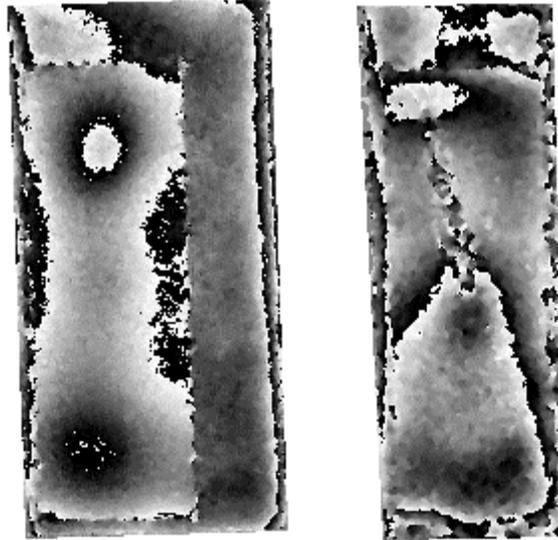


**Figure 3. Distortion fringes for the large mockup coupon during first heating (far left) and cooling (middle and right) cycle. The respective distortions per °C are, from left-to-right: 0.51  $\mu\text{m}/^\circ\text{C}$ , 0.23  $\mu\text{m}/^\circ\text{C}$ , and 0.19  $\mu\text{m}/^\circ\text{C}$ , respectively (rigid body tilt removed).**

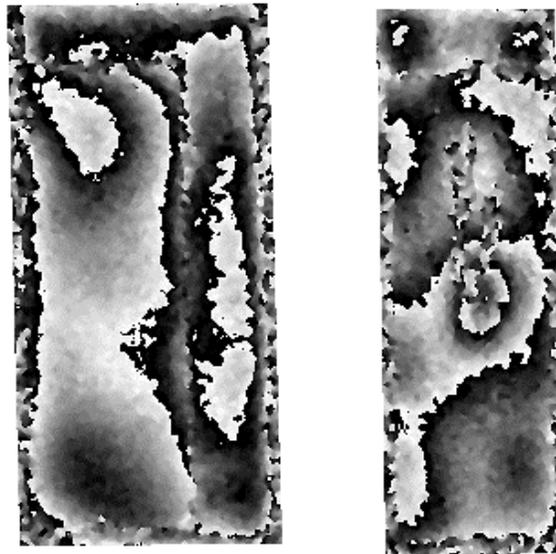


**Figure 4. Distortion fringes for the large mockup coupon during the second heating (far left) and cooling (middle and right) cycle. The respective distortions per °C are, from left-to-right: 0.12  $\mu\text{m}/^\circ\text{C}$ , 0.14  $\mu\text{m}/^\circ\text{C}$ , and 0.08  $\mu\text{m}/^\circ\text{C}$ , respectively (rigid body tilt removed).**

The distortions during the second power cycle are shown in Fig. 5 for both the large and small coupons. The sensitivity coefficients of 0.08 and 0.07  $\mu\text{m}/^\circ\text{C}$  for the large and small coupons, respectively compare with the results of similar tests on mockup #3, Fig. 6.



**Figure 5. Distortion fringes for the large and small coupons corresponding to  $0.08$  and  $0.07 \mu\text{m}/^\circ\text{C}$ , respectively.**



**Figure 6. Distortion fringes for the large and small coupons of mockup #3, corresponding to  $0.05$  and  $0.05 \mu\text{m}/^\circ\text{C}$ , respectively.**