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**MATERIALS ENGINEERING BRANCH  
CODE 541  
LABORATORY REPORT**

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**TO:** 541/Materials Engineering Branch/ M. Viens  
**FROM:** 541/Materials Engineering Branch/M. Sovinski  
**SUBJECT:** Coefficient of Thermal Expansion (CTE) and Glass Transition Temperature ( $T_g$ ) Analysis of RTV-566 Samples (I.D. ZL1193, AA0399, SN-1, SN-2, SN-3, SN-4, SN-5)  
**DATE:** July 15, 2004  
**ANALYSIS #:** MATG 1881 and MATG 1886  
**PROJECT:** GLAST/ACD

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**Samples Submitted:**

Seven samples of RTV-566 silicone were submitted to the Materials Analysis & Technology Group for analysis. The samples were identified as follows: ZL1193; AA0399; SN-1, SN-2, SN-3, SN-4, and SN-5. The ZL1193 and AA0399 samples were from batch #873; the SN-1, SN-2, SN-3, SN-4, and SN-5 samples were all from lot #03021411. Each sample was cured for 7 days at room temperature. This analysis is being done in support of GLAST/ACD.

**Analysis Performed:**

CTE and  $T_g$  analysis was performed using the Thermomechanical Analyzer (TMA) from  $-150^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  with a nitrogen purge and a ramp rate of  $5^{\circ}\text{C}/\text{minute}$ . The samples were cooled to subambient temperatures using liquid nitrogen.

**Results/ Conclusions:**

The project was interested in measuring the coefficient of thermal expansion (CTE) from  $-100^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . Three runs were done for each of the samples. A summary of the CTE data for the RTV-566 samples is provided in Tables 1-7. Plot 1 is an overlay plot of the CTE data for the seven samples. Table 8 provides an overview of historical test data for RTV-566.

As the tables show, the glass transition temperature was consistently at approximately  $-120^{\circ}\text{C}$  for all seven of the samples. The CTE varied from  $343\mu\text{m}/\text{m}^{\circ}\text{C}$  to  $387\mu\text{m}/\text{m}^{\circ}\text{C}$  for the ZL1193, AA0399, SN-1, SN-2, SN-3 and SN-4 samples. The CTE of the SN-5 samples, however, varied widely. Four trials were run of the SN-5 samples due to inconsistencies in the data. The CTE varied from  $378\mu\text{m}/\text{m}^{\circ}\text{C}$  to  $447\mu\text{m}/\text{m}^{\circ}\text{C}$  over the four trials. Given that the other samples from lot #03021411 had a lower CTE and more consistency in the trial data, it can be concluded that sample SN-5 is inherently different from SN-1, SN-2, SN-3, and SN-4. The variation in the SN-5 data may be attributed to, but not limited to, a variation in the method in which the samples were made and a variation in the mix ratio of the components.

**Table 1: Data for ZL1193 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	T <sub>g</sub> ( $^\circ\text{C}$ )
1	343	-119
2	343	-119
3	363	-109
<i>Mean</i>	<i>350</i>	<i>-116</i>
<i>Std. Dev.</i>	<i>11</i>	<i>6</i>

**Table 2: Data for AA0399 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot\text{C}$ )	T <sub>g</sub>
1	343	-121
2	343	-123
3	342	-116
<i>Mean</i>	<i>343</i>	<i>-120</i>
<i>Std. Dev.</i>	<i>1</i>	<i>3</i>

**Table 3: Data for SN-1 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	T <sub>g</sub> ( $^\circ\text{C}$ )
1	374	-124
2	382	-120
3	375	-125
<i>Mean</i>	<i>377</i>	<i>-123</i>
<i>Std. Dev.</i>	<i>4</i>	<i>2</i>

**Table 4: Data for SN-2 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	T <sub>g</sub> ( $^\circ\text{C}$ )
1	383	-126
2	351	-122
3	334	-120
<i>Mean</i>	<i>356</i>	<i>-122</i>
<i>Std. Dev.</i>	<i>25</i>	<i>3</i>

**Table 5: Data for SN-3 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	T <sub>g</sub> ( $^\circ\text{C}$ )
1	386	-124
2	383	-120
3	392	-122
<i>Mean</i>	<i>387</i>	<i>-122</i>
<i>Std. Dev.</i>	<i>4</i>	<i>2</i>

**Table 6: Data for SN-4 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot\text{C}$ )	T <sub>g</sub>
1	349	-113
2	356	-119
3	336	-125
<i>Mean</i>	<i>347</i>	<i>-119</i>
<i>Std. Dev.</i>	<i>10</i>	<i>6</i>

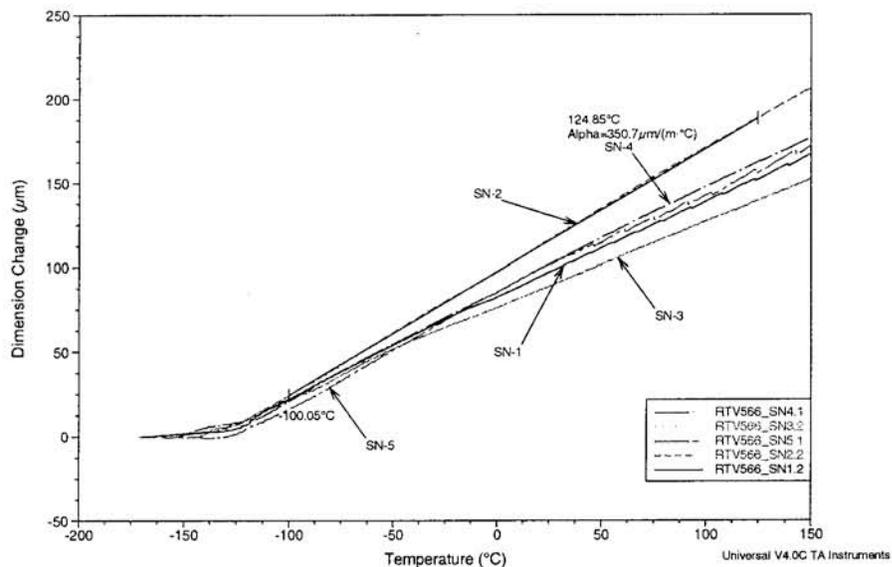
**Table 7: Data for SN-5 Samples**

Trial	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	T <sub>g</sub> ( $^\circ\text{C}$ )
1	428	-117
2	447	-120
3	378	-122
4	379	-118
<i>Mean</i>	<i>408</i>	<i>-119</i>
<i>Std. Dev.</i>	<i>35</i>	<i>2</i>

Table 8: Historical Test Data for RTV-566

Sample	Lot Number	Date Tested	CTE ( $\mu\text{m}/\text{m}\cdot^\circ\text{C}$ )	$T_g$ ( $^\circ\text{C}$ )
RTV-566	-----	1/00	282	-113
RTV-566 + air bubbles	-----	3/04	303	N/A*
CN01704	4031512	3/25/04	312	-122
CN02804	0404283	5/5/04	287	-121
CN03504	873	5/24/04	283	-122
CN04104	931	6/9/04	245	-117

\*The samples analyzed in 3/04 were only tested over the range of  $-60^\circ\text{C}$  to  $70^\circ\text{C}$ ; therefore there is no  $T_g$  data available for this set of samples.



Plot 1. Overlay Plot of RTV-566 Samples

If there are any questions regarding this report, please contact me at x6-1371.

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