LA-II Thermal Coating Summary

Nicholas M. Teti
Swales Aerospace
Beltsville, Maryland 20705

The purpose of this technology demonstration is to validate the thermal performance of an improved white thermal control coating developed by AZ Technology, Inc. The thermal control coating referred to as LA-II, is a low absorptance inorganic white paint. A low absorptance thermal coating will allow radiators to run cooler when exposed to an ultraviolet environment and thereby provide improved performance for space radiators.

Two flight calorimeters shown in Figure 1 were built by Swales Aerospace and flown on the Earth Observing-1 (EO-1) spacecraft. The calorimeters were mounted on a common aluminum bracket that was attached to the EO-1 equipment bay panel, Bay 4 (Carbon-Carbon Radiator panel), as shown in Figure 1. In addition to providing a structural mount to the spacecraft, the bracket allowed the *disc samples* to reside above the radiator surface, thereby increasing the view factor to space and reducing inputs from other spacecraft components.

Using the known NASA/GSFC Z93P White Paint as a baseline for comparison, the data provided from the calorimeters was used to validate the performance of the LA-II low alpha inorganic white paint.

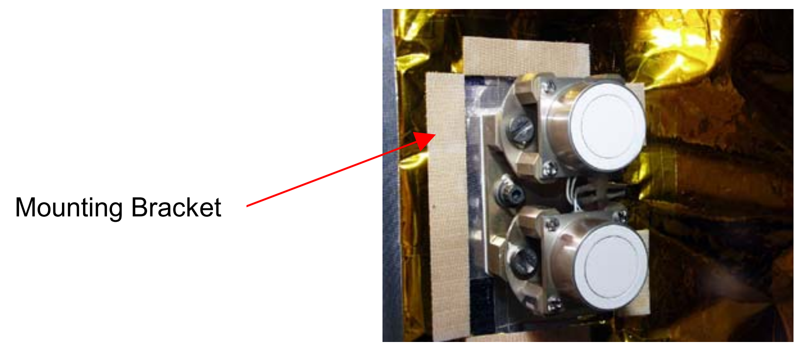

Figure 1. Flight Calorimeters

The calorimeters were calibrated prior to installation on the EO-1 spacecraft. This data defined a starting point for determining the degradation (if any) of the test samples. Figure 2 illustrates the relationship between the calorimeter sensor disk and housing. The external surface of the sensor disc contains the thermal coating, and the internal surface contains the temperature sensor that is intended to record a sample temperature based solely upon the radiative environment and the thermo-optical properties of the sensor disc. Due to the conductive influences between the sensor and housing, the recorded sensor disc temperature is a balance between the environment heat input and the housing temperature. Therefore, both calorimeters (Z93 and LA-II) were calibrated to determine the interface conductance between the calorimeter sensor disc and housing and the relationship between the recorded disc temperatures and the disc theoretical temperatures represented by the test chamber shroud temperature.

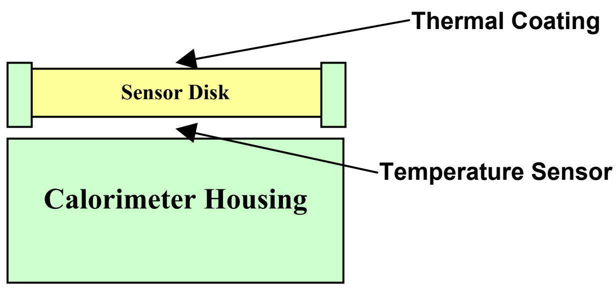

Figure 2. Relationship Between the Calorimeter Sensor Disk and Housing

The calorimeter mounting bracket and calorimeter mass simulators, which were used in the spacecraft thermal balance test, provided temperature data that was used to verify the spacecraft thermal model. Figure 3 shows the excellent thermal model correlation of the Bay 4 equipment panel and EO-1 Hot thermal balance test data. In addition, telemetry data for the calorimeter bracket obtained during the test indicates that a 4-degree Celsius temperature differential existed between the calorimeter bracket and Bay 4 equipment panel.

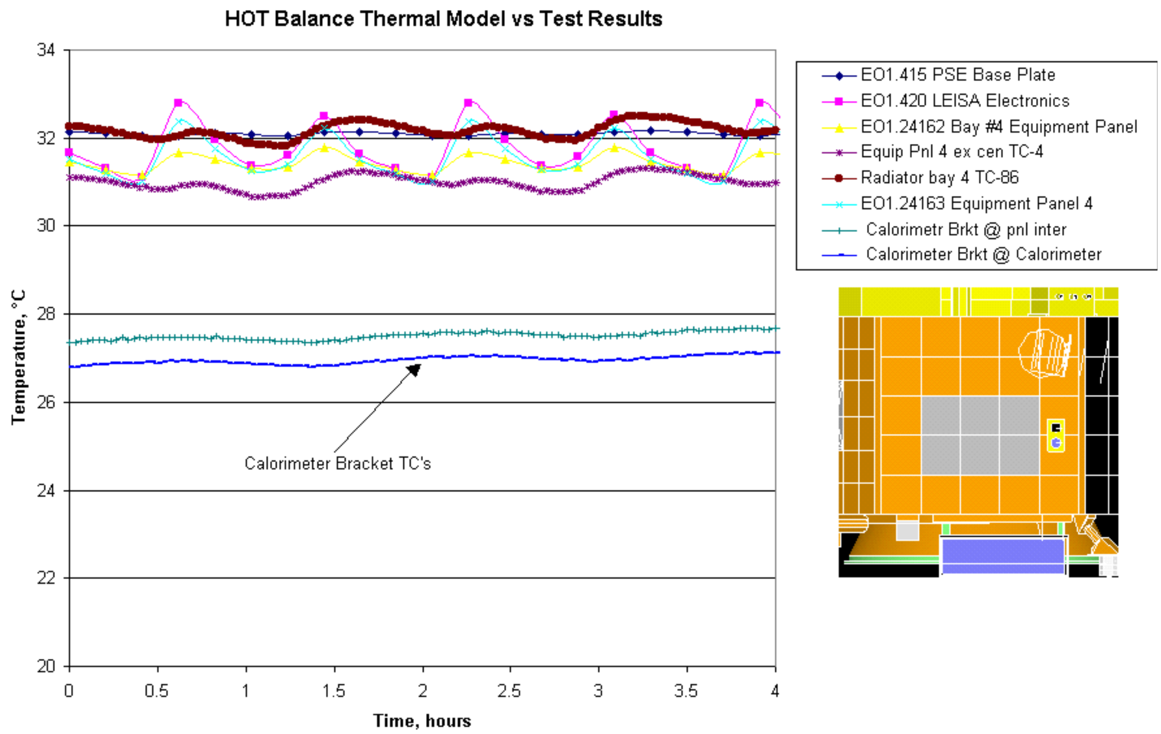

Figure 3. Thermal Model Ground Test Correlation

The summary of data values presented in Table 1 and Figure 4 provides a 12-month temperature comparison for the calorimeter samples. The less than 1°C change in average temperature for this 12-month period indicates that there is no appreciable degradation in the thermal properties for these coatings. However, there is an increase in the maximum temperature of about 1°C for the LA-II thermal coating. The consistent increase in maximum temperatures for the LA-II coating is clearly visible in Figure 4.

Table 1. Calorimeter Sample Flight Data – 12 Months Comparison (°C)

	LA-II (2/21/2001)	Z93 (2/21/2001)			LA-II (2/21/2002)	Z93 (2/21/2002)
	TCALEXP1T	TCALEXP2T	Δ Temp	Δ Temp	TCALEXP1T	TCALEXP2T
	2/21/2001	2/21/2001	LA-II	Z93	02/21/02	02/21/02
Time Weighted Average	-27.46	-25.85	-0.21	-0.54	-27.67	-26.39
Max	-20.24	-16.37	1.11	0.15	-19.13	-16.22
Min	-33.17	-33.17	-0.20	0.00	-33.37	-33.17
Absolute Average	-27.90	-26.33	0.35	0.09	-27.55	-26.24

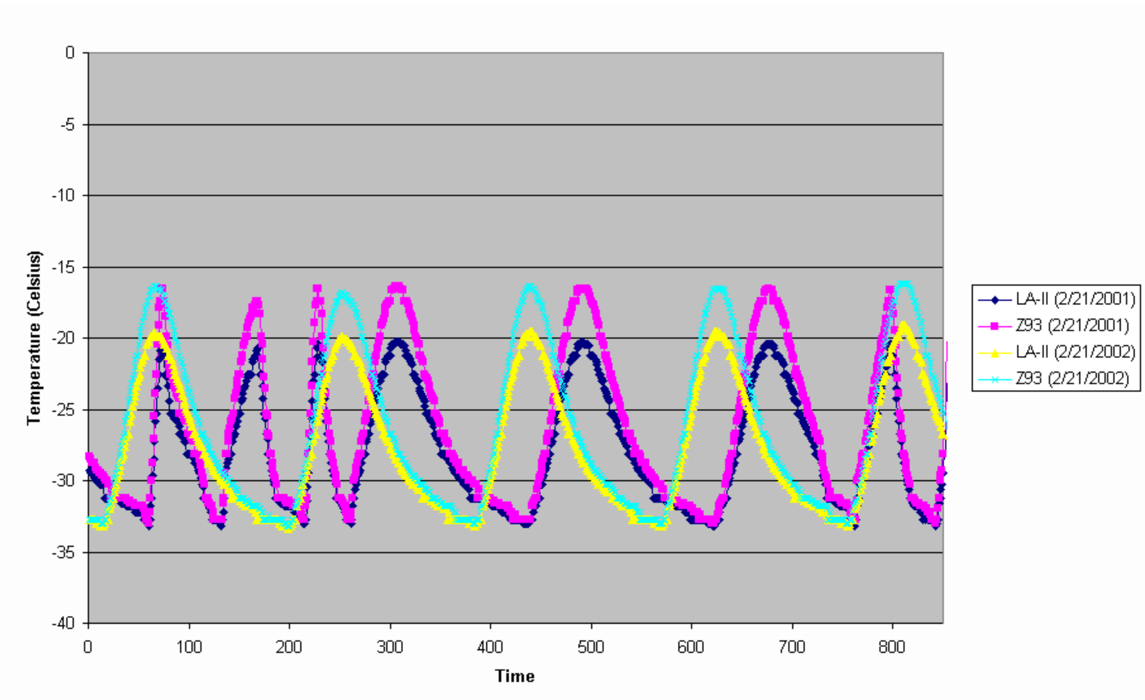

Figure 4. Calorimeter Flight Data 12-Month Comparison

In summary, the transient behavior of both coatings remains constant, indicating a similar response to the on-orbit environment. Excellent thermal model correlation with the beginning of life α/ε values for both coatings indicates that little or no degradation has occurred. However, the increase in maximum temperature values of about 1°C for the LA-II coating over the 12-month period indicates that, although small, there may be some degradation in its solar absorptance. Additional data points are necessary before a conclusive determination of the degradation can be made. In general, however, the LA-II coating still maintains a better α/ε than the Z93 after 12 months as evidenced by the consistently lower maximum temperatures as shown in Table 1 and Figure 4.