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MEASUREMENTS REPORT: THERMAL PROPERTY MEASUREMENTS OF MANNED SPACECRAFT CENTER SPACESUIT MATERIALS

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Signed: F. J. Turnbow
F. J. Turnbow
Test Engineer

Approved: E. E. Luedke
E. E. Luedke
Head, Thermophysics Section

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I. INTRODUCTION

This is the report of normal emittance measurement results for spacesuit materials tested in the TRW Thermophysics Section laboratory. These measurements were taken in response to a verbal request by J. Poradek of the NASA Manned Spacecraft Center. The test specimens were submitted by the customer.

II. METHOD OF MEASUREMENT

Near-normal emittance was determined from reflectance data measured with a Gier Dunkle Infrared Reflectometer (Model DB 100). This instrument is similar to that described by Nelson, et al.[1] Normal emittance (ε_Q) was calculated from the expression

$$\varepsilon_Q = 1 - \rho$$

where ε_Q = normal emittance measured with the Quick Emittance Device

and ρ = reflectance as read directly from the reflectometer scale.

It should be pointed out that these inspection measurements are of limited absolute accuracy (generally ± 0.05), but good relative accuracy (generally ±0.02). Therefore, these measurements, when used in conjunction with accurate absolute methods (e.g., calorimetric methods) are extremely useful for scanning large quantities of similar materials. Care should be exercised when comparing different classes of materials based on the ε_Q measurement only, since the absolute accuracy of the instrument is a strong function of material class; i.e., metals, opaque dielectrics, and semi-transparent materials are all subject to errors of differing magnitude. A complete discussion of the instrument is presented in Reference 1.

III. MEASUREMENT RESULTS

A. Quarter-mil Aluminized Kapton Spacesuit Material

CUSTOMER S/N	TRW LABORATORY S/N	NORMAL EMITTANCE OUTSIDE	NORMAL EMITTANCE INSIDE
A	387-68	0.47_8	0.28_5
B	388-68	0.43_0	0.25_2
C	389-68	0.40_7	0.24_4
D	390-68	0.45_4	0.22_6

B. Helmet Measurement

These measurements were taken at approximately two inch intervals in both a lateral and vertical direction. Lateral measurements were taken, proceeding from the right to the left ear pivot, along a plane bisecting the visor. Vertical measurements were taken along a medial plane from top to bottom.

PART NAME	TRW LABORATORY S/N	NORMAL EMITTANCE (ε_Q) RIGHT-LEFT	TOP-BOTTOM
Sun Visor	411-68	0.55_7 (a)	0.43_8 (a)
		$.49_8$	$.42_8$
		$.43_8$	$.40_8$
		$.42_4$	$.42_3$
		$.42_8$	$.47_4$
		$.43_3$	
		$.48_9$	
Protective Visor	412-68	0.14_7	0.14_3
		$.13_6$	$.13_1$
		$.24_0$	$.18_4$
		$.13_7$	$.42_9$
		$.12_8$	$.86_9$ (b)
		$.34_8$	$.15_3$
			$.12_1$
			$.14_4$

(a) Accuracy of the measurement does not justify a third significant figure. It is shown here, depressed, merely to indicate data trends.

(b) Protective visor bull's-eye area.

IV. REFERENCES

1. Nelson, K. E., Luedke, E. E., and Bevans, J. T., "A Device for the Rapid Measurement of Total Emittance," Journal of Spacecraft and Rockets, pp. 758-760 (May 1966).