To: H. G. Maier
    C. Pel

Date: 15 July 1968

Subject: Thermal Distortion Predictions for
          ULE and Cer-Vit Tracking Mirrors.

From: G. D. Mc Ghee

It is requested that an analysis be performed to predict the response of the ULE and Cer-Vit Tracking Mirrors to "door open" effects of payload orbital operation.

The configuration of the Tracking Mirror is shown in Attachment 1 and the "open door" (sliding mask) view factors are given in Attachment 2.

The end to which this work is directed is assessment of the "open door" performance loss figure agreed to by EK in the latest version of the MOL Program SP/DR (SS-MOL-1B-Integrated, revised 24 May 1968). The environmental conditions related to this requirement are as follows and it it requested that this analysis employ them. These values are contained in the Thermal Interface Specification (Table 2.6-5).

Solar Constant	-	442 BTU/ft^2-hr
Albedo	-	.38
Earth Flux	-	67 BTU/ft^2-hr

The operational assumptions in the new SP/DR should be used, i.e., 6 minutes door open per revolution, nominal 50° north latitute, 6 consecutive revolutions followed with 10 inactive revolutions. The thermal data derived should be sufficient for inputs to structural predictions of the shape of the tracking mirror.

It is requested that this analysis be completed and available by 30 Aug. 1968 to allow adequate Systems Analysis Office use of the data. Additional effort to evaluate the gains associated with masking the opening (Attachment II F 18/28) and providing a tracking door will be required in the future.

GDM:GLH:nt

Attachments:
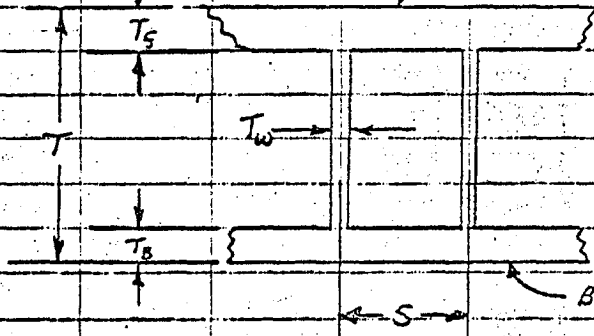1) TM Thermo Mechanical Properties, 1 Page.
2) View Factors, 1 Page.

SECRET DORIAN

Attachment 1

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TM Thermo Mechanical Properties

Configuration

FRONT SURFACE

$\alpha = 0.08 \, ^{+0.02}_{-0.01}$

$\epsilon = 0.03 \, ^{+0.02}_{-0.01}$

BACK SURFACE

$\alpha = 0.14 \, ^{+0.00}_{-0.02}$

$\epsilon = 0.04 \, ^{+0.02}_{-0.01}$

MATERIAL	CER-VIT	ULE
T (inches)	10.0	11.9
T_F (inches)	1.0	0.9
T_B (inches)	0.625	0.5
T_W (inches)	0.312	0.20
S (inches)	5.0	3.0
α - coefficient of expansion (in/in °F)	0.055×10^{-6}	0.027×10^{-6}
k - thermal conductivity (B/hr ft °F)	0.969	0.775
E - Young's modulus (lbs/in²)	13.3×10^{6}	9.7×10^{6}
ν - Poisson's ratio (dimensionless)	0.25	0.172
D - flexural rigidity (in²-lbs)	4.206×10^{8}	5.35×10^{8}
R - TM radius dimension (inches)	35.5	35.5
	N/A	N/A
C_p - specific heat (B/lb-°F)	0.217	0.182
ρ - density (lb/in³)	0.0904	0.080

SECRET DORIAN

SECRET DORIAN

Attachment 2

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View Factors

MASKED OPEN
OPENING DOOR

+Y

X

-Y
EARTH
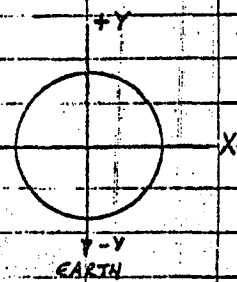
18/28 MASK FULL OPEN $= F_{18/28}$

FULL LC VIEWPORT CUTOUT $= F_{LC}$

X	Y	$F_{18/28}$	F_{LC}
0	0	0.652	0.685
± 12.5	-30.	0.844	0.851
± 12.5	-20.	0.797	0.809
± 12.5	-10.	0.734	0.755
± 12.5	0	0.657	0.690
± 12.5	10.	0.566	0.614
± 12.5	30.	0.376	0.443
± 24.5	-20.	0.811	0.821
± 24.5	-10.	0.750	0.770
± 24.5	0	0.670	0.707
± 24.5	20	0.465	0.541
± 34.5	0	0.684	0.729
0	10	0.564	0.608
0	34	0.344	0.408
0	-10	0.729	0.751
0	-20	0.792	0.805
0	-30	0.839	0.848
0	-34	0.854	0.862