1992

NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

MARSHALL SPACE FLIGHT CENTER
THE UNIVERSITY OF ALABAMA

A STUDY OF THE LUTE METERING STRUCTURE

Prepared By:	James W. Foreman
Academic Rank:	Assistant Professor
Institution and Department	Alabama A & M University Civil Engineering Department
NASA/MSFC	
Office:	Space Science and Applications
Division:	Program Development Group
Branch:	Payload and Orbital Systems
MSFC Colleague(s)	Max Nein Robert Porter

C-2

Two Metering Structure configurations were investigated. The first case was the traditional style metering structure which is larger than the outside diameter of the primary mirror. The second case investigated was the center support concept in which the outside diameter of the structure is less than the inside diameter of the primary mirror. Beryllium was used as the baseline material for this study. Four other materials were considered as candidates for the metering structure. These materials are:

Graphite Epoxy

Aluminum

Titanium

Invar

The loading conditions used for this study were estimated to be:

Quasi Static:	6.0 G (all three directions)
Random Vibration:	30.0 G (applied 1 axis at a time)

Taking advantage of symmetry, it was necessary to apply the lateral loading to only one axis. These loads were applied to both concepts and to all material configurations. The loadings as described above were based on the best available information and is felt to be adequate for this study since it was consistently used for all configurations. A load factor 2.00 was applied to both quasi static and random vibration loads. The allowable stresses are conservatively based yield strenth of the material, except for the struts which are controlled by elastic stability. The stresses determined from each individual loading direction were conservatively combined by the absolute sum method.

A frequency determination was made treating the secondary mirror and metering structure as a two degree -of-freedom system.

Conclusions and Recommendations:

The results of the study as summarized in Table I indicate that the more favorable materials using weight as the criterion are beryllium and graphite epoxy. Either of these materials give a stiff lightweight structure. Graphite epoxy appears to be more favorable because of its low coefficient of thermal expansion. It is recommended that a study be made to determine the advantages and disadvantages of these two materials. Also, further study is needed to determine if there are other candidate materials which might be favored over beryllium or graphite epoxy. Additionally, a more comprehensive dynamic analysis and a stability analysis is recommended.

TABLE I
SUMMARY OF RESULTS
ACCEL/THERM LOADS*

MATERIAL	WEIGHT (LBS)	FREQUENCY (HZ)	DISPLACEMENT ACCEL/THERM* (INCHES/DEG)		
			X	Z	ROT(Y)
BERYLLIUM	6.93	177	.0183 .00087	.0002 .00014	.0067 .0015
GRAPHITE EPOXY	6.67	167	.0198 -	.0002 -	.0072 -
ALUMINUM	26.52	68	.100 .0021	.001 .00035	.037 .0036
TITANIUM	40.0	77	.0815 .00172	.0092 .0029	.0026 .0030
INVAR	80.0	71	.091 -	.001 -	.036 -

*1 DEGREE K DIFFERENTIAL ON 1/3 OF STRUCTURE