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PHOTOELASTIC STUDY

ROVER FLANGE AND CLAMP

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Distribution:

W. T. Geyer
J. E. Fisher ✓
H. L. Brammer
J. L. Mitchell
L. P. Martin
M. A. Fischer
E. G. Fleck
R. N. Curry
M. Wander
File

Prepared by:

R. N. Curry
R. N. Curry
Associate Test Engineer

Eldon G. Fleck
E. G. Fleck
Test Engineer

Marvin Wander
M. Wander
Associate Test Engineer

Approved by:

J. E. Fisher
J. E. Fisher, Manager
Development and Test

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PHOTOELASTIC STUDY
ROVER FLANGE AND CLAMP

1. INTRODUCTION

This two-dimensional photoelastic study was performed by Experimental Mechanics at the request of the Structural Analysis Group, Engineering Systems Analysis, via Development and Test Work Order No. 2-0238. The program was undertaken as a means of determining what effect a notch at the base of the flanges had on the strength of these parts. These notches were proposed as a means of clamping the shield and reflectors.

2. OBJECTIVE

The objective of this test was to determine the amount of increased stress in the flange and clamp at the required locations shown in Exhibit 1, due to various-sized notches cut in the base of the flanges. Exhibits 4 through 10 illustrate the stress distribution in each of the aforementioned cases caused by identical loadings.

3. CONCLUSIONS

The conclusion reached on the basis of this test is that the notches, in each of the five cases, had no significant effect on the stress magnitudes or distribution. Evidence of this is illustrated in Exhibit 9 and Exhibit 10 which are enlargements of the two extreme cases in the area of Point 1.

4. DISCUSSION

The full-scale model was constructed from three sheets of CR-39 plastic. A calibration bar was made from each sheet and fringe constants were evaluated accordingly. Very little machining stresses were induced as illustrated by Exhibit 3.

The models were placed in a standard straining frame and loaded in tension as shown in Exhibit 1. An effort was made to place the centers of the loading holes on the centerline of the clamp-flange bearing surfaces, but an inspection indicated that these holes were .06 inches off center. This induced a small moment which caused the flanges to rotate until equilibrium was reached. The effect of the misalignment was investigated and found to be negligible.

The tensile force used was 50.7 lbs. in all cases. This force was selected because it was light enough to stay within the range of optical linearity and heavy enough to minimize frictional effects.

The time lapse for photographing the model was the same for all cases, and was very short due to the use of a fast film. For this reason, optical creep was not a problem.

Difficulty was experienced in trying to maintain the same gap between the clamp and flange in all five cases. The gap ranged from 0.100" to 0.150", but showed no significant effect on the stress distribution.

The Tardy Method was used to determine the partial fringe orders

at Points 2, 3, 5, 6, 9 and 10. Fringe orders were approximated at Points 1, 4, 7 and 8 with the use of a Zeiss 25X microscope, to the nearest tenth of a fringe.

The accuracy in determining the fringe order was hampered due to a misalignment in the new polariscope. Since then, the instrument has been accurately aligned for future work.

Next, the model stresses were calculated. The basic equation used to compute stresses in the clamp and flange was:

$$p - q = \frac{nf}{t}$$

Maximum and minimum principal stresses are denoted by p and q respectively. Since all ten locations at which stresses were desired are on a free boundary of the model, the minimum principal stress, q, is always zero and can be eliminated from the equation. The material fringe constant (f), for tension and compression, was determined for each sheet of plastic from which the models were cut and used accordingly. The thickness (t) was measured at each point and was used in computing the stress at that point. These data are shown in Exhibit 2. The ratios of the stresses in Case 1 to Cases 2, 3, 4 and 5 were also computed at the ten points of interest, and are tabulated in Exhibit 2.

ROVER FLANGE-CLAMP STUDY

DATA SHEET

Maximum Stress

<u>Location Points</u>	<u>Case 1 (psi)</u>	<u>Case 2 (psi)</u>	<u>Case 3 (psi)</u>	<u>Case 4 (psi)</u>	<u>Case 5 (psi)</u>
1	2528 Tens	2308 Tens	2088 Tens	2584 Tens	2235 Tens
2	365 Comp	365 Comp	402 Comp	378 Comp	402 Comp
3	-	220 Comp	220 Comp	251 Comp	220 Comp
4	2307 Tens	2268 Tens	1922 Tens	2398 Tens	2192 Tens
5	384 Comp	384 Comp	423 Comp	377 Comp	423 Comp
6	-	231 Comp	231 Comp	252 Comp	231 Comp
7	2578 Tens	2328 Tens	2149 Tens	2631 Tens	2149 Tens
8	2368 Tens	2050 Tens	2121 Tens	2602 Tens	2015 Tens
9	535 Comp	535 Comp	535 Comp	608 Comp	535 Comp
10	464 Comp	464 Comp	464 Comp	522 Comp	464 Comp

RATIO OF CASE 1 TO CASES 2 THROUGH 5

<u>Location Points</u>	<u>Case 2 Case 1</u>	<u>Case 3 Case 1</u>	<u>Case 4 Case 1</u>	<u>Case 5 Case 1</u>
1	0.9	0.8	1.0	0.9
2	1.0	1.1	1.0	1.1
3	--	--	--	--
4	1.0	0.8	1.0	1.0
5	1.0	1.1	1.0	1.1
6	--	--	--	--
7	0.9	0.8	1.0	0.8
8	0.9	0.9	1.1	0.8
9	1.0	1.0	1.0	1.0
10	1.0	1.0	1.0	1.0

EXHIBIT 2

ZERO READING

EXHIBIT 3

CASE 1

EXHIBIT 4

CASE 2
EXHIBIT 5

CASE 3
EXHIBIT 6

CASE 4
EXHIBIT 7

CASE 5
EXHIBIT 8

CASE 1 POINT 1
EXHIBIT 9

CASE 5 POINT 1
EXHIBIT 10