[redacted] UNCLASSIFIED

0663

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1st Review Date: 8/20/98	Determination (Circle Numbers):
Authority: ADD	1 Classification Retained
Name: R B Crane	2 Classification Changed to: U
2nd Review Date: 9/10/98	3 Contains No DOE Classified Information
Authority: ADD	4 Coordinate With:
Name: W Layne	5 Contains UCAI?
	6 Comments: OK for Open net

OCT 1 9 1955

Case No. 661.00
Ref. Sym: 1612 (212)
Project No. TM-287
XW-31, 3-2

MR. A. W. FITE - 1333

Attn: Mr. P. R. Owens - 1333-2

Re: Static Test of XW-31

RECEIVED
OCT 20 1955
R & D FILES

Summary of Results

Static loads simulating Nike thrust and maneuvering loads were applied to the XW-31. In the first test the unit withstood a tensile longitudinal load of 150 percent design limit load (17,100 pounds) combined with a lateral load of 150 percent design limit load (15,400 pounds). In the second test the unit withstood a compressive longitudinal load of 150 percent design limit load (57,400 pounds) combined with a lateral load of 15,400 pounds. No indication of excessively high stress was observed in either test. All of the above loads were design ultimate.

The unit was then subjected to a longitudinal tensile load to failure. The bolts connecting the forward Nike case section to the load plate failed at 328 percent design limit load (56,000 pounds). No other indication of damage was observed except for damage to the Nike structure where the bolts failed.

Object of Test

The object of this test was to determine the structural adequacy of the XW-31 and the Nike case sections, paying particular attention to the wire-filled spun groove and clamp ring joints, when subjected to design ultimate Nike thrust and maneuvering loads.

Reason for Test

The test was requested in a Work Order Authorization from Mr. S. A Moore, 1326, to Mr. P. H. Adams, 1612, dated March 23, 1955. Due to Superintendency 1300 reorganization, Division 1333 has assumed responsibility for this component.

Summary of Past Tests

No previous tests have been performed on this object by Organization 1612.

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO: U	AUTHORITY: W C. Layne
Emelda Selph 9/28/98	
PERSON CHANGING MARKING & DATE	RECORD ID: 98SN3918
W C Layne 9/28/98	
PERSON VERIFYING MARKING & DATE	DATED: 9/10/98

CDL No.	
ACCOUNTABILITY CARD	
FILE No.	XW-31 3-2

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Setup for Test

I. Figures 1 through 3 are photographs depicting test setup for the tension tests. The eyebolt shown at the center of the load plate in Fig. 3 was for the purpose of applying the axial tensile load in the destruction test. Figure 4 is a photograph depicting test setup for the compression test.

II. The following components were tested:

1. One XW-31, Dwg. No. SK(1326)43320.

2. Two Nike case sections, Dwg. No. 8162809.

III. The following test equipment was used:

1. Two calibrated pull rods, 3/4 inch diameter, Nos. 13 and 15, sensitivity 5.45 pounds per microinch per inch.

2. One calibrated pull rod, 2 inch diameter, No. 1, sensitivity 36.7 pounds per microinch per inch.

3. Two Simplex hydraulic pumps, capacity 9000 psi.

4. Two Simplex hydraulic rams, capacity 60 tons.

5. One Blackhawk hydraulic ram, capacity 50 tons.

6. Three Baldwin strain indicators, type L, Serial Nos. J-59252, J-59191, and 199375.

7. One Baldwin load cell No. 1114, capacity 50,000 pounds, calibration 12.4 pounds per microinch per inch.

8. Two switching and balancing boxes, 40 channels each.

IV. The following instrumentation was used in the test:

1. Fourteen Baldwin SR-4 rosettes, type AR-7-2, resistance 120 ohms, gage factor 1.95, auxiliary factor 1/150.

2. Stresscoat No. 1207.

3. Four Starrett dial indicators, range 1 inch, division 0.001 inch.

Figures 5 and 6 are photographs showing location of the rosettes. Figure 7 is a sketch identifying and orienting the rosettes. Figure 8 is a photograph showing location and orientation of the dial indicators.

Procedure

The test request specified longitudinal loads colinear with the longitudinal axis and lateral loads through the cg. As it was not feasible to locate the line of action of the lateral load through the cg, the lateral load was moved to the front load plate and the ensuing moment of translation was compensated for by locating the longitudinal load axis a proportional distance from the longitudinal axis of the weapon. Figures 9 and 10 are sketches showing actual and equivalent loadings for the compression and tension tests, respectively. Figure 11 is a sketch showing loading condition for the destruction test. Details of procedure unique to each test are as follows:

Test No. 1 — (Design ultimate tensile and side loads) The specimen was mounted as shown in Fig. 1 and loaded as shown in Fig. 10. The specimen was Stresscoated and dial indicators were mounted as shown in Fig. 8. The dial indicators measured movement between the components joined by the clamp ring. Loads were applied in increments listed in Table I and the dial indicators read and recorded at each increment. The load was relaxed and the Stresscoat patterns marked between increments of load.

Test No. 2 — (Design ultimate compressive and side loads) The specimen was mounted as shown in Fig. 1 and loaded as shown in Figs. 3 and 9. Loads were applied in increments listed in Table II. The loads were relaxed and Stresscoat patterns marked between increments.

Test No. 3 — (Design ultimate tensile and side loads) The specimen was instrumented with strain gages as shown in Figs. 5 and 6. Mounting and loading arrangements were similar to Test No. 1. Loads were applied in increments listed in Table III and values of strain were read and recorded for each increment.

Test No. 4 — (Design ultimate compressive and side loads) The instrumentation used in Test No. 3 was also used in this test. Mounting and loading arrangements were identical to those used in Test No. 2. The loads were applied in increments listed in Table IV and strains were read and recorded at each increment.

Test No. 5 -- (Tensile loads to destruction) An axial tensile load was applied through the eyebolt shown in Fig. 3. Figure 11 is a sketch showing loading conditions. Mounting arrangement was identical to the previous tests. Loads were applied in increments listed in Table V and the dial indicators were read and recorded at each increment to 30,000 pounds. At this point the dial indicators were removed and the test continued to destruction.

Results

No excessively high stresses were observed in any test. The bolted, wire-filled groove and clamp-ring joints withstood (combined longitudinal and lateral) loads of 150 percent design limit load and a longitudinal load only of 328 percent design limit load without apparent damage. Results obtained for each test are as described below:

Tests Nos. 1 and 3 (combined design ultimate tensile and side loads). Figures 12 through 15 are photographs showing Stresscoat patterns. The numbered patterns are applicable to this test. Table I lists loads corresponding to the numbered patterns and the dial indicator readings. Table III lists the tensile load-strain data. Table VI lists stresses computed from the data in Table III for maximum load.

Tests Nos. 2 and 4 (Design ultimate compressive and side loads). Figures 12 through 15 are photographs showing the Stresscoat crack patterns. The lettered patterns apply to this test. The loads corresponding to the lettered patterns are listed in Table II. It should be noted that the patterns were obtained during application of load and are therefore indicative of tensile stresses (compressive stresses would cause cracks during relaxation of load).

The compressive load-strain data are listed in Table IV. The maximum stresses computed from the data in Table IV are listed in Table VI.

Test No. 5 (Load to destruction by application of axial tensile load only).

The front load plate developed excessive deflections at loads above 50,000 pounds. This put the bolts, connecting the load plate to the specimen, in bending and they failed at a maximum load of 56,000 pounds. There was no apparent damage to any component or to the bolted, wire-filled groove, or clamp-ring connections.

Conclusions and Recommendations

All components and connections are capable of carrying design ultimate load. One clamp ring, however, permitted a movement between joined parts of 0.022 inch at ultimate load. The method of closing the clamp rings is slow, difficult, and difficult to obtain uniformity of tightness. It was necessary to remove the clamp ring to insert the bolts connecting the mounting ring to the Nike case section.

The Nike case section exhibited tangential tensile stresses under compressive load. This was probably due to the mounting casting acting as a wedge and expanding the diameter of the skin. The tensile stresses in the mounting castings were probably due to bending as the loads transmitted from the XW-31 were on a different diameter than the loads transmitted through the Nike skin.

Robert I. Butler
ROBERT I. BUTLER - 1612-2

Approved by: Paul E. Adams
PAUL E. ADAMS - 1612

RIB:1612-2:as

Copy to:
T. B. Morse, 1610
J. P. Wamser, 1282
R. E. Fisher, 1621
C. L. Gomel, 5523
R. K. Smeltzer, 1922-2 [redacted]
F. C. Hale, 1922-3

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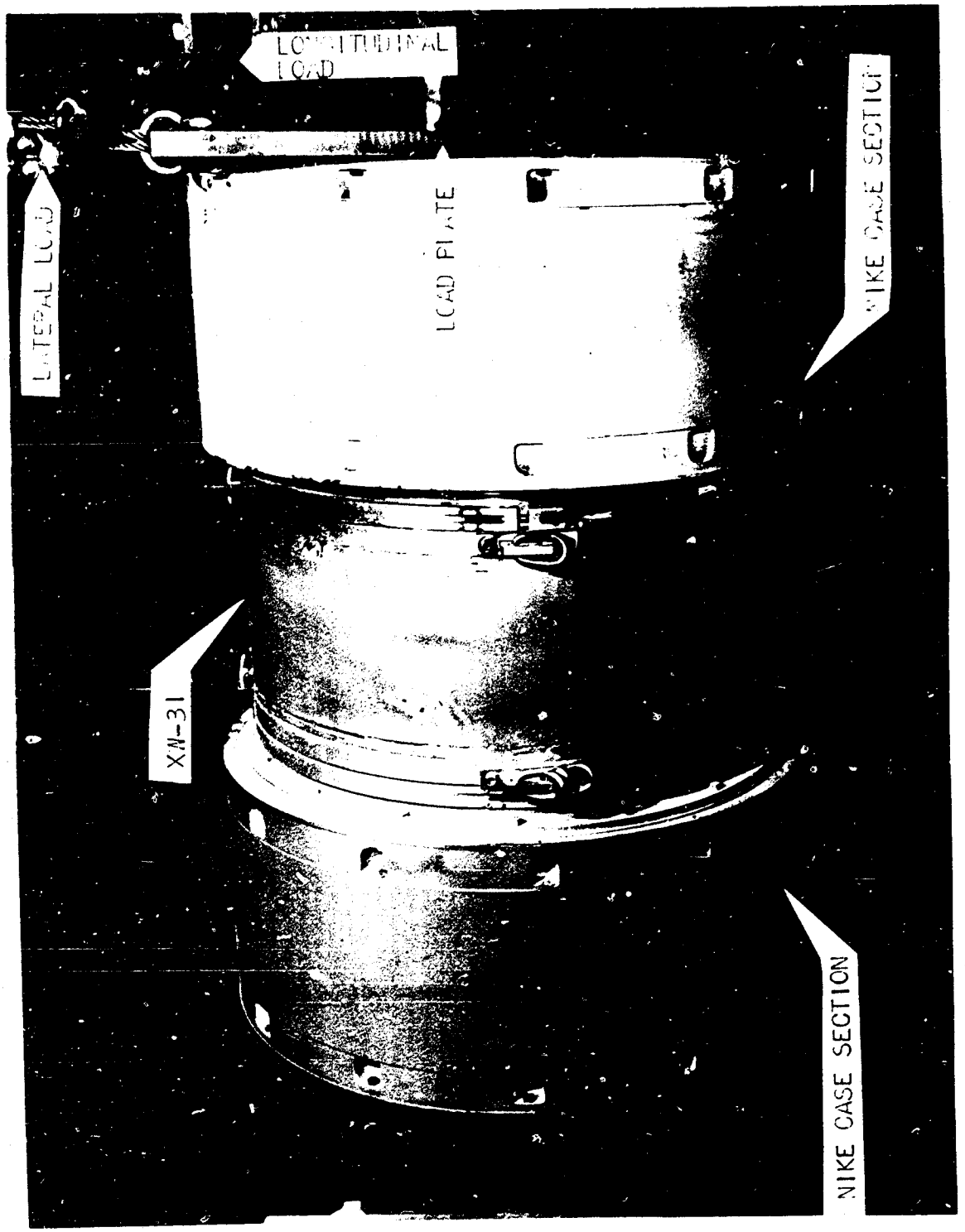

FIG. 1--TEST SERIES FOR STATIC PART OF XW-31--TEST NO. 1

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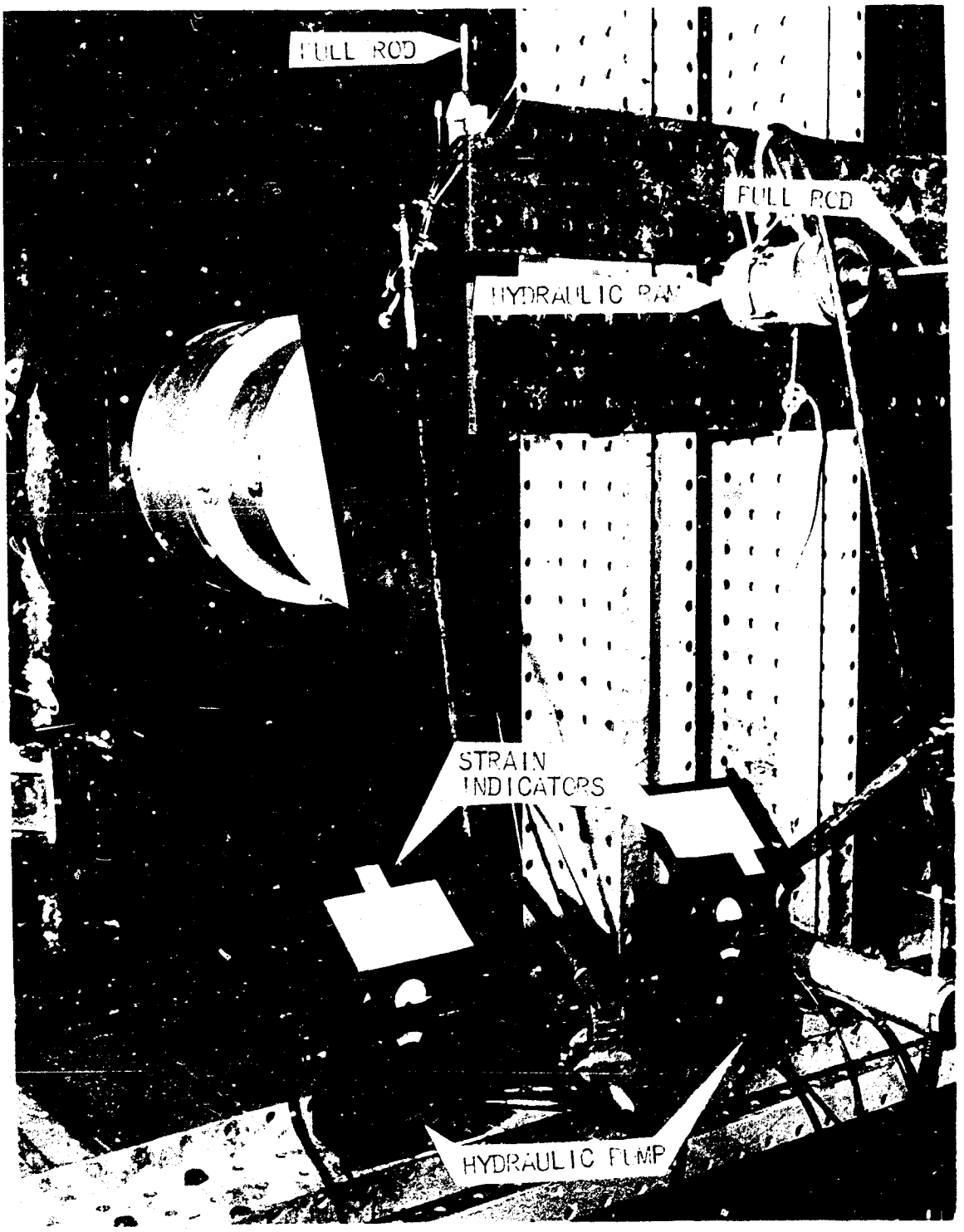

FIG. 2--TEST SETUP FOR STATIC TEST OF XW-31--TEST NO. 1

D# 65762

REF. SYM: 1612 (212)
PROJECT NO. TT-297

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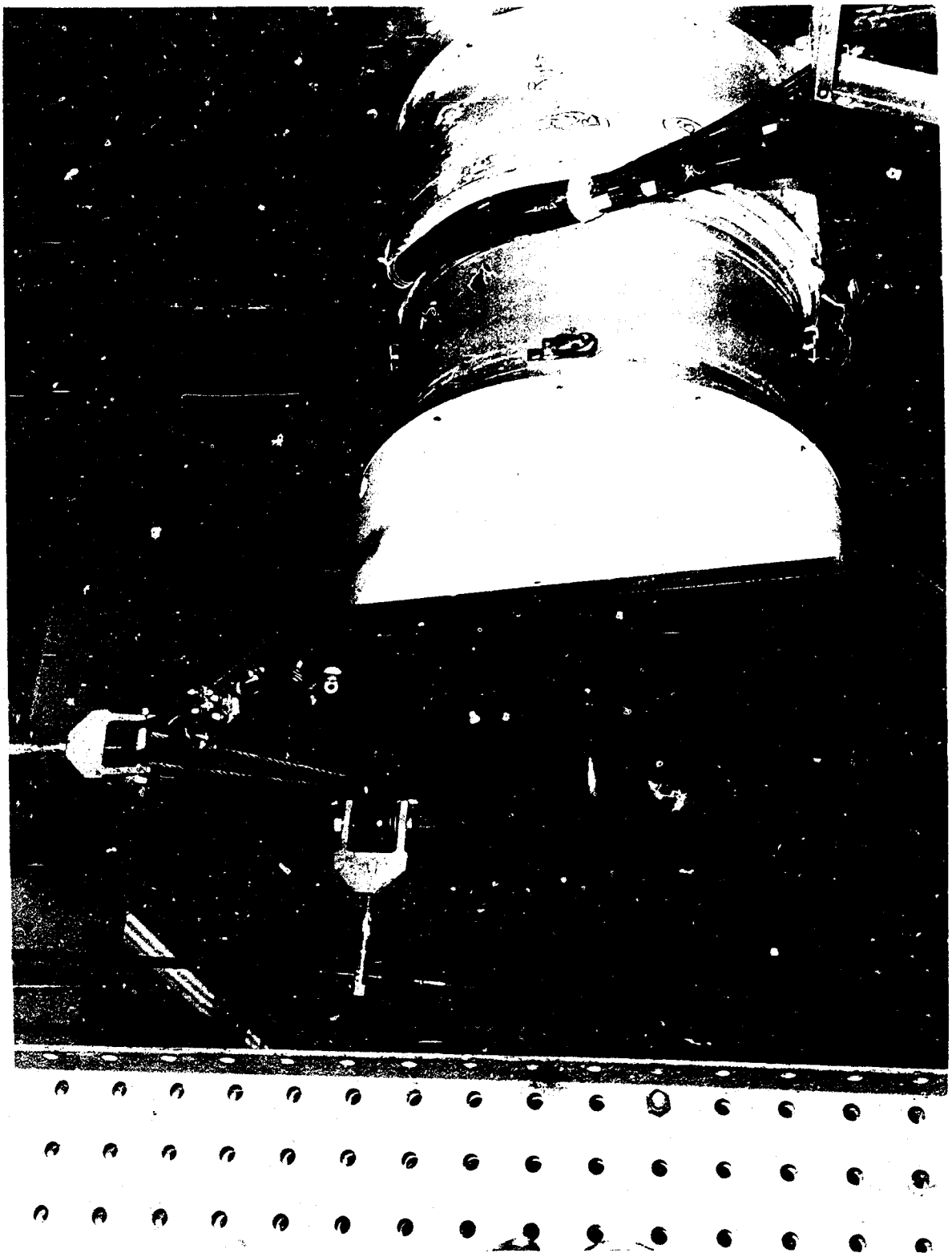

FIG. 3--TEST SETUP FOR STATIC TEST OF XV-3I--TEST NO. 3

REF. SYS: 1612 (212)
PROJECT NO. TR-287

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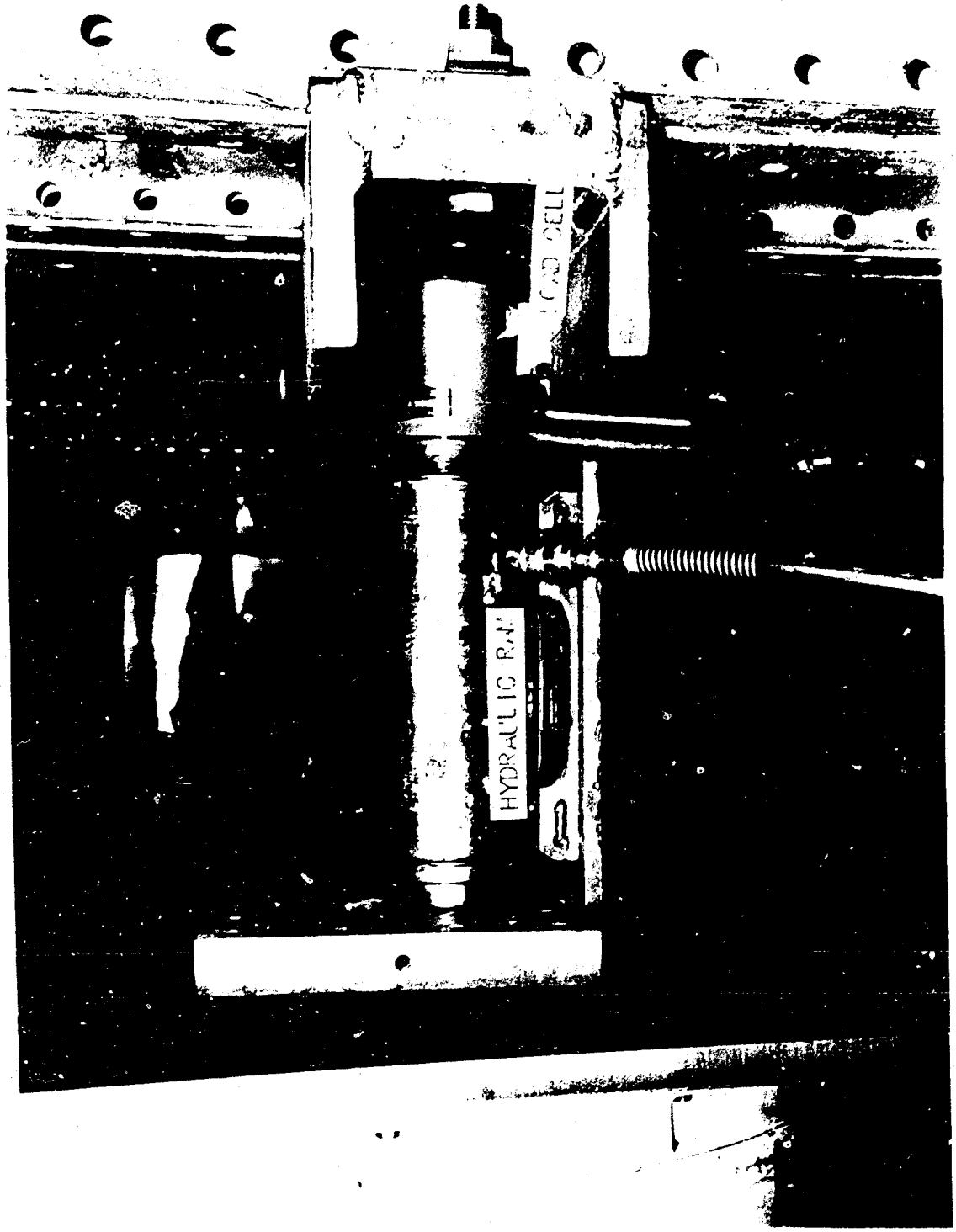

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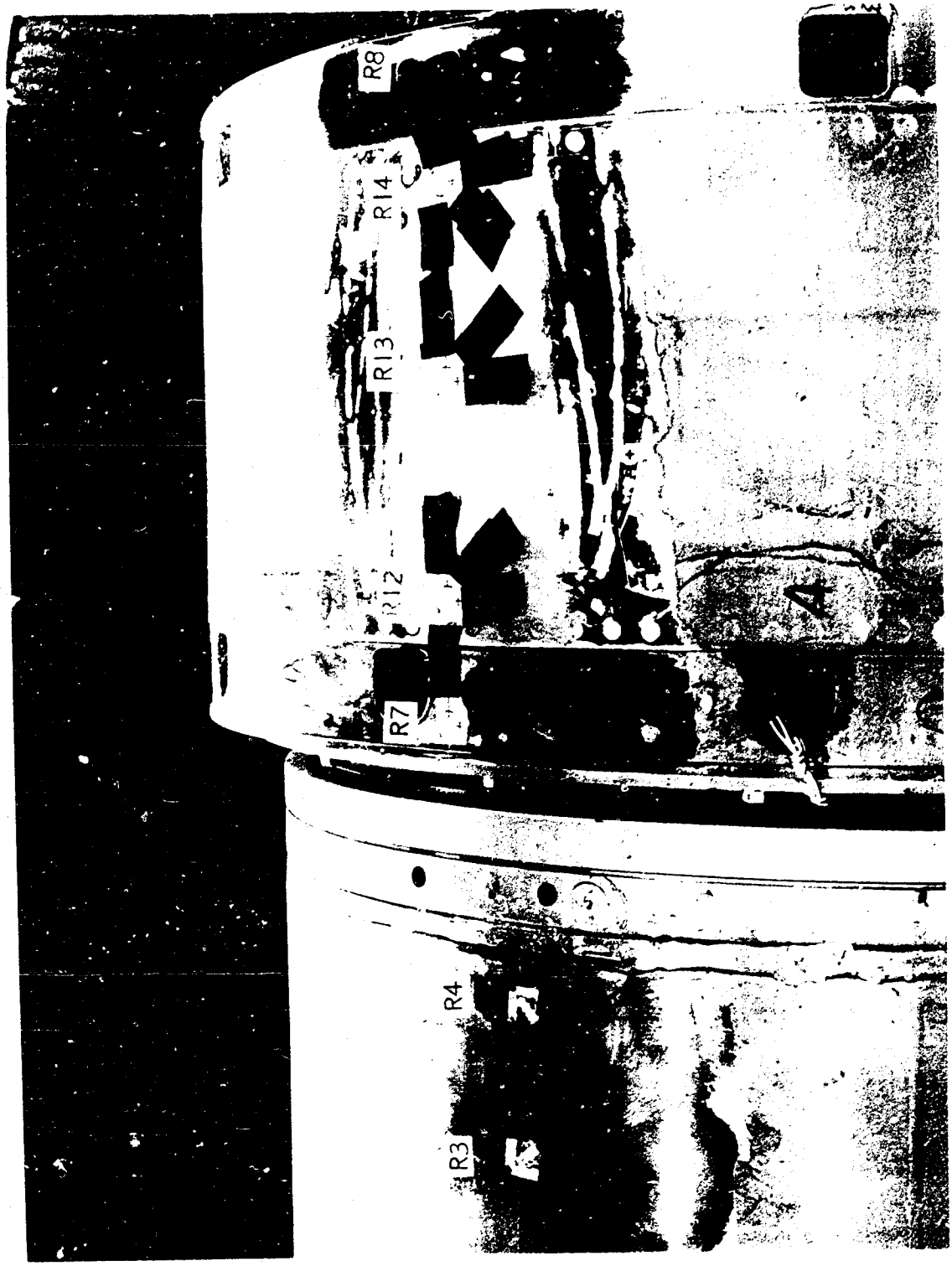

FIG. 5--LOCATION OF STRAIN GAGE ROSETTES--STATIC TEST OF X-31

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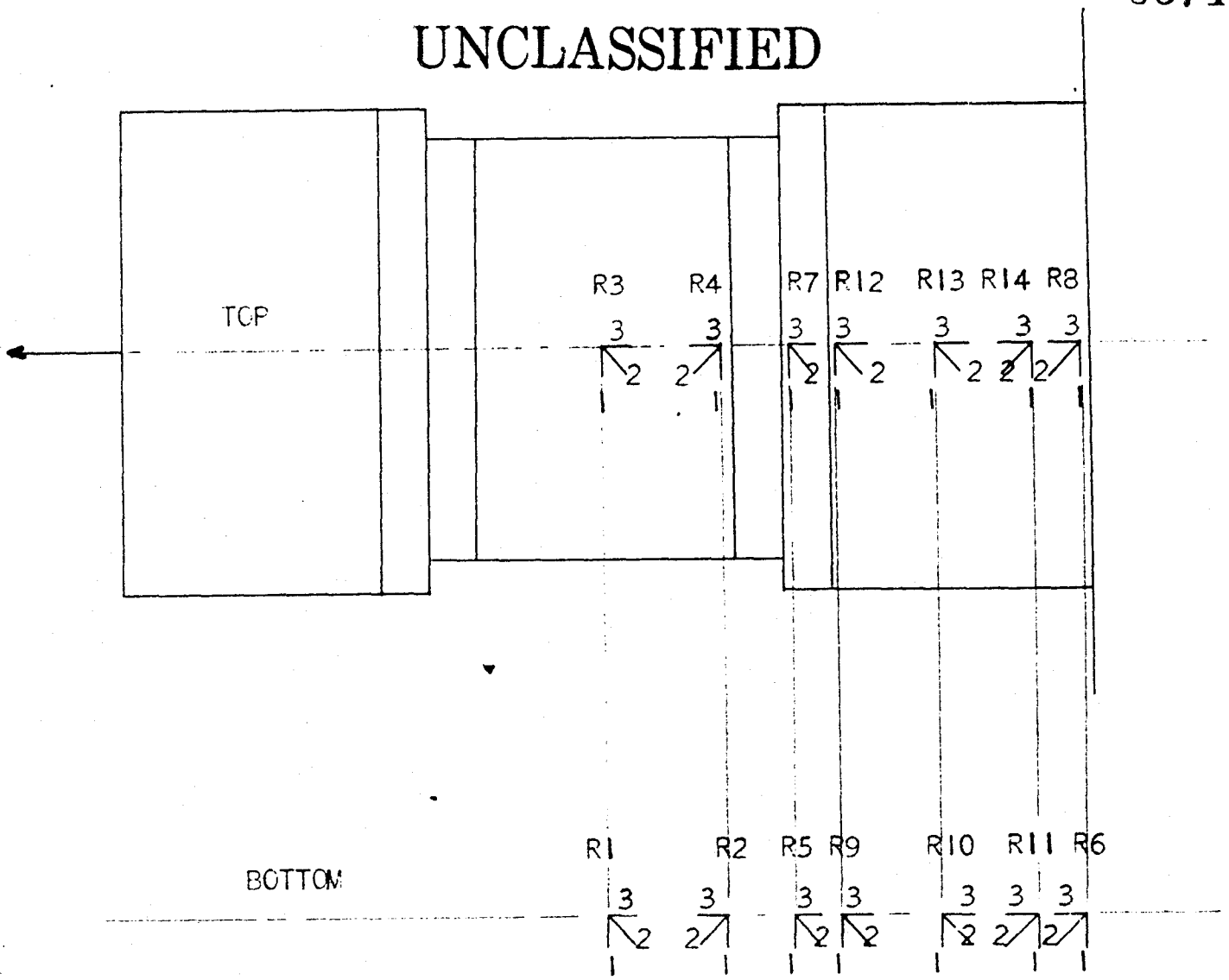

FIG. 7--LOCATION AND ORIENTATION OF STRAIN GAGE ROSETTES--STATIC TEST OF XW-31

REF. SYM: 1612 (212)
PROJECT NO. TM-287

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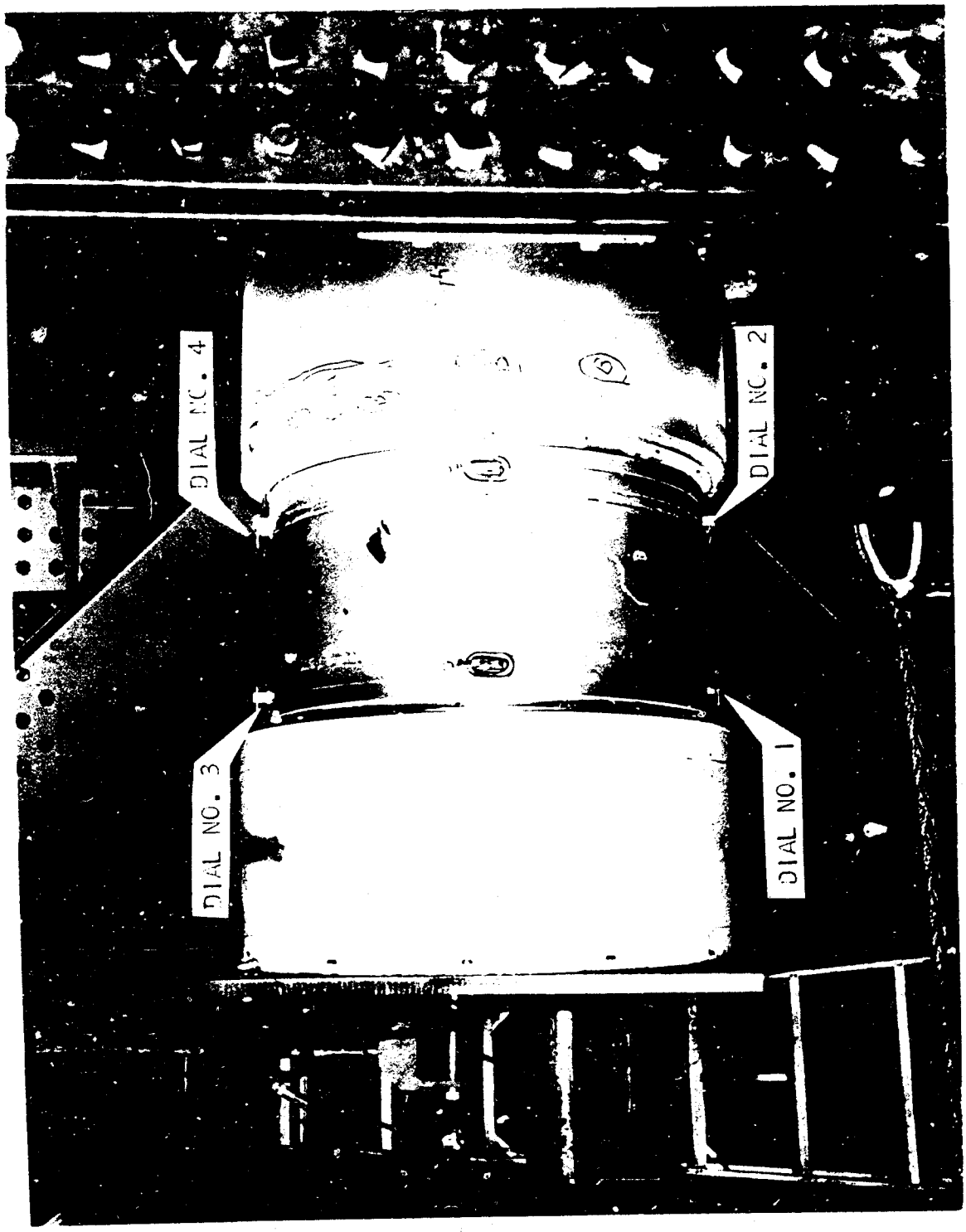

FIG. 8--LOCATION OF DIAL INDICATORS--STATIC TEST [illegible]

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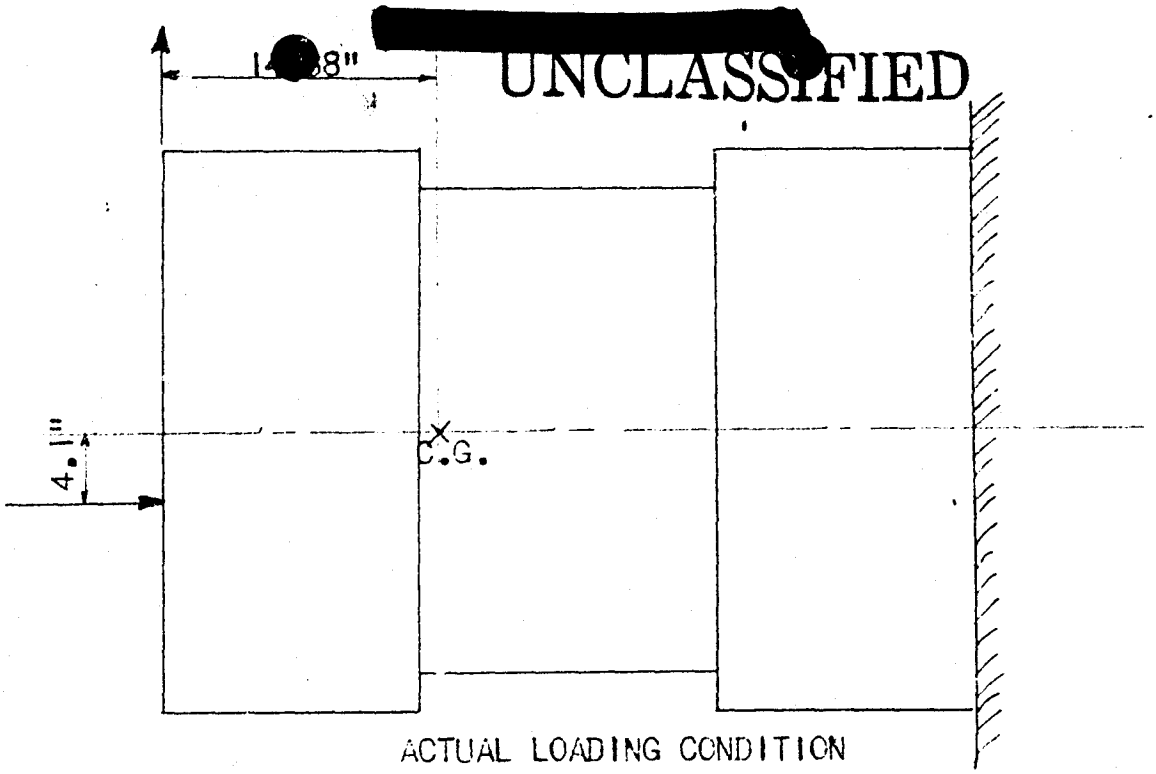
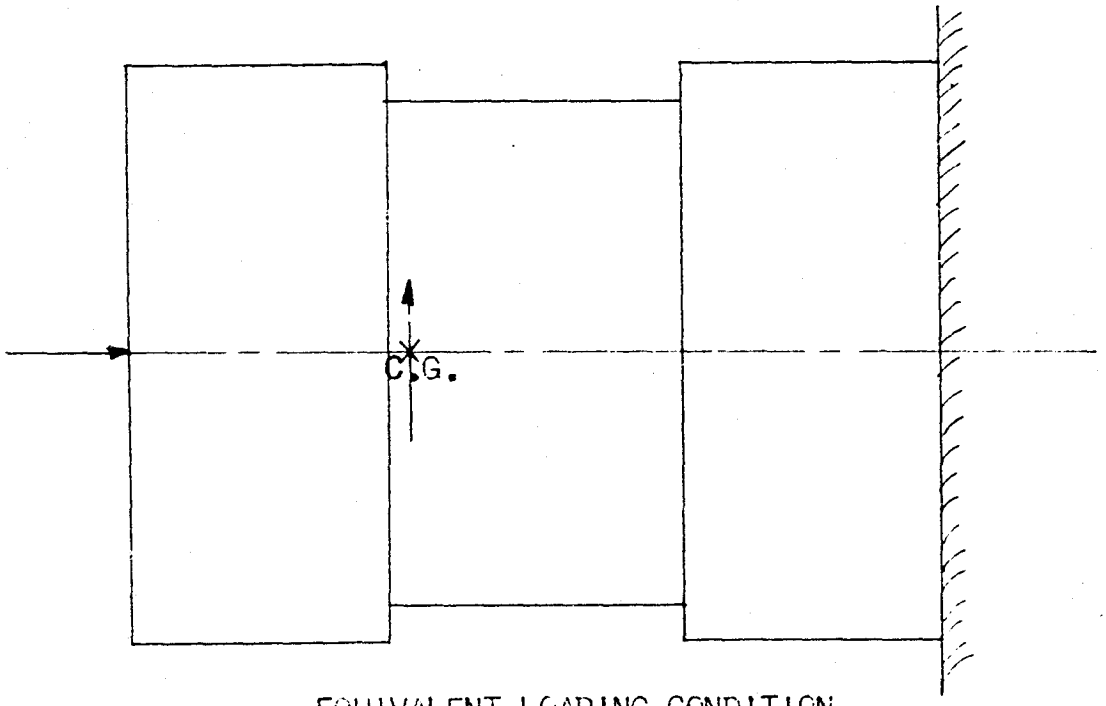
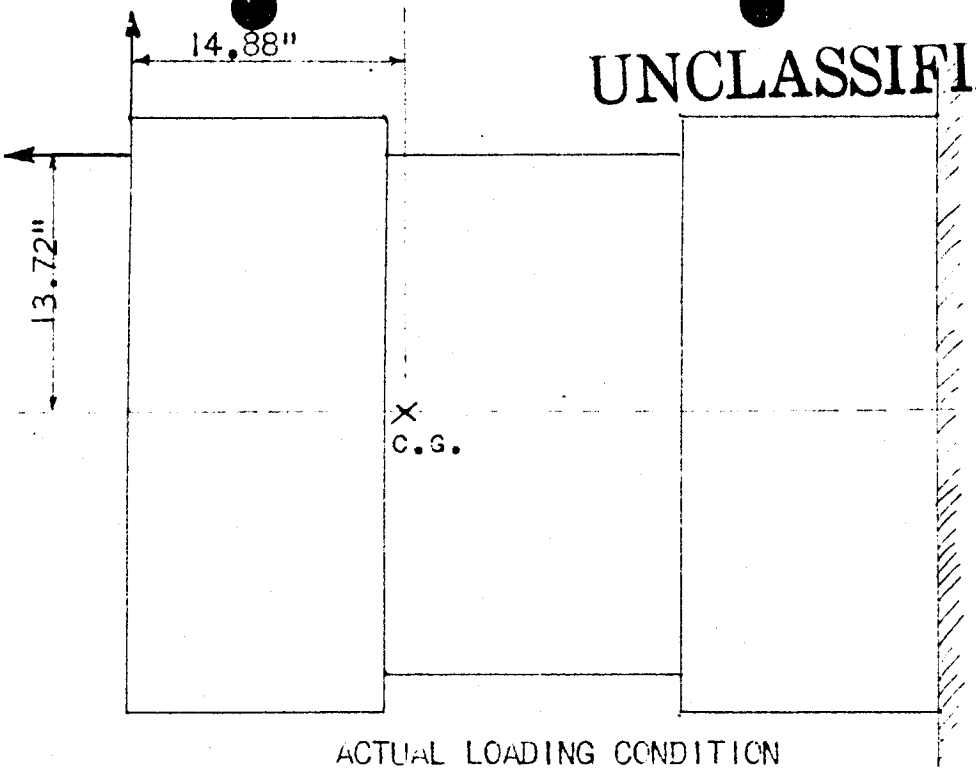


ACTUAL LOADING CONDITION

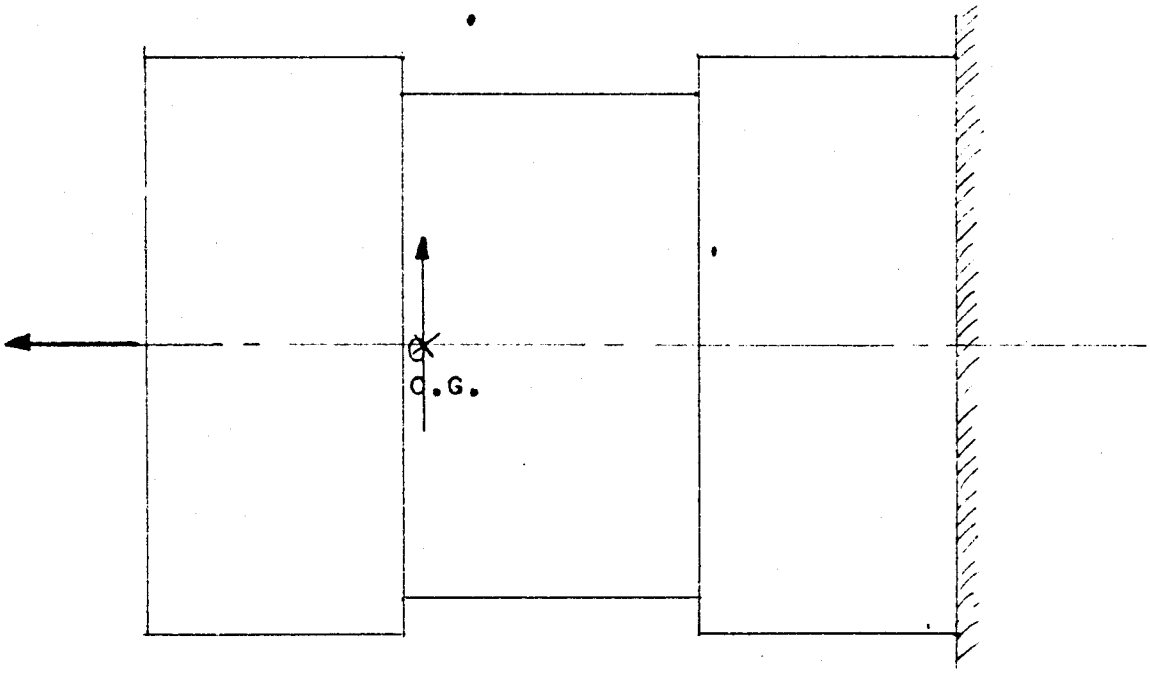


EQUIVALENT LOADING CONDITION

FIG. 9--ACTUAL AND EQUIVALENT LOADING CONDITIONS--STATIC TEST OF XW-31



ACTUAL LOADING CONDITION



EQUIVALENT LOADING CONDITION

FIG. 10--ACTUAL AND EQUIVALENT LOADING CONDITIONS -- STATIC TEST OF XW-31

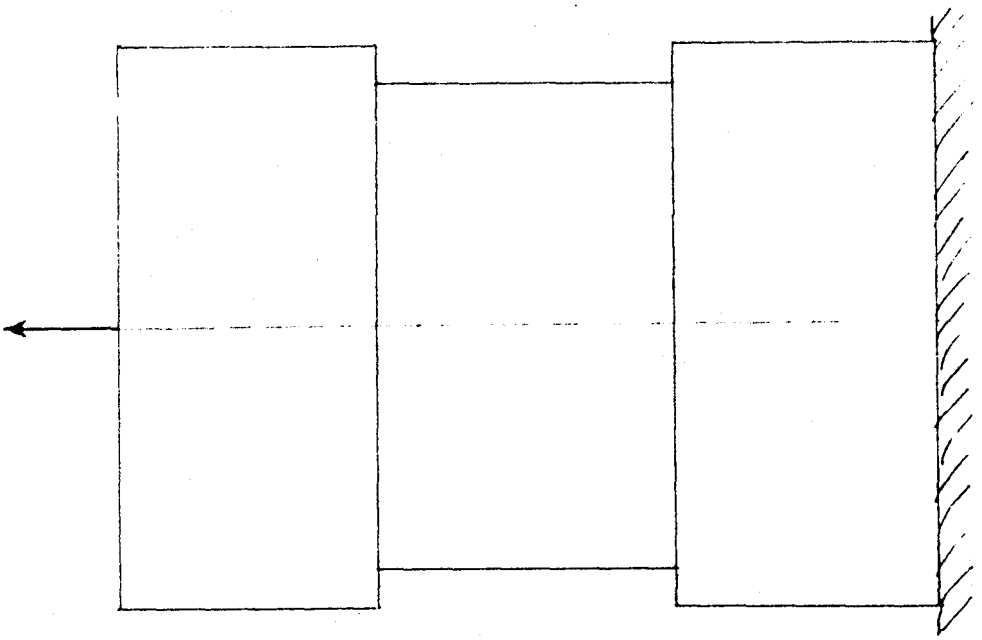


FIG. 11--LOADING CONDITIONS FOR DESTRUCTION TEST OF XW-31

REF. SYM: 1612 (212)
PROJECT NO. TM-287

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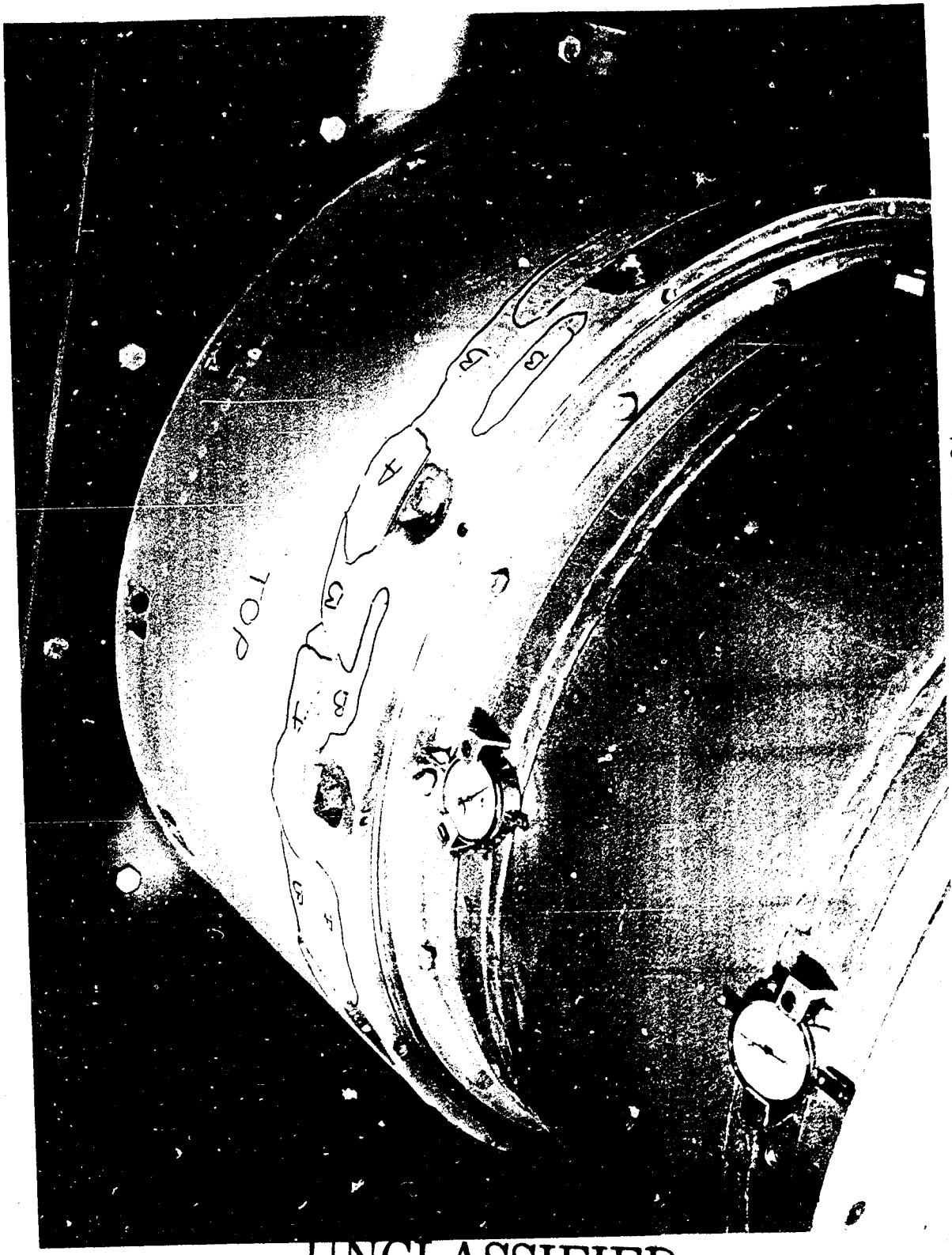

FIG. 12--STRESSCOAT CRACK PATTERNS--STATIC TEST OF XW-31

REF. SM: 1612 (212)
PROJECT NO. TR-287

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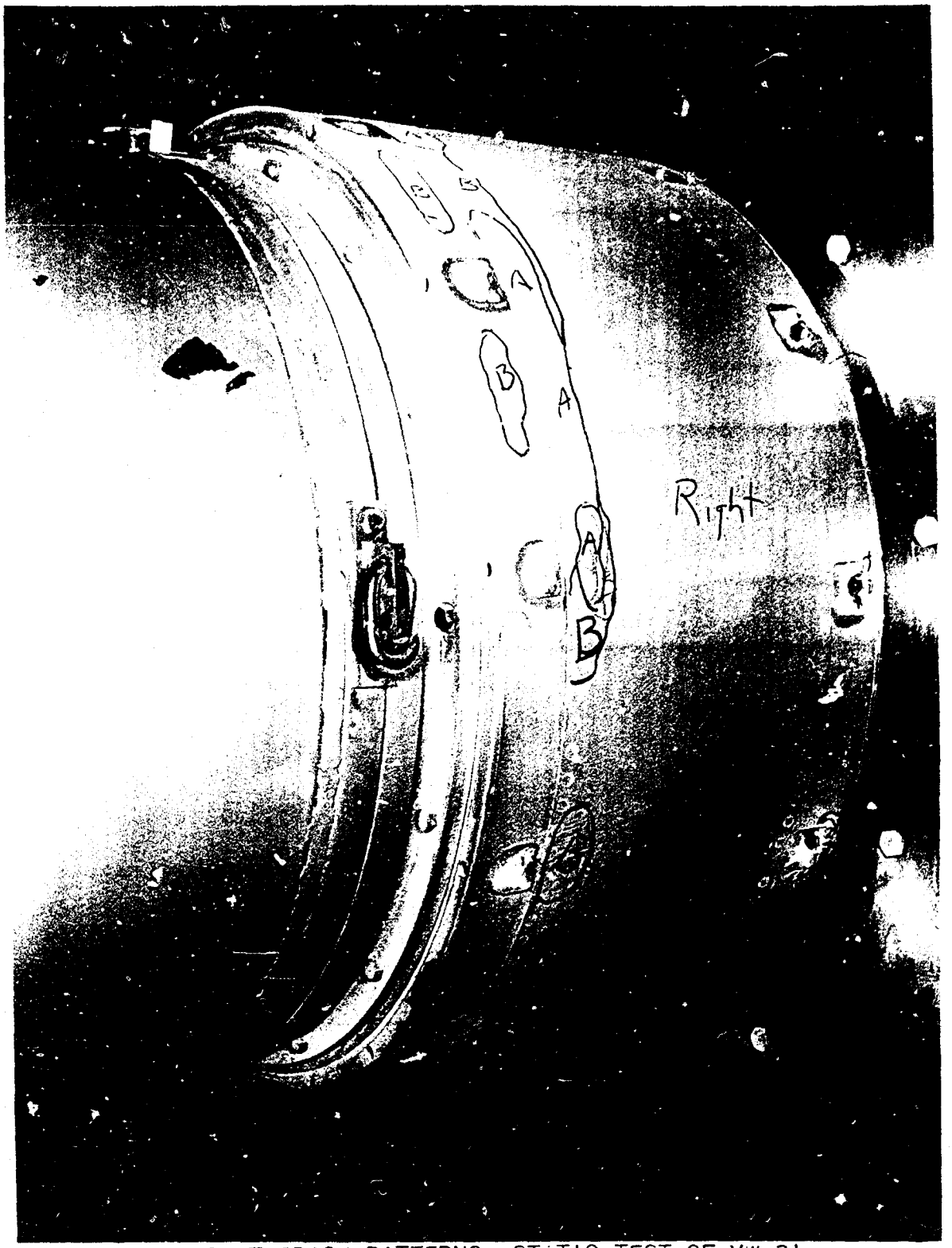

FIG. 13--STRESSCOAT CRACK PATTERNS--STATIC TEST OF XW-31

D#64739

REF. SYM: 1612 (212)
PROJECT NO. TM-287

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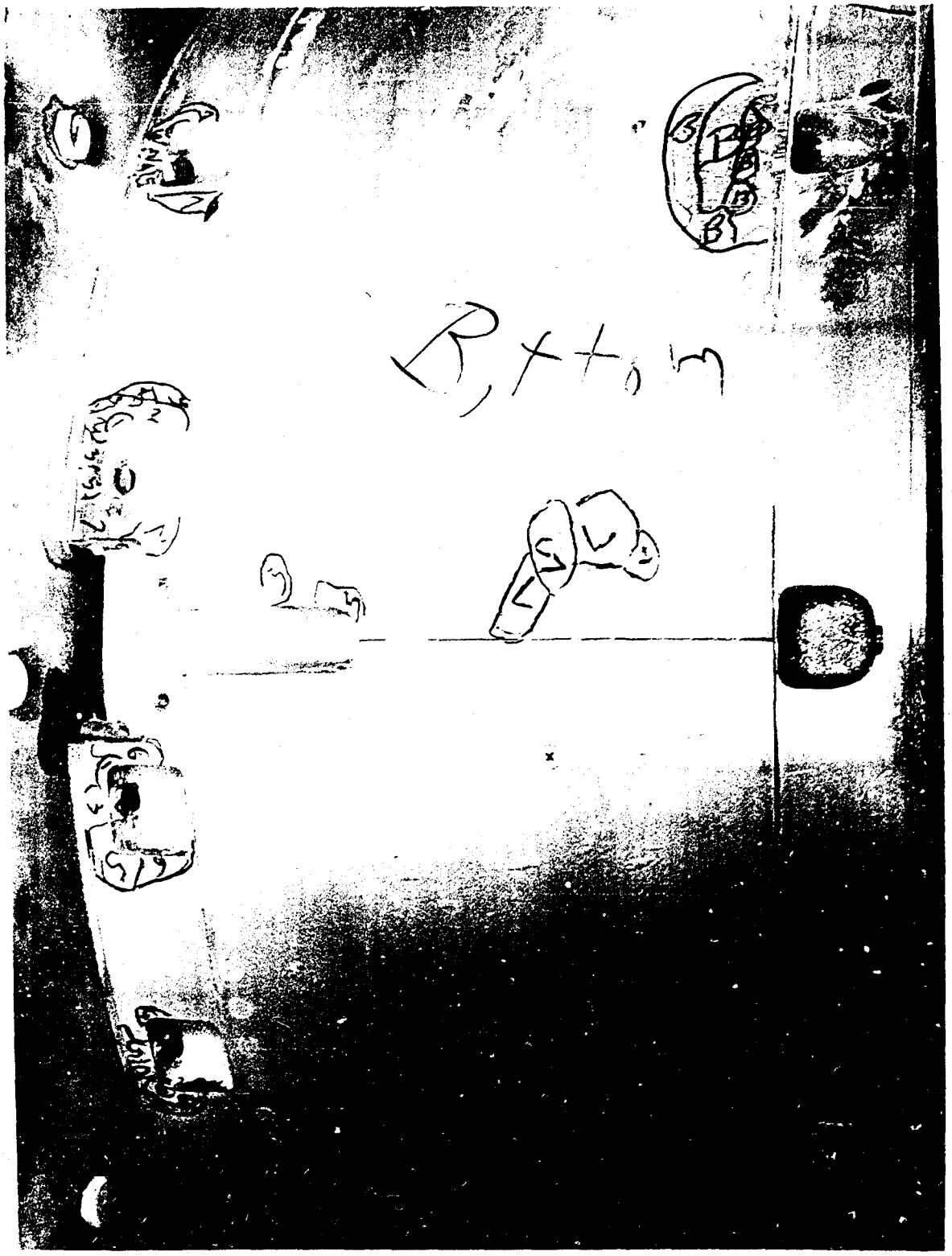

FIG. 14--STRESSCOAT CRACK PATTERNS--STATIC TEST OF XN-31

REF. SYM: 1612 (212)
PROJECT NO. TM-287

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FIG. 15--STRESSCOAT CRACK PATTERNS--STATIC TEST OF XW-31

D# 64742

REF. SYM: 1612 (212)
PROJECT NO. TM-287

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TABLE I

LOAD-STRAIN DATA

STATIC TEST OF XW-31—TEST NO. 1

Percent Design Limit Load	Load (Pounds) Longitudinal	Load (Pounds) Lateral	Pattern No.	Dial Readings (inches) D_1	D_2	D_3	D_4
0.	0	0	—	0	0	0	0
19.3	2,200	2,000					
23.2	2,640	2,400					
27.8	3,170	2,880					
33.3	3,800	3,460					
40.0	4,560	4,150					
48.0	5,470	5,000					
57.4	6,550	6,000	1				
68.8	7,850	7,200	2				
82.8	9,450	8,650	3				
100	11,400	10,400	4				
115	13,100	12,100	5	.014	.003	.001	.002
132	15,100	13,500	6	.016	.006	.005	.002
150	17,100	15,400	7	.022	.012	.006	.003
0	0	0	—	.011	.007	.002	.001

NOTE: Stresscoat sensitivity — 700 microinches per inch.

TABLE II

LOAD-STRAIN DATA

STATIC TEST OF XW-31--TEST NO. 2

Percent Design Limit Load	Load (Pounds) Longitudinal	Lateral	Pattern No.
0	0	0	-
144	55,000	14,800	A
150	57,400	15,400	B
132	*50,500	13,500	-
117	44,700	12,000	-
58	22,350	6,000	-
0	0	0	-

* Specimen maintained under longitudinal load of 57,400 for two hours, then relaxed in increments. No relaxation cracks appeared.

NOTE: Stresscoat sensitivity -- 800 microinches per inch

TABLE III

LOAD-STRAIN DATA--ROSETTES

STATIC TEST OF XW-31--TEST NO. 3

Load Pounds x 10^3		Strain (microinches/inch)														
		Rosette No. 1			Rosette No. 2			Rosette No. 3			Rosette No. 4			Rosette No. 5		
Long.	Lat.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	2.7	-10	70	30	30	10	10	-10	0	-50	-10	-10	-10	150	45	-50
6	5.4	-30	20	70	85	20	10	0	-5	0	10	-5	-5	110	-40	-70
9	8.1	-40	25	80	205	65	50	-20	-15	-10	-10	-15	-20	50	-145	-85
12	10.8	-40	30	110	350	110	65	0	-15	10	-20	-20	0	20	-205	-95
15	13.5	-65	40	160	580	145	90	-15	-10	-25	-40	-20	0	10	-300	-120
17.1	15.4	-80	40	190	660	140	130	0	-10	-5	-70	-25	35	10	-350	-140

		Rosette No. 6			Rosette No. 7			Rosette No. 8			Rosette No. 9			Rosette No. 10		
Long.	Lat.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	2.7	0	400	50	10	0	10	-260	-80	60	-65	-120	-100	-40	-10	120
6	5.4	0	855	60	35	20	20	-570	-200	90	-180	-225	-250	-75	-60	220
9	8.1	5	1245	70	70	30	20	-920	-450	-30	-300	-390	-415	-110	-90	315
12	10.8	0	1480	40	110	50	0	-1105	-550	-10	-370	-460	-500	-120	-90	380
15	13.5	-20	1870	30	230	125	0	-1430	-660	30	-520	-575	-590	-150	-110	480
17.1	15.4	-18	2050	-10	280	140	-30	-1700	-740	65	-590	-640	-690	-170	-120	540

		Rosette No. 11			Rosette No. 12			Rosette No. 13			Rosette No. 14		
Long.	Lat.	1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	2.7	-45	0	10	35	0	-10	0	-20	-15	35	80	55
6	5.4	-140	-20	0	70	-10	-10	10	-50	-30	80	180	120
9	8.1	-200	-15	15	160	5	-30	15	-40	-110	85	190	115
12	10.8	-220	0	35	160	10	-20	20	-90	-140	60	170	120
15	13.5	-260	0	70	320	40	-35	50	0	-245	70	180	135
17.1	15.4	-300	0	75	280	25	-70	50	-130	-260	50	200	160

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TABLE IV

LOAD-STRAIN DATA--ROSETTES

STATIC TEST OF XW-31--TEST NO. 4

Load Pounds x 10^3		Strain (microinches/inch)														
		Rosette No. 1			Rosette No. 2			Rosette No. 3			Rosette No. 4			Rosette No. 5		
Long.	Lat.	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1.3	10	-10	-15	10	10	5	0	0	-30	10	10	-5	15	25	10
10	2.6	25	-10	-35	10	10	10	0	10	-50	0	15	0	30	50	10
15	4.0	35	-15	-50	20	20	20	0	15	-65	25	10	-10	50	70	20
20	5.4	45	-20	-70	20	20	20	-35	20	-90	30	10	-20	60	85	30
25	6.7	60	-30	-100	20	25	35	-40	30	-115	70	10	-50	80	110	40
30	8.0	65	-25	-110	25	30	45	-35	30	-140	70	15	-60	75	110	40
35	9.4	70	-20	-130	30	50	65	-50	40	-170	50	15	-50	80	120	60
40	10.7	90	-25	-155	40	70	90	-40	50	-190	40	20	-50	45	130	70
45	11.2	100	-25	-170	45	80	100	-70	60	-220	35	40	-50	45	130	70
50	13.4	125	-10	-180	60	100	110	-95	60	-245	-10	30	-40	55	150	80
57.4	15.4	150	-20	-205	100	115	120	-90	75	-270	-20	50	-10	20	145	90

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Long.	Lat.	Rosette No. 6			Rosette No. 7			Rosette No. 8			Rosette No. 9			Rosette No. 10		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1.3	0	-20	-10	40	40	20	30	40	-10	25	15	0	10	0	-10
10	2.6	0	-30	-15	70	65	30	65	60	-30	60	30	0	20	-10	-35
15	4.0	0	-10	-10	110	100	40	30	40	-75	90	60	10	25	-20	-50
20	5.4	0	-10	0	160	145	50	-80	-20	-130	130	75	15	45	-25	-80
25	6.7	-10	-10	-10	210	190	60	-230	-100	-175	185	120	30	50	-50	-120
30	8.0	-20	-30	-15	250	225	70	-420	-180	-175	195	120	30	60	-50	-140
35	9.4	-50	-90	-45	300	270	80	-530	-240	-160	220	150	45	60	-60	-160
40	10.7	-70	-170	-60	340	305	90	-560	-260	-160	260	185	60	70	-75	-185
45	11.2	-140	-260	-125	400	380	120	-720	-340	-130	260	190	75	60	-90	-185
50	13.4	-155	-275	-145	425	400	130	-800	-370	-130	300	210	80	70	-70	-185
57.4	15.4	-175	-410	-190	500	500	150	-960	-405	-130	315	215	100	70	-70	-210

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Lower Half

Long.	Lat.	Rosette No. 11			Rosette No. 12			Rosette No. 13			Rosette No. 14		
		1	2	3	1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1.3	10	-5	0	110	15	0	15	-55	-15	10	60	5
10	2.6	10	-10	-10	200	30	0	25	-85	-35	30	40	0
15	4.0	20	-15	-15	310	45	20	35	-130	-80	60	90	15
20	5.4	35	-10	-15	440	70	20	55	-175	-140	100	135	20
25	6.7	55	-10	-25	580	110	30	70	-190	-195	120	180	20
30	8.0	60	-10	-20	700	150	40	80	-210	-260	120	180	25
35	9.4	70	-10	-10	835	200	50	100	-230	-320	135	210	20
40	10.7	90	-20	-25	900	240	70	110	-230	-340	150	230	15
45	11.2	85	-15	-20	1120	315	105	135	-260	-420	165	240	25
50	13.4	105	+5	0	1265	370	120	160	-300	-460	200	260	40
57.4	15.4	100	0	0	1500	500	190	170	-340	-560	245	260	50

UNCLASSIFIED

TABLE V

LOAD-DEFLECTION DATA

DESTRUCTION TEST OF XW-31

Load Pounds x 10^3	Deformation (inches) D_1	D_2	*D_3	D_4
0	0	0	0	0
15	.007	.005		.006
20	.013	.006		.008
25	.018	.007		.011
30	.029	.009		.013
35				
40				
56		Failure of bolts		

* Dial No. 3 inoperative this test.

TABLE VI

MAXIMUM STRESSES

STATIC TEST OF XW-31--TEST NOS. 3 AND 4

Rosette No.	Test No. 3 Stress (psi x 10^3)			Test No. 4 Stress (psi x 10^3)		
	Su	Sv	T	Su	Sv	T
1	+5.30	-0.88	3.09	-5.16	+2.94	4.05
2	+22.11	+4.90	8.61	+4.68	+4.18	0.25
3	+0.28	-0.18	0.18	-13.40	-1.10	6.15
4	+1.90	-0.50	1.20	-2.09	+0.87	1.48
9	-9.72	-8.98	0.37	+3.83	+2.23	.80
10	+6.16	-0.76	3.46	-2.10	0	1.05
11	-3.29	-0.05	1.62	+1.25	+0.21	.52
12	+3.83	-0.71	2.27	+17.78	+6.82	5.48
13	-2.73	-0.39	1.17	-5.48	-0.02	2.83
14	+2.38	+0.74	0.82	+3.25	+1.05	1.10

NOTE: Su, Sv -- principle stresses.
T -- maximum shearing stress.
Rosettes Nos. 1, 2, 3, and 4 on steel.
Rosettes Nos. 9, 10, 11, 12, 13, 14 on aluminum.
Rosettes Nos. 5, 6, 7, 8 on magnesium.
E is not constant, therefore, stress computations were not attempted for the gages on magnesium.