UNCLASSIFIED [redacted]

0502

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1st Review Date: 8/11/98 Authority: ADC Name:	Determination (Circle Numbers): 1. Classification Retained 2. Classification Changed to: U 3. Contains No DOE Classified Information 4. Coordinate With: 5. Contains UCNI 6. Comments:
2nd Review Date: 8/20/98 Authority: ADO Name: W Layne	

NOV 19 1956

Case No. 690.00
Ref. Sym: 1612 (346)
Project No. TM-412
File: TX-28, 3-2

MR. S. A. MOORE - 1224

Attn: Mr. L. M. Spivey - 1224-2

Re: Static Test of TX-28 Mockup Unit

CDL No.	
ACCOUNTABILITY CARD	BM
FILE No. TX-28 3-2	

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Summary of Results

A mockup of the center section of the TX-28, consisting of a hollow aluminum (75ST-6) cylinder having a wall thickness of 9/16-inch and filled with iso-cyanate plastic, was statically tested to five conditions.

Condition 1 (rolling pullout loads at aft lug and sway braces) produced failure on the threads of the mild steel insert resulting from the radial lug load at 100 per cent of limit load. The same condition produced failure on the threads in the aluminum case at the redesigned insert when 115 per cent of limit load was reached. The case of a new cylinder with a new insert cracked in a longitudinal direction above the insert at 120 per cent of limit load for the same loading condition.

The cylinder withstood 150 per cent of limit loads for Conditions 4, 6, and 7 (rolling pullout loads at forward lug and sway braces) and 200 per cent of limit load for Condition 5 (ejector load) without showing appreciable damage.

Condition 2 (rolling pullout) and Condition 3 (arrested landing) were included on the Work Order but were omitted from testing at the suggestion of the consultant.

When applied singly, a radial lug load of 36,400 pounds, a sway brace load of 52,000 pounds on a 3/4-inch diameter pad and a sway brace load of 80,000 pounds on a two-inch diameter pad each produced failure.

The handling fitting withstood 150 per cent and 200 per cent of limit loads, respectively, for the two handling conditions tested.

Object of Test

The test was performed to determine the strength characteristics of an aluminum case with the idea that an aluminum case might be used in lieu of a steel case for the TX-28. In addition, the handling fittings were tested to determine if they had adequate strength for the handling and shipping loads. Tables I and II give limit loads for both the cylinder and the handling fitting.

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO: U Emilda Selph 8/25/98 PERSON CHANGING MARKING & DATE	AUTHORITY: W.C. Layne RECORD ID: 98SN3784
WC Layne 8/25/98 PERSON VERIFYING MARKING & DATE	DATED: 8/20/98

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Reason for Test

The test was conducted as a result of the Work Order Authorization dated April 25, 1956, from Division 1224 to Division 1612.

Function of Object Tested

The object tested is a mockup of the center section of TX-28 case. The case furnishes the ballistic shape for the weapon, furnishes a means for attaching the weapon to the airplane and contains the explosive elements.

Summary of Past Tests

A previous static test was performed on a TX-28 mockup unit by Division 1612 with the results given in the report, Static Lug and Sway Brace Test of TX-28 Mockup Unit, Ref. Sym: 1612 (241), TM-312, dated December 5, 1955. The "Summary of Results" from this report is as follows:

> "The test cylinder, which has been designed to simulate one possible configuration near the aft lug of the TX-28 store, was statically tested to eight separate loading conditions plus a final loading to failure. The eight loading conditions, five of which were 115 per cent of design limit load, and three of which were 150 per cent of design limit load, produced no noticeable damage to the test article. Near the end of testing, a modified version of one of the latter three conditions was extended to 210 per cent of design limit load without producing failure. The loading condition which produced failure of the threads on the lug and in the cylinder consisted of a vertical lug load (up) of 53,520 pounds (230 per cent of limit load) and a sway brace load of about 80,000 pounds (about 225 per cent of limit load). Maximum and minimum principal strain data was obtained at critical points on the cylinder."

The cylinder in the previous test was made of steel whereas the cylinder in the present test was made of aluminum (75ST-6).

Setup for Test

Figure 1 shows the general setup for test Condition 1 of the cylinder. Figure 2 shows a closeup view of the setup for test Condition 1. A sway brace pad having a 2.25-inch diameter and contoured to fit the cylinder was used for the sway brace loading.

Condition 4 used the same setup as shown in Figs. 1 and 2. Except the longitudinal load on the lug was omitted. Condition 4 used a 1.6 inch diameter sway brace pad with a flat end.

Condition 6 used the same setup as Condition 4 except in Condition 6 a two-inch diameter sway brace pad with a spherical surface was used.

Condition 7 used the same setup as Condition 4 except Condition 7 used a 3/4-inch diameter sway brace pad with a spherical surface.

Figure 3 shows the setup for applying the ejector load of Condition 5 to the cylinder. Figure 4 shows the setup for testing the handling fitting under test. Condition 1 for the handling fittings. Figure 5 shows the setup for testing handling Condition 2.

The components making up the test article are the Lug, Aft, Dwg. No. DS(1326)51218; Insert, Dwg. No. SK(1224)61206; and the cylinder. The first cylinder tested was lined with 1/4-inch firm sponge rubber and filled with high density iso-cyanate plastic. The second cylinder was not lined with rubber.

The following test equipment was used:

1 - Simplex ram and pump - 30 ton capacity.
1 - Simplex ram and pump - 60 ton capacity.
1 - Blackhawk ram and pump - 50 ton capacity.
1 - Blackhawk ram and pump - 7-1/2 ton capacity.
3 - SR-4 Strain Indicators, Serial Nos. J-59252, 199375, and J-92499.
1 - One-inch calibrated pull bar No. F, sensitivity = 0.1088 microinches/inch/pound.
1 - One-inch calibrated pull bar No. B, sensitivity = 0.1043 microinches/inch/pound.
1 - Load cell, 50,000 lb. capacity, Serial No. 1114, sensitivity = 0.0797 microinches/inch/pound.
1 - Load cell, 2000 lb. capacity, Serial No. 20-871, sensitivity = 1.96 microinches/inch/pound.
1 - Switchbox.
1 - Outside micrometer, 20-inch throat.
1 - Sadic Automatic Data Processing System, Model 34-112M1.

The following instrumentation was used:

1 - Starrett dial indicator, 0.001 inch graduations, range 1.0 inch.
12 A-7 strain gages used as four three-element rosettes, Res. = 120 ±.3 ohms, G.F. = 1.90 ± 2 per cent, Lot 232-11.

The location of the strain gages is shown in Figure 6.

Procedure

The unit (9/16-inch thickness - 75ST-6 aluminum cylinder with a mild steel insert) was mounted in the static jig as shown in Figs. 1 and 2. The loads for Condition 1, Table I, were applied in increments of 20 per cent up to 100 per cent of limit load at which load failure precluded further loading. Strain readings were taken at each load increment. Outside diametrical measurements were taken through the lug, 90° from the lug and through the sway brace near the upper end of the cylinder at some of the increments of load and also for zero load after some of the increments.

Because the insert was damaged, no further tests were run on this cylinder until the insert was redesigned but the handling fitting was attached to the cylinder and was tested to 150 per cent of Handling Condition 1, Table II. The setup for this test is shown in Fig. 4. Vertical deflections at the edge of the fitting were taken at several loads up to 150 per cent.

The insert for the lug was redesigned using high heat treat steel (140,000 - 160,000 psi). A setup was again made as shown in Figs. 1 and 2, using the redesigned insert. The unit was then loaded in increments of 20 per cent up to 115 per cent of limit load for cylinder condition No. 1 at which load failure precluded further testing for this condition. Strain readings were taken at each load increment.

The handling fitting was attached to the cylinder and loaded to 200 per cent of limit load for Handling Condition 2 listed in Table II, as shown in Fig. 5. Vertical deflection readings were taken at the edge of the fitting for the various increments of load from zero to 200 per cent.

A new cylinder (9/16-inch thickness - 75ST-6 aluminum) with a new insert was again set up in the static jig as shown in Figs. 1 and 2. The unit was loaded in increments of 20 per cent up to 120 per cent of limit load for cylinder condition No. 1, Table I. Strain readings were taken at each load increment.

A crack in the cylinder was repaired before further testing was continued as described in the following paragraphs.

Using the setup as shown in Figs. 1 and 2 but omitting the longitudinal lug load, the unit was loaded to 115 per cent of limit load for Conditions 4, 6, and 7, respectively, Table I. Next, the unit was loaded to 150 per cent of limit load for Conditions 4, 6, and 7.

With the setup as shown in Fig. 3, the case was loaded to 200 per cent of limit load for Condition 5, Table I.

The cylinder was loaded to failure using only a sway brace load with the 3/4-inch diameter sway brace pad having a 2-inch spherical radius on its contact surface with the cylinder.

The cylinder was loaded to failure using only a sway brace load with the 2-inch diameter sway brace pad having a 2-inch spherical radius on its contact surface with the cylinder.

The cylinder was loaded to failure using only the radial lug load.

Results

The first unit which was tested, failed at 100 per cent of limit load for Condition 1, Table I, by stripping the threads on the mild steel insert as shown in Figs. 6 and 7. The diametrical measurements of the cylinder for several load increments are given in Table III. The strain readings with the computed maximum and minimum principal strains are shown in Table IV.

The insert was redesigned using 4340 steel heat treated to 140,000 - 160,000 psi, and inserted into the same case 180° from the previous insert. For Condition 1, Table I, failure occurred at 115 per cent of limit load by stripping the threads in the aluminum case as shown in Fig. 8. The strain readings with the computed maximum and minimum principal strains are shown in Table V.

The new cylinder with a new insert failed at 120 per cent of limit load when loaded according to Condition 1, Table I. The failure consists of the crack in the cylinder above and below the insert as shown in Fig. 9. The strain readings with the computed maximum and minimum principal strains are shown in Table VI.

The latter cylinder withstood loads first up to 115 per cent of limit load and then up to 150 per cent of limit load for Conditions 4, 6, and 7, Table I, without any appreciable damage. No instrumentation was used for these three conditions.

When loading the cylinder with the two-inch diameter sway brace pad, failure occurred at a sway brace load of 80,000 pounds. The area of failure is shown in Fig. 10.

When applying a sway brace load on a 3/4-inch diameter pad, a hole was punched in the cylinder at a load of 52,000 pounds. The failure is shown on Fig. 11.

When loading the cylinder with the radial lug load only, a crack formed in the cylinder at a load of 36,400 pounds but additional load was applied to

38,000 pounds without producing complete failure. Figure 11 shows the crack in the cylinder.

The deflection data resulting from the tests on the handling fittings are shown in Table VI. The load-deflection curves for the handling fittings are shown on Figs. 12 and 13. The handling fittings withstood the loads imposed upon them without producing failure or excessive deflection.

Conclusions

It is concluded that the two cylinders tested lacked adequate strength to withstand the loads from Condition 1. However, the second cylinder was able to withstand all other design loading conditions imposed upon it. It is also concluded that the handling fitting has adequate strength for the design conditions.

Harry P. Wheeler
HARRY P. WHEELER - 1612-2

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

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TABLE I

LIMIT CYLINDER LOADS -- STATIC TEST OF TX-28 MOCKUP UNIT

Condition No.	Load in Pounds: Lug Load Longitudinal	Lug Load Radial	Sway Brace Load	Sway Brace Pad	Ejector Load	Type of Load
1	-1,160	35,730	28,640	A	--	Rolling Pullout
2	6,250	27,340	39,800	A	--	Rolling Pullout
3	-16,650	15,170	9,190	A	--	Arrested Landing
4	--	18,000	18,000	B	--	Rolling Pullout
5	--	--	--	--	19,000	Ejector
6	--	18,000	18,000	C	--	Rolling Pullout
7	--	18,000	18,000	D	--	Rolling Pullout

NOTES:

(a) Plus longitudinal lug load is toward support.
(b) Plus radial lug load is outward from cylinder.
(c) Sway brace pad "A" is 2.25" O.D. contoured to fit cylinder.
(d) Sway brace pad "B" is 1.6" O.D. with flat end.
(e) Sway brace pad "C" is 2.0" O.D. with a two-inch spherical radius on contact surface with cylinder.
(f) Sway brace pad "D" is 3/4" O.D. with a two-inch spherical radius on contact surface with cylinder.
(g) Ejector pad is 1.0" O.D. with flat end.
(g) Conditions 2 and 3 were on the work order but were omitted for testing at suggestion of consultant.

TABLE II

LIMIT HANDLING FITTING LOADS -- STATIC TEST OF TX-28 MOCKUP UNIT

Condition No.	Loads in Pounds Longitudinal Load	Lateral Load
1	6,950	540
2	10,720	—

NOTES: The longitudinal load of 6,950 pounds is applied through one bolt.

The load is 10,720 pounds is applied through two bolts.

The lateral load of 540 pounds is applied to the fitting, perpendicular to the direction of the longitudinal load and parallel to mounting bases of the cylinder.

TABLE III

DIAMETRICAL MEASUREMENTS OF OUTSIDE OF CYLINDER -- STATIC TEST OF TX-28 MOCKUP UNIT

Per Cent of Limit Load	Diameter thru Lug	Diameter 90° from Lug	Diameter thru Sway Brace
0	19.946	19.955	19.951
20	--	--	--
40	--	--	--
60	--	19.865	--
0	19.950	19.946	19.948
80	--	19.846	--
0	19.965	19.938	19.960
100	--	--	--
0	19.987	19.937	19.965

NOTE: The above measurements were taken one to two inches below the top of the cylinder.

TABLE IV

STRAIN READINGS AND COMPUTED MAXIMUM AND MINIMUM PRINCIPAL STRAINS (CONDITION I - CYLINDER WITH MILD STEEL INSERT)
STATIC TEST OF TX-28 MOCKUP UNIT

Per Cent of Limit Load	Strain Reading at the Following Gages in Microinches Per Inch											
	1 - 2 - 3			4 - 5 - 6			7 - 8 - 9			10 - 11 - 12		
20	1805	660	-330	-155	-195	770	Gage Out	-465	-435	-315	-610	-1140
40	4430	1395	-590	-400	-535	1910	Gage Out	-820	-760	-765	-850	-1110
60	7270	2140	-760	-530	-830	2805	Gage Out	-1370	-1320	-885	-1160	-1835
80	12770	2705	-1735	-2540	-2250	4000	Gage Out	-2170	-2150	-1010	-1380	-2500
100	Failed at 100 per cent before strain readings could be taken.											
0	9720	-150	-3285	-2500	-3700	-770	Gage Out	-450	-280	95	130	360

Per Cent of Limit Load	Maximum and Minimum Principal Strains in Microinches Per Inch							
	1 - 2 - 3		4 - 5 - 6		7 - 8 - 9		10 - 11 - 12	
	e_u	e_v	e_u	e_v	e_u	e_v	e_u	e_v
20	1800	-310	990	-370	--	--	-310	-1160
40	4480	-600	2480	-950	--	--	-760	-1140
60	7410	-840	3700	-1400	--	--	-860	-1880
80	13270	-2130	5120	-3640	--	--	-950	-2600
100	--	--	--	--	--	--	--	--
0	10500	-4000	560	-3870	--	--	390	70

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TABLE V

STRAIN READINGS AND COMPUTED MAXIMUM AND MINIMUM PRINCIPAL STRAINS (CONDITION I - CYLINDER WITH REDESIGNED INSERT)
STATIC TEST OF TX-28 MOCKUP UNIT

Per Cent of Limit Load	Strain Readings at the Following Gages in Microinches Per Inch											
	1 - 2 - 3			4 - 5 - 6			7 - 8 - 9			10 - 11 - 12		
20	2150	531	-528	-356	-170	1430	-146	-315	-393	-323	-551	-757
40	4390	1070	-1070	-600	-390	2760	-390	-680	-810	-510	-960	-1520
60	7380	1780	-1850	-930	-740	4460	-650	-1160	-1440	-650	-1420	-2340
80	11100	2500	-2900	-1100	-1200	5800	-900	-1500	-1900	-700	-1800	-3300
100	16500	2900	-5100	-1400	-2300	7400	-1100	-2000	-2600	-800	-2300	-4400
115	Failed at 115 per cent before strain readings were taken.											
0	9900	-70	-5750	-650	-3770	-1990	280	-430	-490	30	-180	-670

Per Cent of Limit Load	Maximum and Minimum Principal Strains in Microinches Per Inch										
	1 - 2 - 3		4 - 5 - 6		7 - 8 - 9		10 - 11 - 12	
	e_u	e_v	e_u	e_v	e_u	e_v	e_u	e_v
20	2170	-530	1670	-590	-140	-400	-330	-760
40	4440	-1090	3300	-1120	-380	-830	-520	-1530
60	7460	-1880	5420	-1860	-650	-1460	-670	-2350
80	11250	-2970	7270	-2530	-910	-1920	-720	-3320
100	16800	-5290	9850	-3790	-1110	-2630	-820	-4430
115	--	--	--	--	--	--	--	--
0	10130	-5940	1180	-3850	390	-600	50	-700

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TABLE VI

STRAIN READINGS AND COMPUTED MAXIMUM AND MINIMUM PRINCIPAL STRAINS (CONDITION I - NEW CYLINDER WITH NEW INSERT)
STATIC TEST OF TX-28 MOCKUP UNIT

Per Cent of Limit Load	Strain Readings at the Following Gages - Microinches Per Inch											
	1 - 2 - 3			4 - 5 - 6			7 - 8 - 9			10 - 11 - 12		
20	728	340	-108	-21	-113	230	-268	-155	-251	-150	-250	-731
40	1730	710	-150	-10	-140	790	-540	-390	-500	-300	-460	-1320
60	2870	1080	-210	30	-170	1340	-790	-630	-810	-380	-630	-1830
80	3820	1400	-240	80	-230	1840	-1140	-850	-1050	-630	-940	-2640
100	7730	2400	320	770	-910	1410	-1410	-1180	-1440	-820	-1100	-3100
115	9470	2780	340	980	-1020	1610	-1630	-1360	-1630	-950	-1210	-3450
0	2490	320	230	240	-440	-550	0	-40	-120	-70	60	-30
115	9620	2790	330	1010	-1040	1630	-1490	-1310	-1530	-1000	-1170	-3240
120	Failed at 120 per cent of limit load											

Per Cent of Limit Load	Maximum and Minimum Principal Strains - Microinches Per Inch											
	1 - 2 - 3			4 - 5 - 6			7 - 8 - 9			10 - 11 - 12		
	e_u	e_v		e_u	e_v		e_u	e_v		e_u	e_v	
20	730	-100		350	-140		-160	-370		-100	-790	
40	1730	-140		1050	-260		-400	-670		-210	-1430	
60	2890	-200		1780	-370		-640	-980		-260	-1970	
80	3850	-240		2430	-500		-860	-1350		-440	-2860	
100	8070	60		3110	-900		-1200	-1680		-570	-3390	
115	9940	-30		3620	-1000		-1380	-1910		-640	-3800	
0	2890	-150		330	-640		0	- 20		60	-160	
115	10110	-60		3690	-1020		-1330	-1720		-690	-3590	
120	--	--		--	--		--	--		--	--	

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TABLE VII

DEFLECTION OF HANDLING FITTING -- STATIC TEST OF TX-28 MOCKUP

Per Cent of Limit Load	Deflection in Inches: Handling Condition 1	Deflection in Inches: Handling Condition 2
20	.010	.010
0	--	.002
40	.020	.022
0	--	.005
60	.032	.033
0	.011	.006
80	.043	.042
0	.015	.010
100	.052	.048
0	.017	.011
115	.059	.058
0	.019	.015
130	.066	.064
0	.021	.017
140	.070	--
0	.023	--
150	.075	.072
0	.025	.021
160		.077
170		.081
180		.085
190		.089
200		.095
0		.031

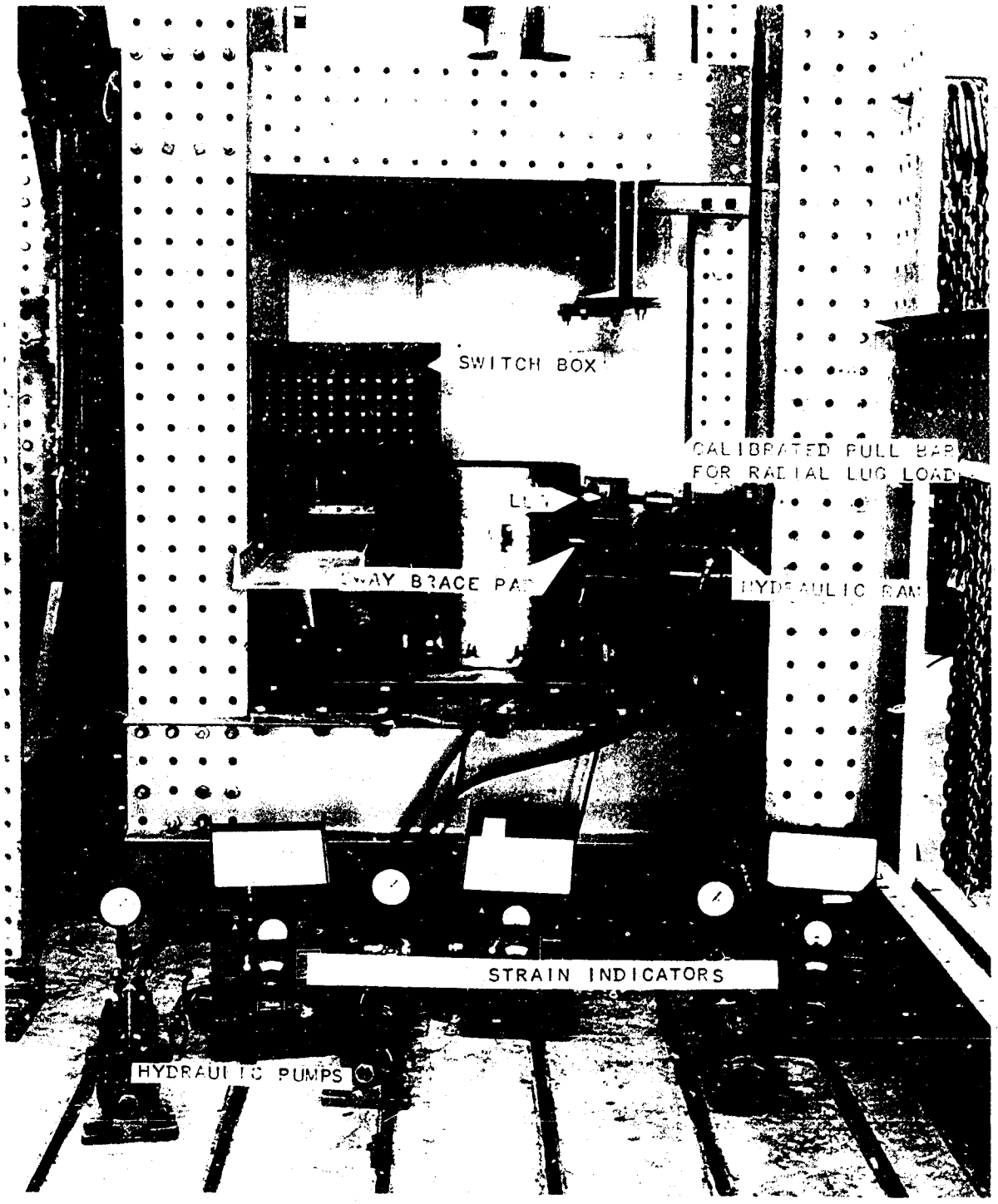

FIG. 1 -- TEST SETUP FOR CONDITION 1 (ROLLING FLIGHT) - STATIC TEST OF TX-2 ROCKUP UNIT.

D# 80649

REF. SYM: 1612 (346)
TM-412

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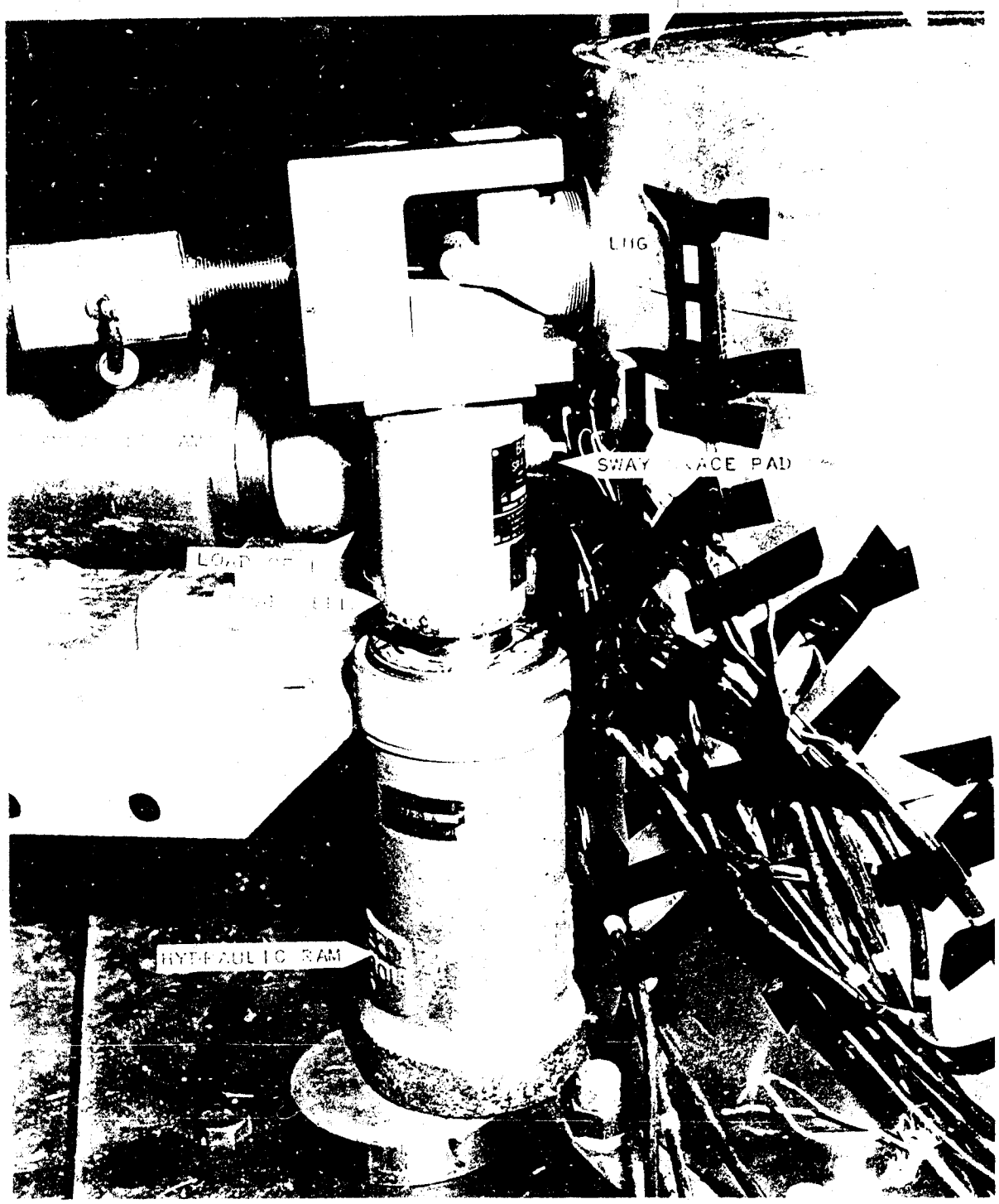

D# 80652

REF. SYS: 161P (346)
TL-412

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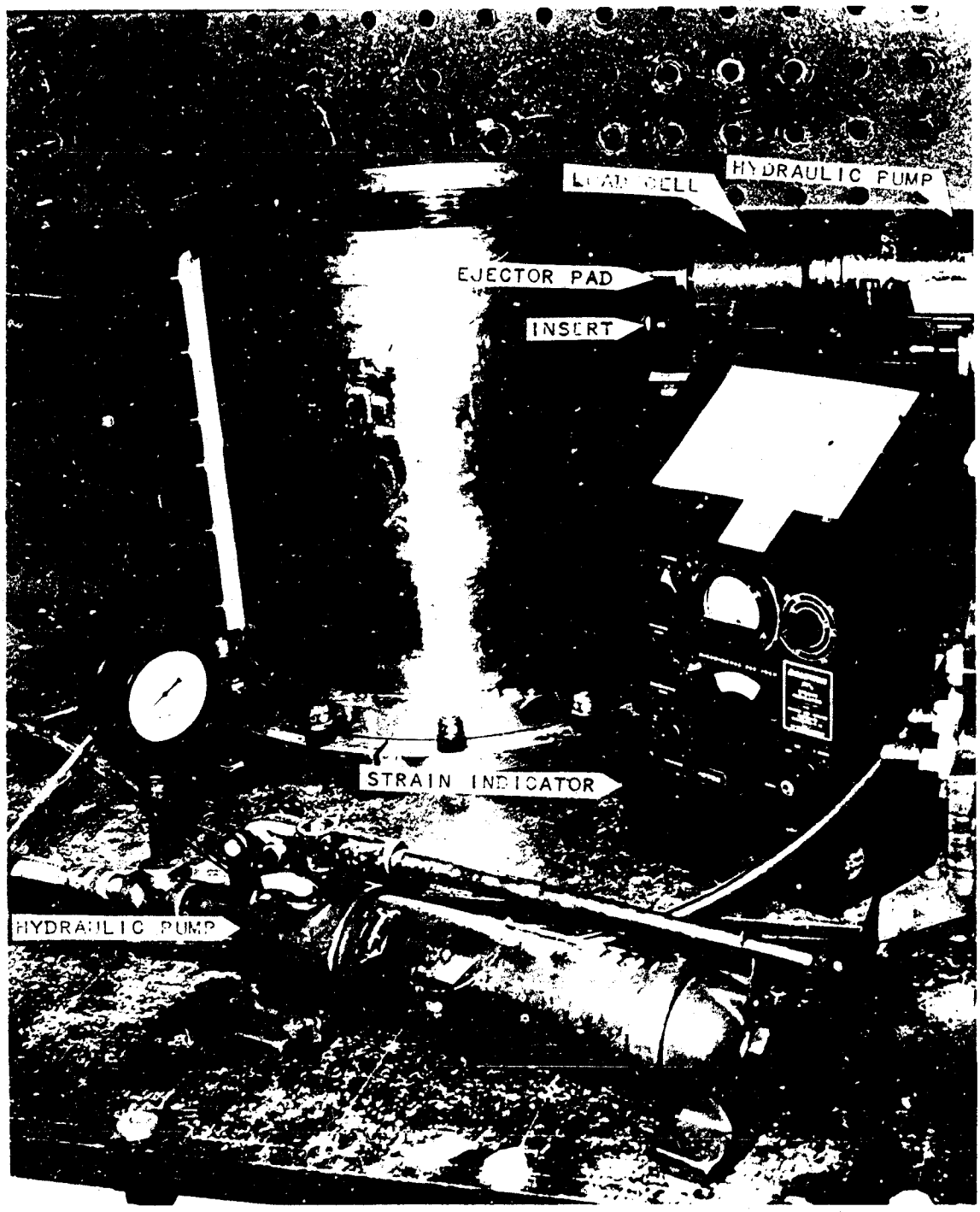

FIG. 3 -- TEST SETUP FOR CONDITION 5 (EJECTOR LOAD) - STATIC TEST OF TX-28 MOTOR UNIT

D# 80648

REF. SYM: 1612 (346)
TM-412

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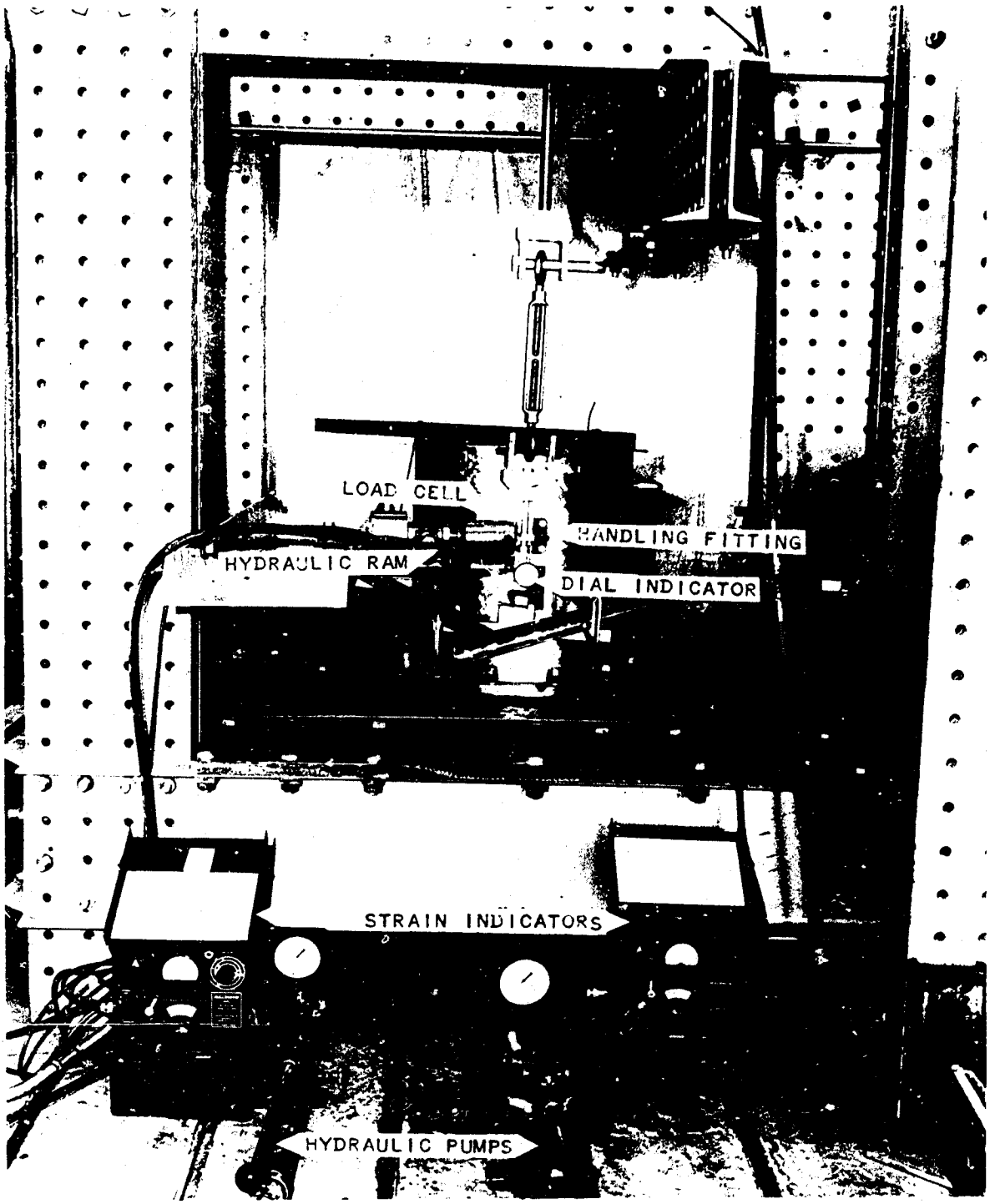

FIG. 4 -- TEST SETUP FOR HANDLING CONDITION I - STATIC TEST OF TX-28 MOCKUP UNIT

D# 80653

REF. SYM: 1612 (346)
TM-412

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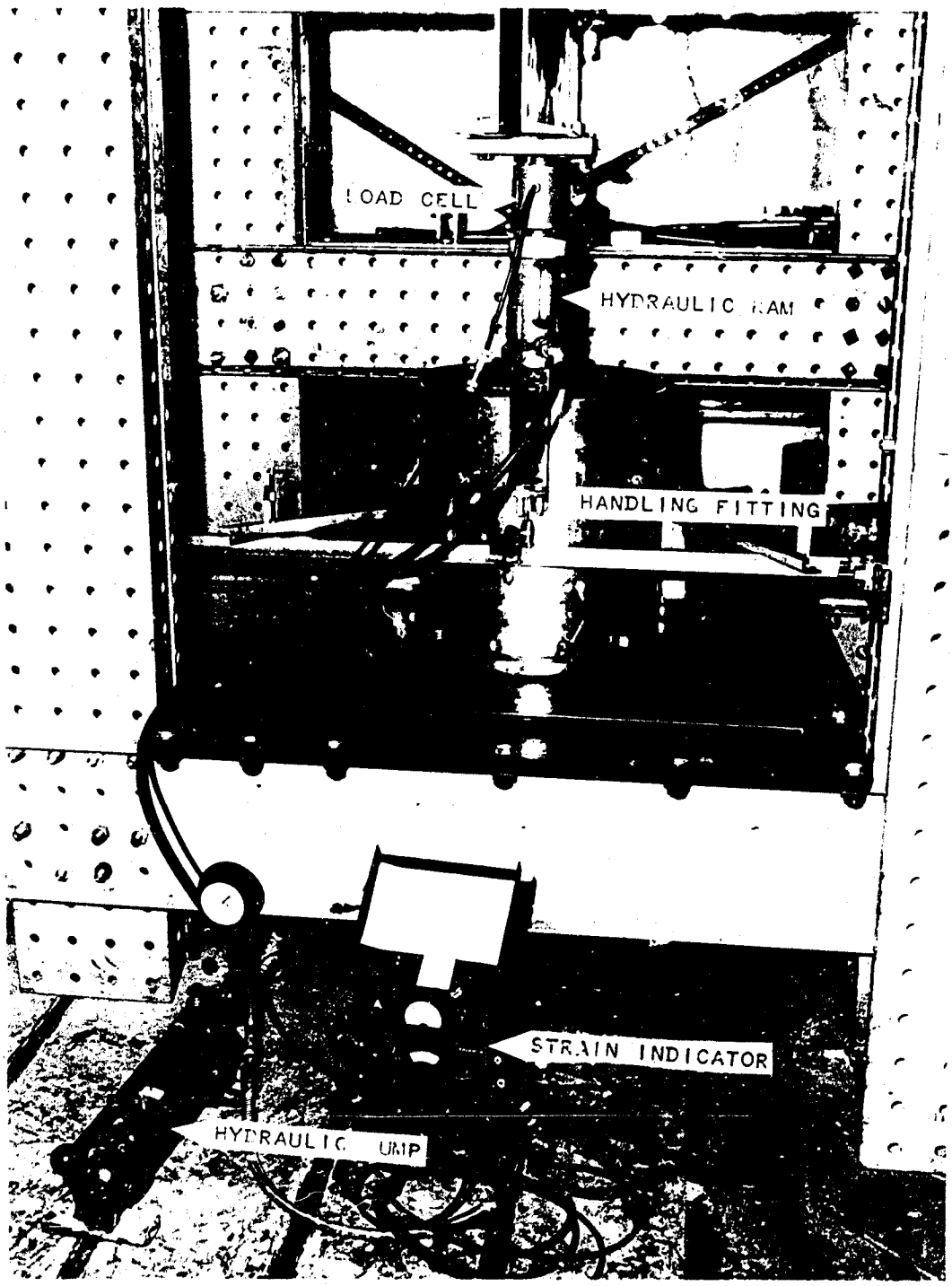

FIG. 5 -- TEST SETUP FOR HANDLING CONDITION 2 - STATIC TEST OF TX-2[illegible] PICKUP UNIT

D# 80654

REF. SYM: 1612 (346)
TM-412

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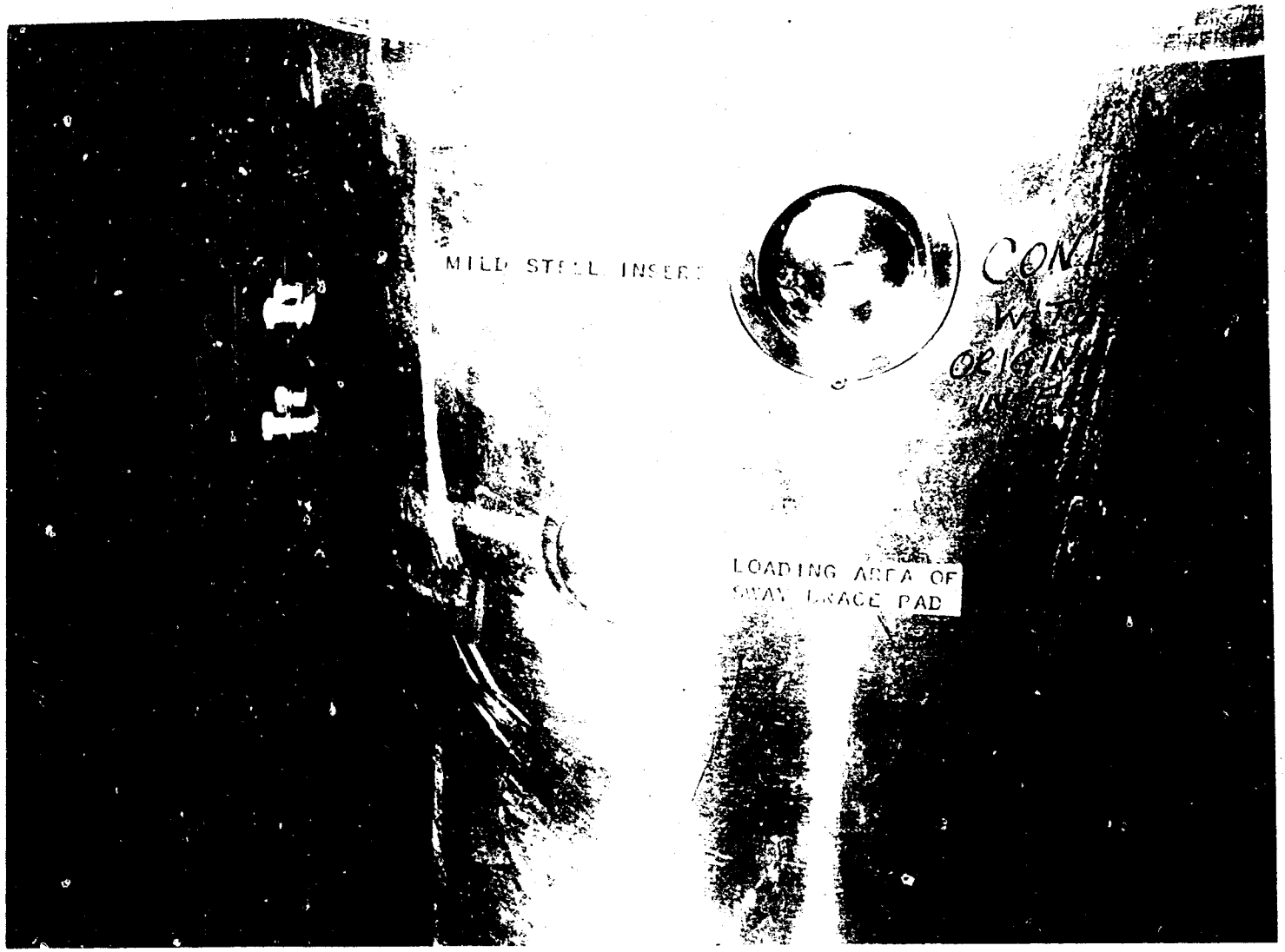

FIG. 6 -- LOCATION OF STRAIN GAGES FOR CONDITION I (ROLLING FULLOUT)
STATIC TEST OF TX-28 MOCKUP UNIT

D# 80655

REF. SYM: 1612 (346)
TM-412

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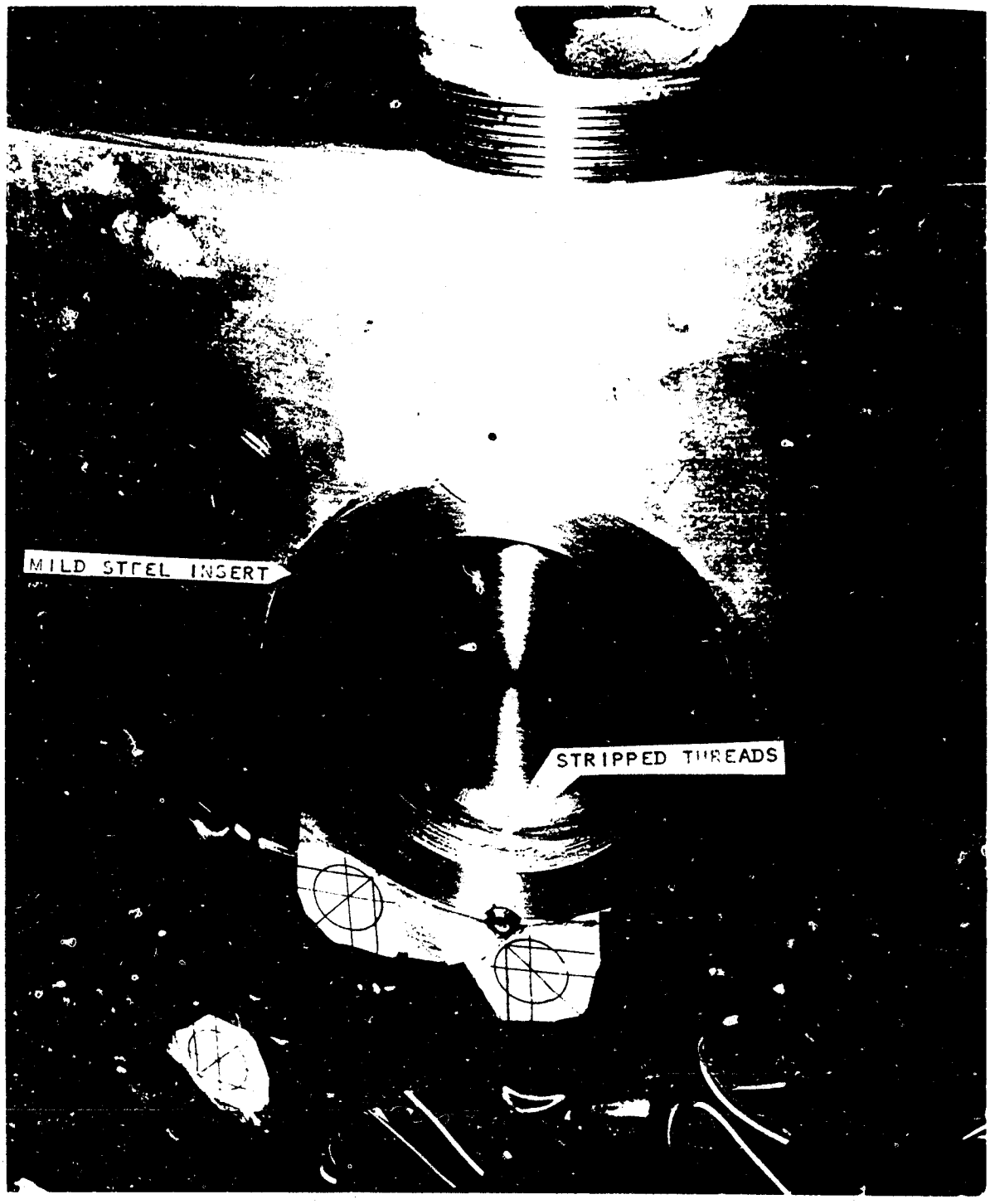

FIG. 7 -- FAILURE OF THREADS IN MILD STEEL INSERT, CONDITION I - STATIC TEST OF TX-28 MOCKUP UNIT

D# 80656

REF. SYM: 1612 (346)
TM-412

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FIG. 8 -- FAILURE OF THREADS IN ALUMINUM CASE, CONDITION I - STATIC TEST OF TX-28 MOCKUP UNIT

D# 80650

REF. SYM: 1612 (346)
TM-412

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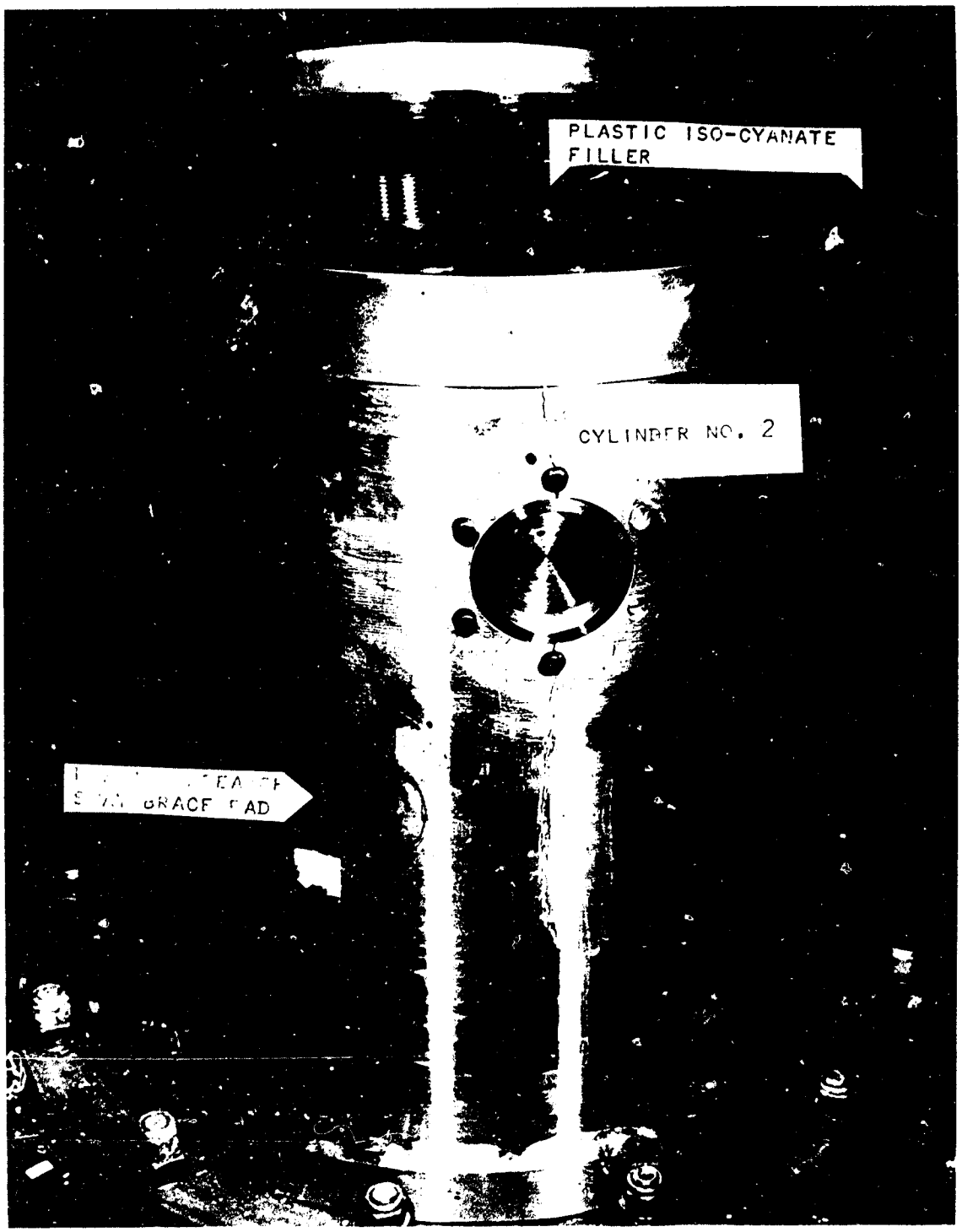

FIG. 9 -- FAILURE OF SECOND CYLINDER FROM CONDITION I - STATIC TEST OF TX-28 MOCKUP UNIT

D# 80657

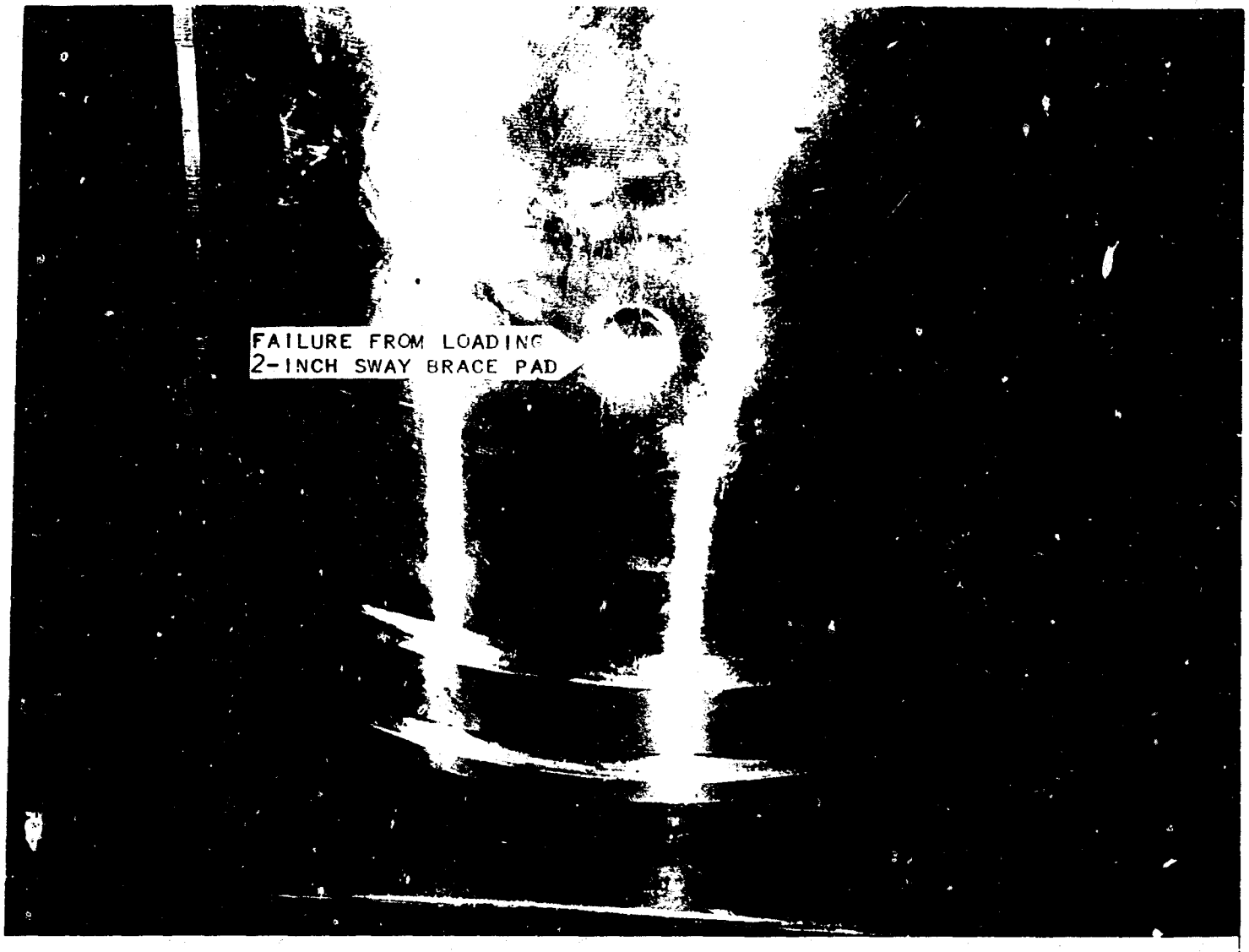

FIG. 10 -- FAILURE OF SECOND CYLINDER FROM TWO-INCH DIAMETER SWAY BRACE PAD -- STATIC TEST OF TX-28 MOCKUP UNIT.

D# 80651

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TM-412

#525

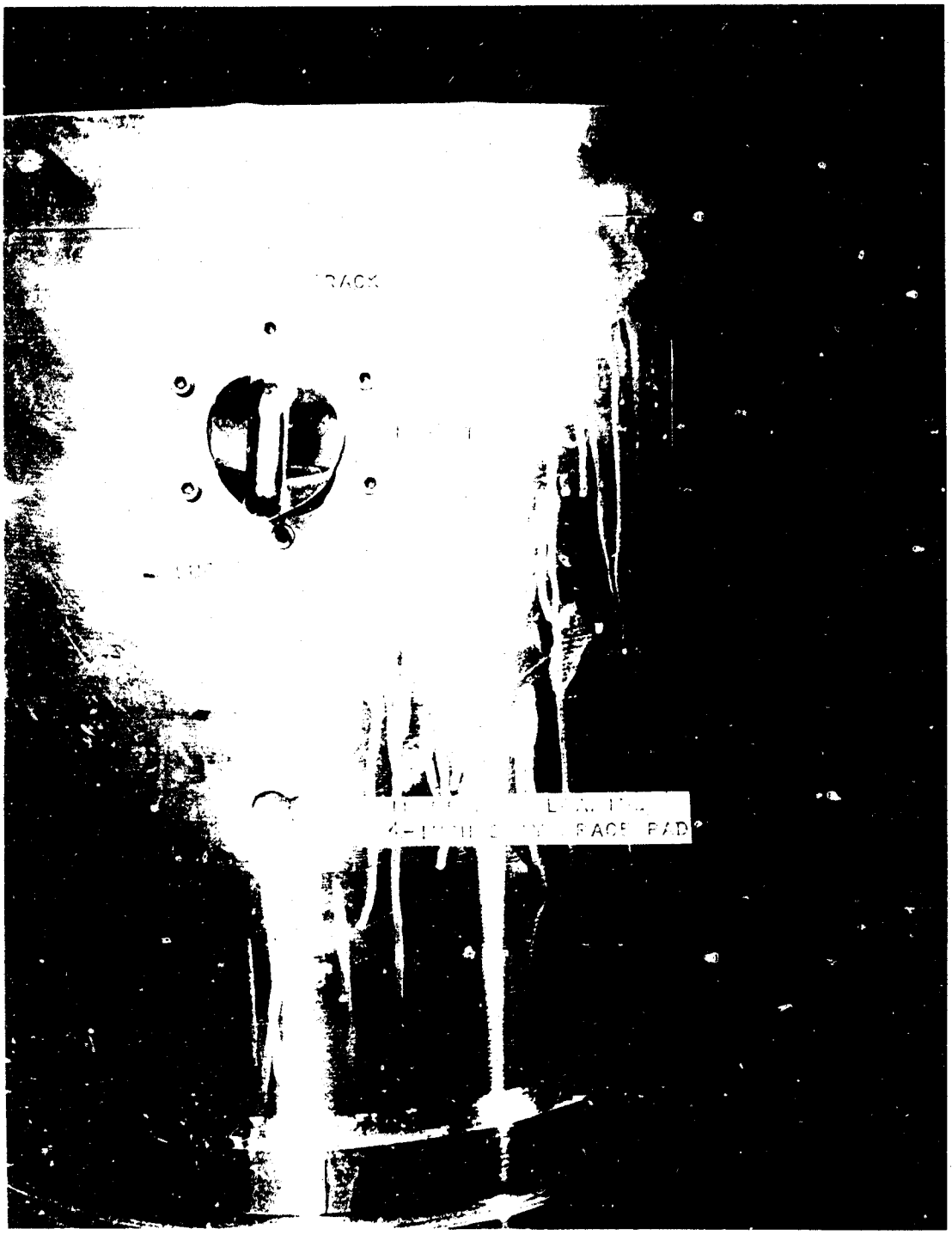

FIG. 11 -- FAILURE OF SECOND CYLINDER FROM 3/4-INCH DIAMETER SWAY BRACE PAD AND FROM LUG LOAD -- STATIC TEST OF PM-2[illegible] MOCKUP UNIT.

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PM-412

[redacted]

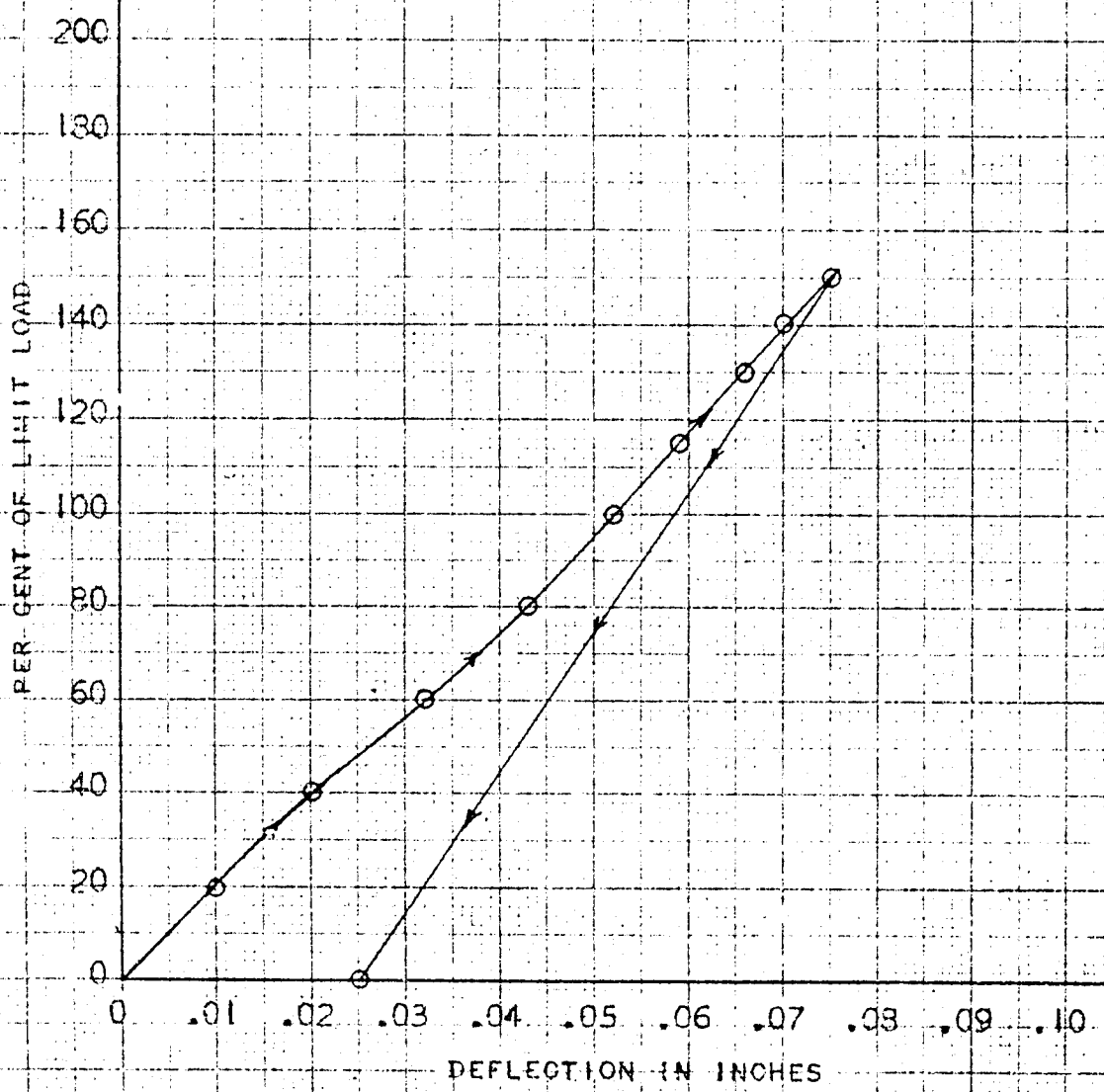

FIG. 12 -- LOAD-DEFLECTION CURVE FROM HANDLING CONDITION I -- STATIC TEST OF TX-28 MOCKUP UNIT

REF. SYM: 1612 (346)
TM-412

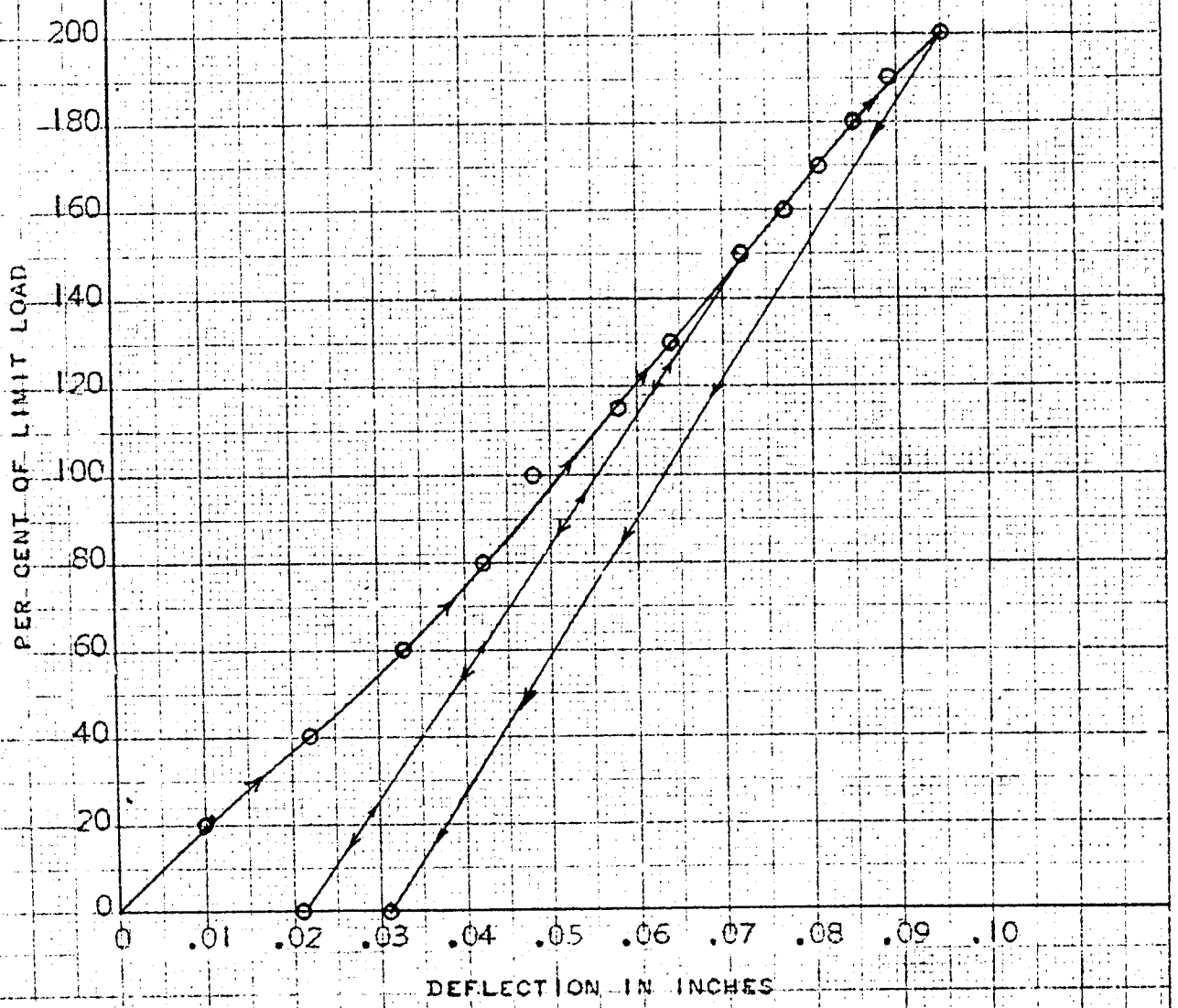

FIG. 13 -- LOAD-DEFLECTION CURVE FROM HANDLING CONDITION 2 -- STATIC TEST OF TX-28 MOCKUP UNIT

REF. SYM: 1612 (346)
TM-412