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10/22/98 R B Craner ... NR
OK for Openness
TCG-NNT-1

JAN 25 1955
Case No. 672.00
Ref. Sym: 1612 (159)
Project No. TM-243

MR. W. M. WELLS - 1332

Attn: Mr. B. G. Prentice - 1332-2

Re: Static Test of Fins on Baro Research Test Vehicle

Summary of Results

The fin assembly on the baro research test vehicle was statically loaded perpendicular to the fin until failure occurred. The weld failed on the bottom side of the right fin holder when the load reached 11,000 lbs. per fin.

Deflections were read up to a load of 9000 lbs. per fin at which load the maximum deflection of the fins was 1.731" at a distance of 4.00" from the outboard edge of the fin holder. The maximum measured strain on the fins at a load of 11,000 lbs., just prior to failure of the weld, was slightly in excess of 10,000 micro-inches per inch.

Object of Test

The test was conducted to determine the ultimate strength and load-deflection characteristics of the fin assembly under a load distribution simulating air loads in flight.

Reason for Test

The test was requested in a Work Order Authorization dated September 24, 1954 from Mr. W. M. Wells, 1332 to Mr. P. H. Adams, 1612. The test of a second fin holder without instrumentation as requested in the Work Order Authorization was omitted at the request of the consultant. The requestor's consultant was Mr. B. G. Prentice.

Function of Object Tested

The fin assembly acts as a stabilizer for a high speed test vehicle.

Summary of Past Test

No previous static tests have been performed on this fin assembly.

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Setup for Test

The object being tested was attached to the jig with four bolts. The longitudinal axis of the cylinder and the surface of the fins were parallel to the floor. The setup for loading with instrumentation is shown in Figs. 1 and 2. An identical setup minus the instrumentation was used in the loading to develop cracks in the Stresscoat. The Sadic System, Fig. 3, was used to measure and automatically record the output of the strain gages.

The drawings which pertain to the object tested are as follows:

Title	Drawing No.
Fin	SK(1332)-39200
Fin Holder	SK(1332)-39149
Fin Assembly	SK(1332)-39148
Static Test Loads, Fin Assembly	SK(1332)-39651

The following equipment was used in the test:

2 - SR-4 Type L strain indicators, Serial Nos. J-92499 and J-92498

2 - SR-4 Load cells, 10,000 lb. cap., Serial Nos. 655 and 6049

1 - Simplex hydraulic pump, Serial No. 684

1 - Blackhawk hydraulic pump, Serial No. C-196577

2 - Blackhawk rams, 50 ten cap., Serial Nos. B-282295 and C-19101

1 - Sadic Automatic Data Processing System, Model 34-112M1

The following instrumentation was used:

16 - A-8 strain gages, resistance 119.5 ± .3 ohms, gage factor 1.83 ± 2%, Lot No. 232-11
The location of these strain gages is shown in Figs. 4 and 5.

5 - Starrett dial indicators, graduated to .001" with a range of 1.0". The location of these indicators is shown in Figs. 1 and 2.

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Precedure

Stresscoat was applied to the fin assembly after which the assembly was mounted to the static jig. The loads were applied to the under side of the fins by means of two hydraulic rams and measured by load cells used in conjunction with strain indicators.

The fins were loaded to a specific value, the load was released and the fin assembly was examined for cracks in the Stresscoat. This procedure was repeated with each load being 1.2 times the preceding value until a load of 2160 pounds was reached. The initial load was 200 lbs.

After completion of the phase of the test pertaining to Stresscoat, the Stresscoat was removed from the fin assembly and sixteen A-8 strain gages were mounted as shown in Figs. 4 and 5. The fin assembly was again mounted to the static jig as shown in Figs. 1 and 2 and loads were applied to the fins by the two calibrated load cells mounted on hydraulic rams. The loads were applied in increments of 500 lbs. beginning with zero load. After each load increment of 500 lbs., the dial indicators were read and the Sadic System measured and recorded the strain of the strain gages. This procedure was repeated until a load of 9000 lbs. per fin was reached. At 9000 lbs., a minor failure occurred in the hardware attaching the fin assembly to the static jig which necessitated releasing of the loads. While the fins were unloaded, the four dial indicators on the fins were read. The failure was repaired and the fin assembly was again loaded until failure of a weld occurred.

Results

The results of loading the fin assembly to produce cracks in the Stresscoat are shown in Figs. 6, 7, 8, and 9. The initial cracks, designated as No. 1, occurred at a load of 500 lbs. The final cracks, outside the line bounding area No. 8, occurred at a load of 2160 lbs. With a threshold sensitivity of 600 micro-inches per inch for the Stresscoat, it can be concluded that the cracks formed in the aluminum (75S-T6) fin when the stresses reached about 6000 psi. Similarly, it can be concluded that the cracks formed in the steel fin holder at a stress of approximately 18,000 psi. The calculated stresses on the fins and fin holder with a load of 2160 lbs. per fin are shown in Table I.

When loaded to ultimate strength, a failure occurred in the weld attaching the fin holder to the cylinder at a load of 11,000 lbs. per fin as shown in Fig. 10.

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Ref. Sym: 1612 (159)

The deflections, with a load of 9000 lbs. per fin, as read on dial indicators Nos. 1, 2, 3, 4, and 5, were 1.310, 1.633, 1.404, 1.731, and 1.013 inches, respectively. The load vs deflection curves are shown on Fig. 11. After loading up to 9000 lbs. per fin and then releasing the load to zero, the deflections, with zero load for dial indicators Nos. 1, 2, 3, and 4, were 0.162, 0.204, 0.270, and 0.289 inches, respectively. No comparable reading was taken for dial indicator No. 5. The deflections as plotted on Fig. 11 are tabulated in Table II.

The tabulation of the strains for the 16 strain gages are shown in Tables III, IV, and V from which the load vs strain curves were plotted as shown in Figs. 12, 13, 14, 15, and 16. The readings of strain gages No. 6 and 9 appeared unreliable for loads exceeding 9000 lbs. per fin and have been omitted from load vs strain curves. No reason for this unreliability is apparent. Strain gage No. 5 experienced the greatest strain slightly exceeding 10,000 microinches per inch. The last reading for gage No. 5, at a 11,000 lb. load, was 9990 microinches per inch. However, the Sadic System indicated that reading was not a firm value since the range was limited to 9990 microinches per inch. From extrapolation, it is concluded that the last reading should have been about 10,500 microinches per inch.

Strain gages No. 13, 14, 15, and 16, on the fin holder, experienced rather small strains. The greatest strain of these four gages was 2060 microinches per inch. Prior to the test, it was thought that gages No. 14 and 16 would develop rather large strains. However, following the test, and upon closer examination of the equilibrium of forces between the fin and the fin holder it is concluded that the strains should be relatively small at the location of gages No. 14 and 16.

Conclusions

It is concluded that the strength of the fin assembly is adequate and that the deflections under the static test loads are not excessive.

HARRY P. WHEELER - 1612-2

Approved by: PAUL H. ADAMS - 1612

HPW:1612-2:as

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Ref. Sym: 1612 (159)
Project No. TM-243

Copy to:
T. B. Morse, 1610
W. E. Caldes, 5513
J. P. Wamser, 1282
F. C. Hale, 1925-2
G. M. Byrne, 1922-2

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Ref. Sym: 1612 (159)
Project No. TM-243

TABLE I

CALCULATED STRESSES FROM STRESSCOAT PATTERN -- STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

Load Number	Magnitude of Load (lbs)	Location of Stresscoat Patterns (Ref. Nos. in Figs. 6 - 9)		Calculated Stresses at Load of 2160 lbs. and at Stresscoat Pattern Locations (psi)	
				Steel	Aluminum
1	200	No Patterns		less than 18,000	less than 6000
2	240	No Patterns		less than 18,000	less than 6000
3	290	No Patterns		less than 18,000	less than 6000
4	350	No Patterns		less than 18,000	less than 6000
5	420	No Patterns		less than 18,000	less than 6000
6	500	1	$\frac{(2160)}{(500)}(E)(\epsilon)$	77,800	25,900
7	600	2	$\frac{(2160)}{(600)}(E)(\epsilon)$	64,800	21,600
8	720	3	$\frac{(2160)}{(720)}(E)(\epsilon)$	54,000	18,000
9	860	4	$\frac{(2160)}{(860)}(E)(\epsilon)$	45,200	15,100
10	1040	5	$\frac{(2160)}{(1040)}(E)(\epsilon)$	37,200	12,500
11	1250	6	$\frac{(2160)}{(1250)}(E)(\epsilon)$	31,100	10,400
12	1500	7	$\frac{(2160)}{(1500)}(E)(\epsilon)$	25,900	8,600
13	1800	8	$\frac{(2160)}{(1800)}(E)(\epsilon)$	21,600	7,200
14	2160	All others	$\frac{(2160)}{(2160)}(E)(\epsilon)$	18,000	6,000

NOTE: Time increments for loading are sufficiently short to neglect creep of stresscoat.

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TABLE II

DEFLECTIONS - STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

Load lbs.	Deflection in inches of Dial Indicators				
	No. 1	No. 2	No. 3	No. 4	No. 5
0	0	0	0	0	0
500	.050	.060	.046	.067	.048
1000	.111	.139	.111	.148	.101
1500	.176	.223	.183	.236	.159
2000	.243	.310	.259	.330	.221
2500	.309	.394	.331	.417	.277
3000	.376	.480	.409	.509	.331
3500	.447	.569	.486	.599	.381
4000	.517	.657	.564	.692	.435
4500	.599	.756	.648	.791	.495
5000	.677	.845	.724	.882	.550
5500	.746	.933	.803	.978	.604
6000	.825	1.029	.885	1.077	.660
6500	.899	1.120	.963	1.174	.713
7000	.977	1.219	1.049	1.278	.769
7500	1.057	1.316	1.145	1.395	.826
8000	1.136	1.416	1.218	1.493	.885
8500	1.219	1.519	1.308	1.609	.947
9000	1.310	1.633	1.404	1.731	1.013
0	0.162	0.204	0.270	.289	---

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TABLE III

STRAINS FOR GAGES NO. 1 TO 6 INCLUSIVE - STATIC TEST OF FINS ON BARO RESEARCH VEHICLE

Load lbs.	Strain in Micro-inches per inch for Strain Gages No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	8	-2	6	6	8	11
500	-182	-306	-182	-179	-243	-217
1000	-368	-612	-389	-356	-499	-452
1500	-539	-888	-596	-529	-766	-636
2000	-740	-1160	-820	-710	-1020	-820
2500	-920	-1430	-980	-880	-1270	-960
3000	-1110	-1760	-1160	-1110	-1510	-1140
3500	-1330	-2070	-1330	-1330	-1730	-1260
4000	-1520	-2330	-1460	-1540	-1970	-1460
4500	-1720	-2580	-1620	-1770	-2230	-1640
5000	-1930	-2870	-1720	-2010	-2460	-1780
5500	-2150	-3110	-1830	-2250	-2680	-1970
6000	-2360	-3490	-1920	-2480	-2940	-2180
6500	-2580	-3850	-1990	-2730	-3220	-2380
7000	-2830	-4170	-2100	-2980	-3580	-2620
7500	-3110	-4490	-2180	-3250	-4010	-2850
8000	-3320	-4780	-2330	-3480	-4910	-3090
8500	-3570	-5150	-2500	-3790	-6230	-3340
9000	-3840	-5470	-2680	-4050	-7220	-3590
Load on fins released to zero and then reloaded.						
9500	-4180	---	-3050	-4460	-7930	-5690
10,000	-4400	-6040	-3120	-4650	-8540	-5760
10,500	-4660	-6540	-3300	-4940	-9560	-5850
11,000	-4960	-7210	-3460	-5220	*-9990	-6000

NOTE: Minus strain indicates compression.
Plus strain indicates tension

* Capability of machine.

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TABLE IV

STRAINS FOR GAGES NO. 7 TO 12 INCLUSIVE - STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

Load lbs.	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12
0	4	6	6	10	6	20
500	183	326	264	188	225	276
1000	368	579	533	375	474	481
1500	547	825	808	553	715	671
2000	740	1040	1050	740	930	860
2500	920	1240	1240	950	1140	1050
3000	1130	1460	1440	1180	1350	1230
3500	1340	1690	1640	1430	1570	1410
4000	1550	1890	1830	1670	1800	1620
4500	1780	2120	2020	1930	2040	1820
5000	2010	2330	2170	2180	2250	2030
5500	2230	2540	2340	2450	2490	2250
6000	2450	2780	2520	2720	2710	2470
6500	2680	3020	2650	2990	2930	2680
7000	2910	3250	2830	3270	3160	2920
7500	3120	3460	2930	3560	3370	3150
8000	3270	3640	3000	3810	3560	3350
8500	3450	3870	3180	4070	3820	3620
9000	3630	4070	3320	4280	4020	3860
Load on fins released to zero and then reloaded.						
9500	3850	4350	6140	4740	--	--
10,000	4060	4530	6390	5010	4330	4510
10,500	4350	4750	6670	5250	4480	4690
11,000	4640	4930	6960	5520	4640	4920

NOTE: Minus strain indicates compression and plus strain indicates tension.

TABLE V

STRAINS FOR GAGES NO. 13 TO 16 INCLUSIVE - STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

Load lbs.	Strain in Micro-inches per inch for Strain Gages No. 13	No. 14	No. 15	No. 16
0	10	4	8	15
500	-43	179	-23	190
1000	-89	465	-65	438
1500	-120	752	-102	703
2000	-140	1010	-130	970
2500	-170	1230	-160	1160
3000	-220	1350	-190	1310
3500	-240	1470	-230	1430
4000	-260	1590	-250	1540
4500	-290	1700	-280	1630
5000	-340	1790	-330	1700
5500	-380	1870	-360	1790
6000	-430	1930	-390	1850
6500	-460	1990	-430	1910
7000	-530	2010	-460	1970
7500	-650	1840	-520	2010
8000	-730	1800	-540	2010
8500	-790	1780	-570	2040
9000	-860	1760	-620	2060
Load on fins released to zero and then reloaded.				
9500	--	--	-640	2050
10,000	-1150	1820	-650	2060
10,500	-1220	1820	-680	2060
11,000	-1300	1810	-730	1940

NOTE: Minus strain indicates compression and plus strain indicates tension.

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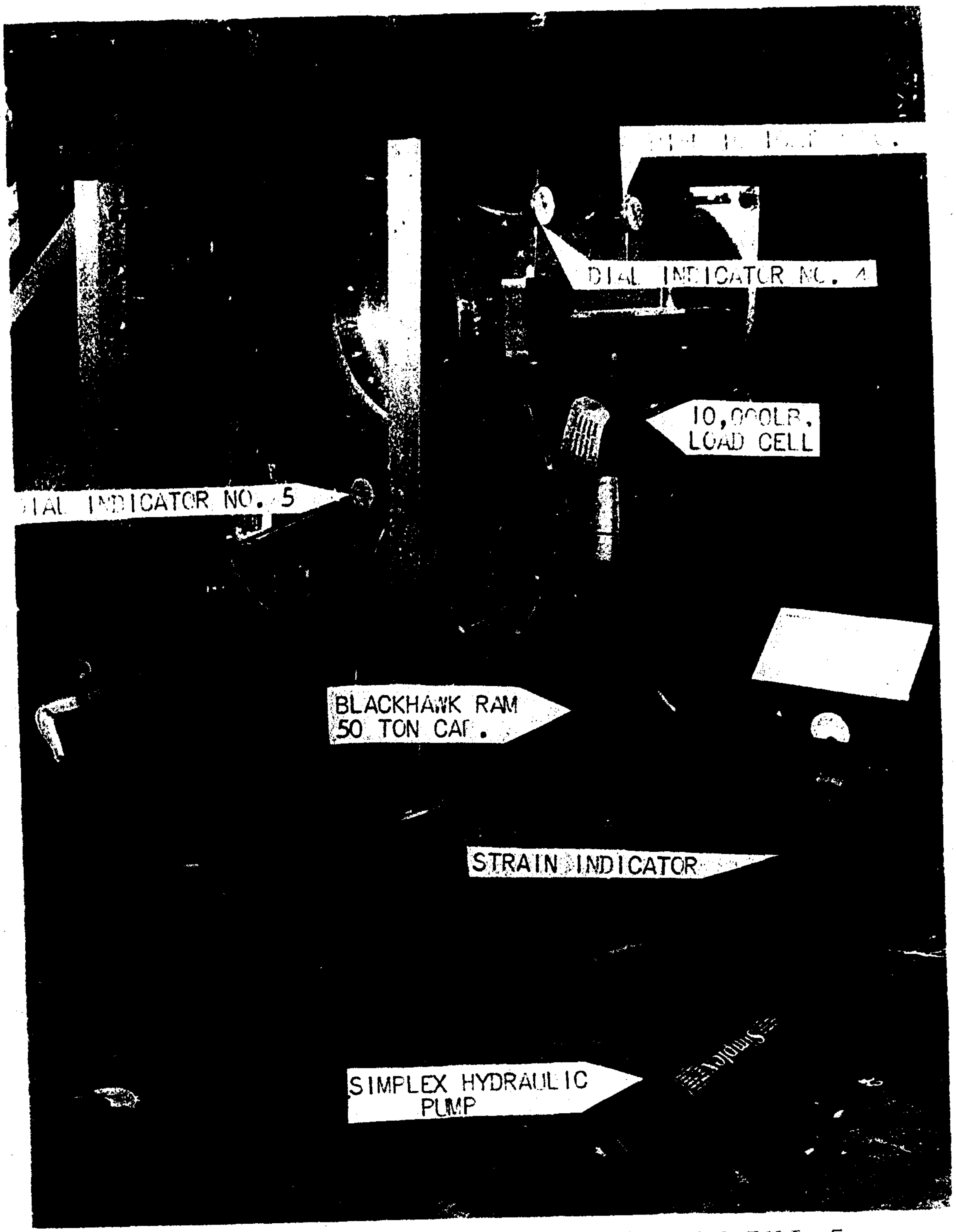

[illegible] OF TEST SETUP [illegible] SIDE--STATIC TEST OF [illegible] RESEARCH TEST VEHICLE

D# 56271

T[illegible]-243
[illegible]

[redacted]

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[redacted]

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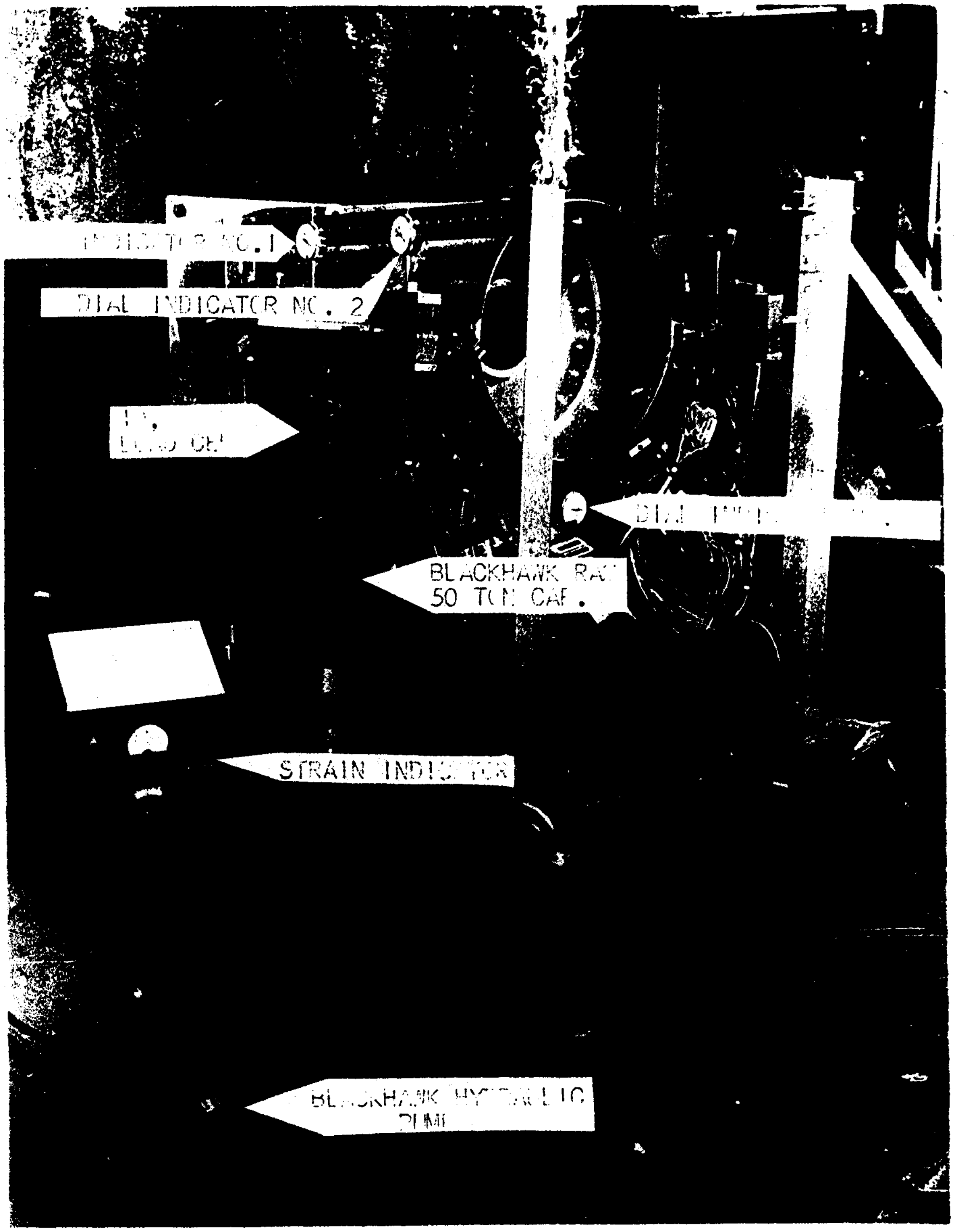

[illegible]--VIEW OF TEST SETUP FROM LEFT SIDE--STATIC TEST OF FINS [illegible] RESEARCH TEST VEHICLE

D# 56270

TL-213
REF. [illegible]

[redacted]

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[redacted]

D# 55238

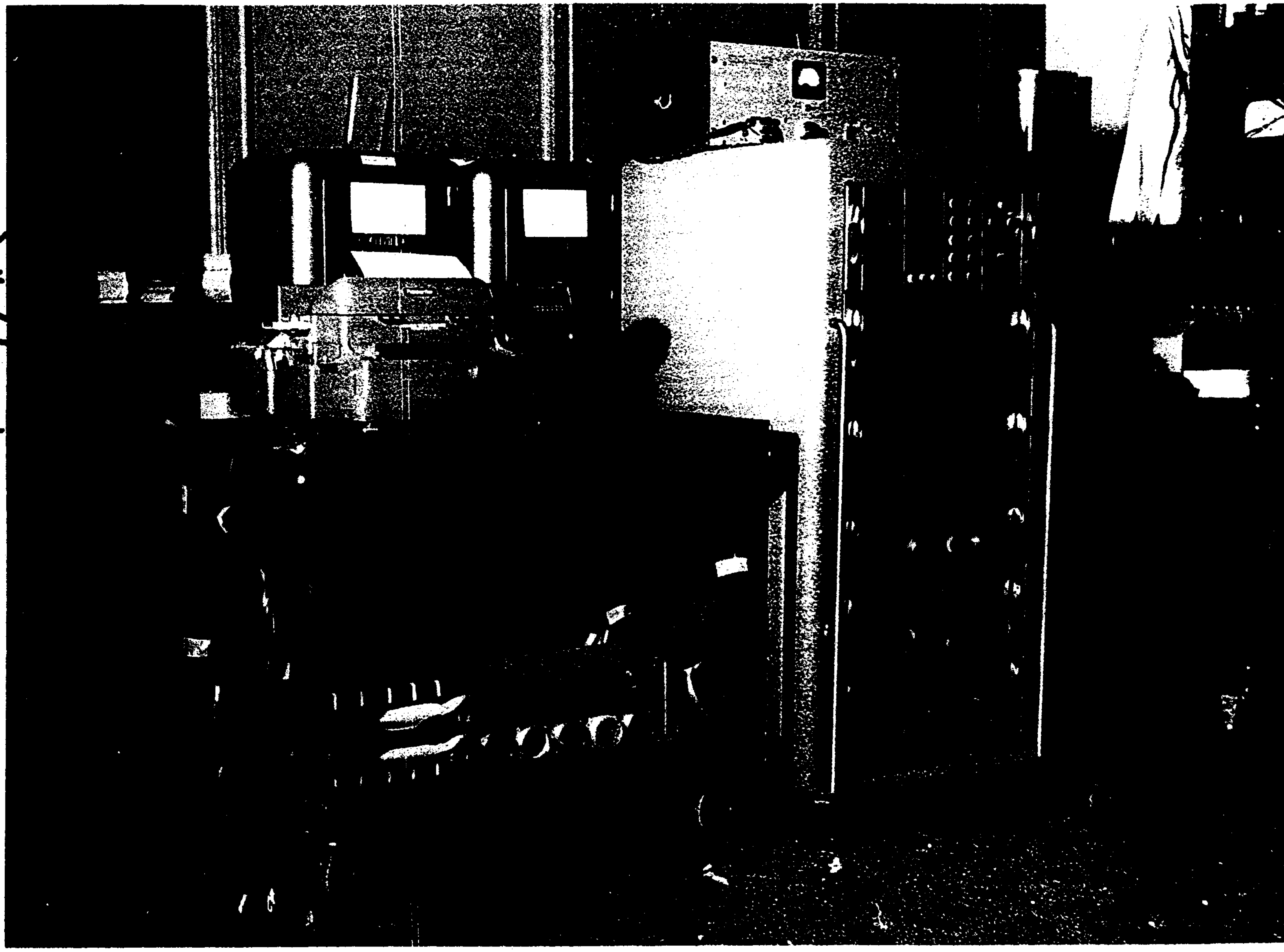

FIG. 3--SADIC AUTOMATIC DATA PROCESSING SYSTEM, MODEL 34-112MI--STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

TM-243
REF. SYM: 1612(159)

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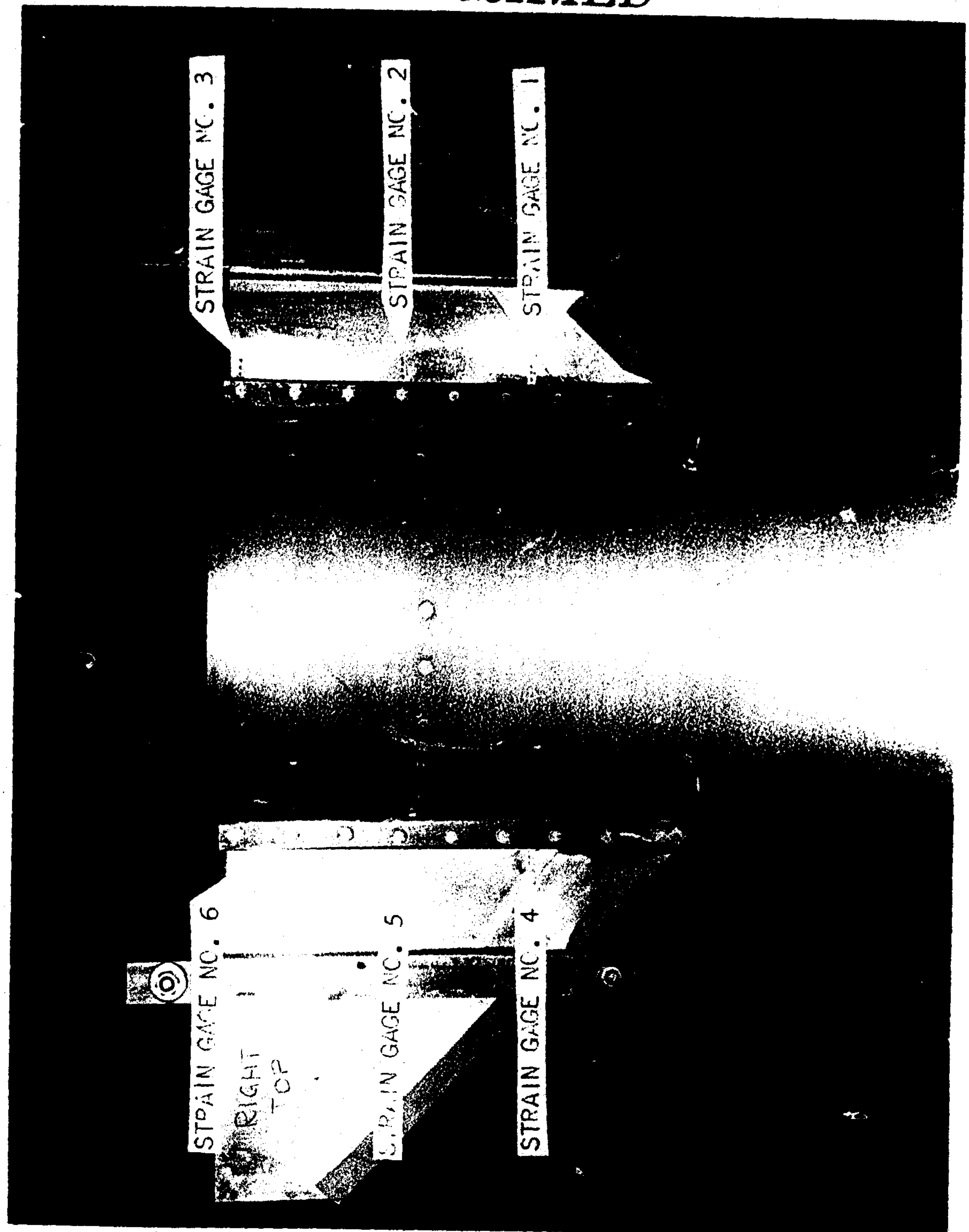

FIG. 4--STRAIN GAGES ON TOP OF FINS--STATIC TEST OF FINS ON RAPC RESEARCH TEST VEHICLE

D# 56273

TM-213
REF. SYM: 1-12-1[illegible]

[redacted]

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[redacted]

UNCLASSIFIED

#7792

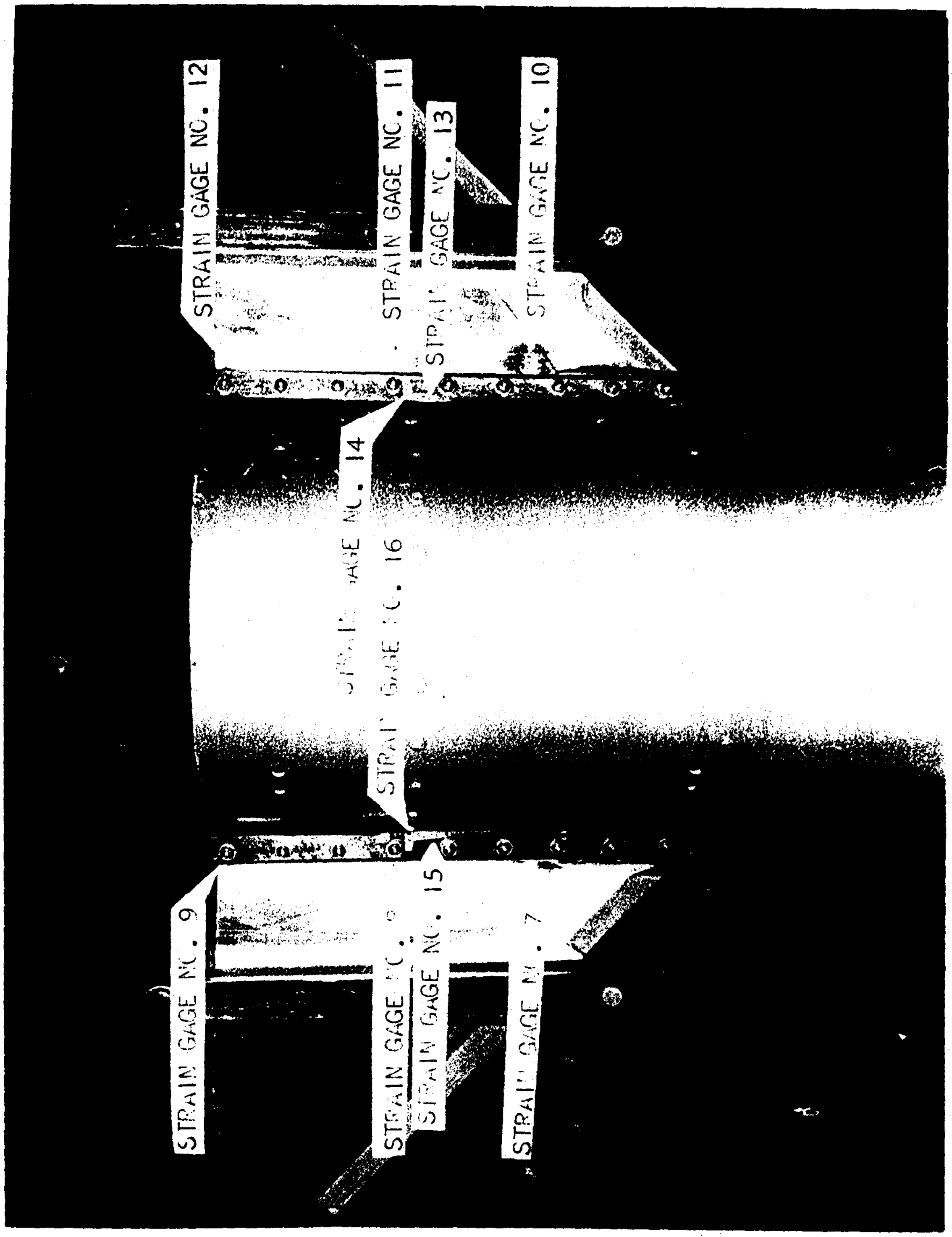

FIG. [illegible]--STRAIN GAGES [illegible] FINS--STATIC TEST OF FINS [illegible] RESEARCH TEST VEHICLE

D#56272

TM-[illegible]
REF. SY: [illegible]

[redacted]

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FIG. 6--STRESSCOAT CRACKS ON BOTTOM SURFACE, RIGHT FIN--STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

[redacted]

#1794

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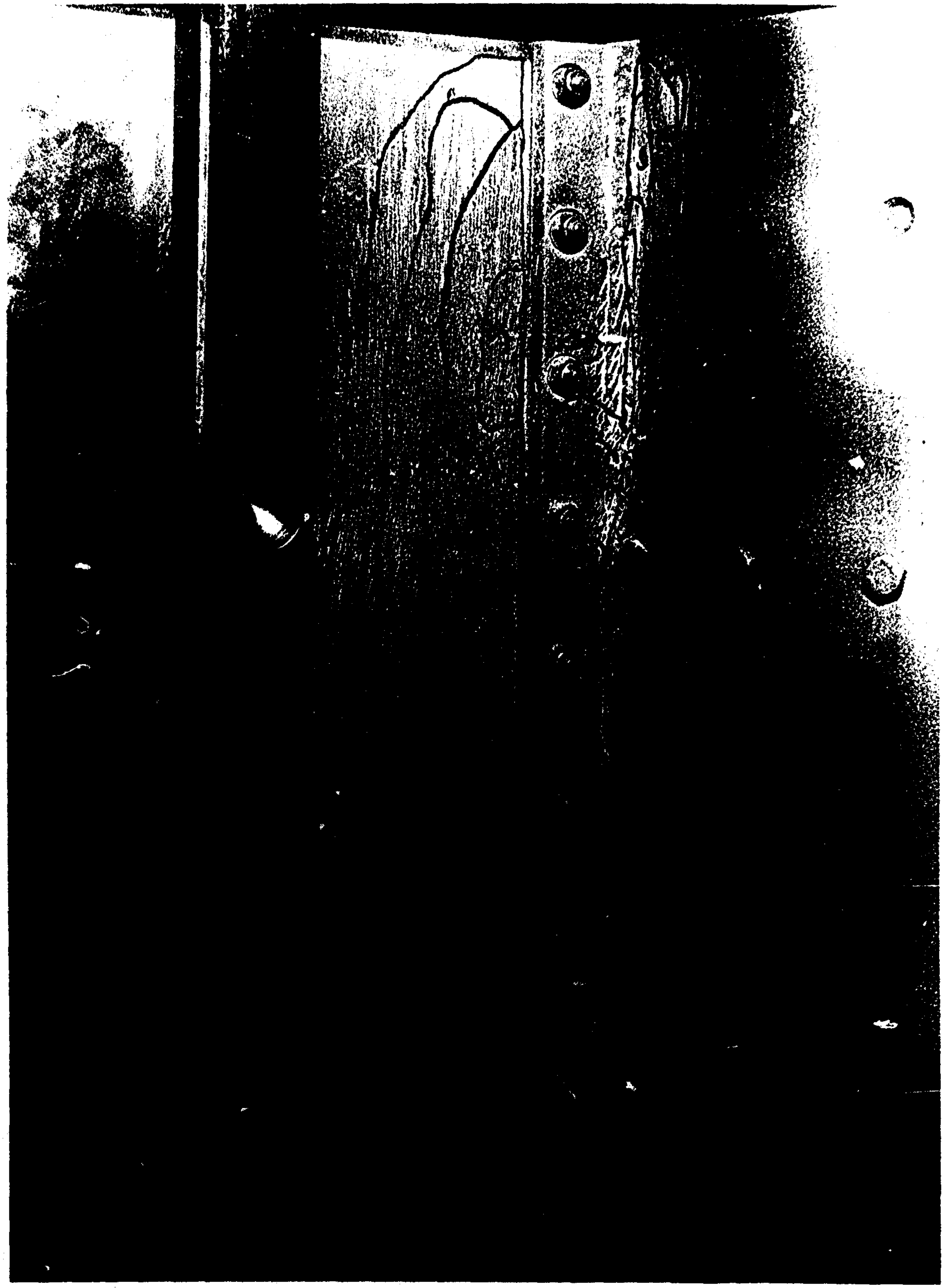

FIG. 7--STRESSCOAT CRACKS ON BOTTOM SURFACE, LEFT FIN--STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

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TM-243
REF. SYM: 1612(159)

[redacted]

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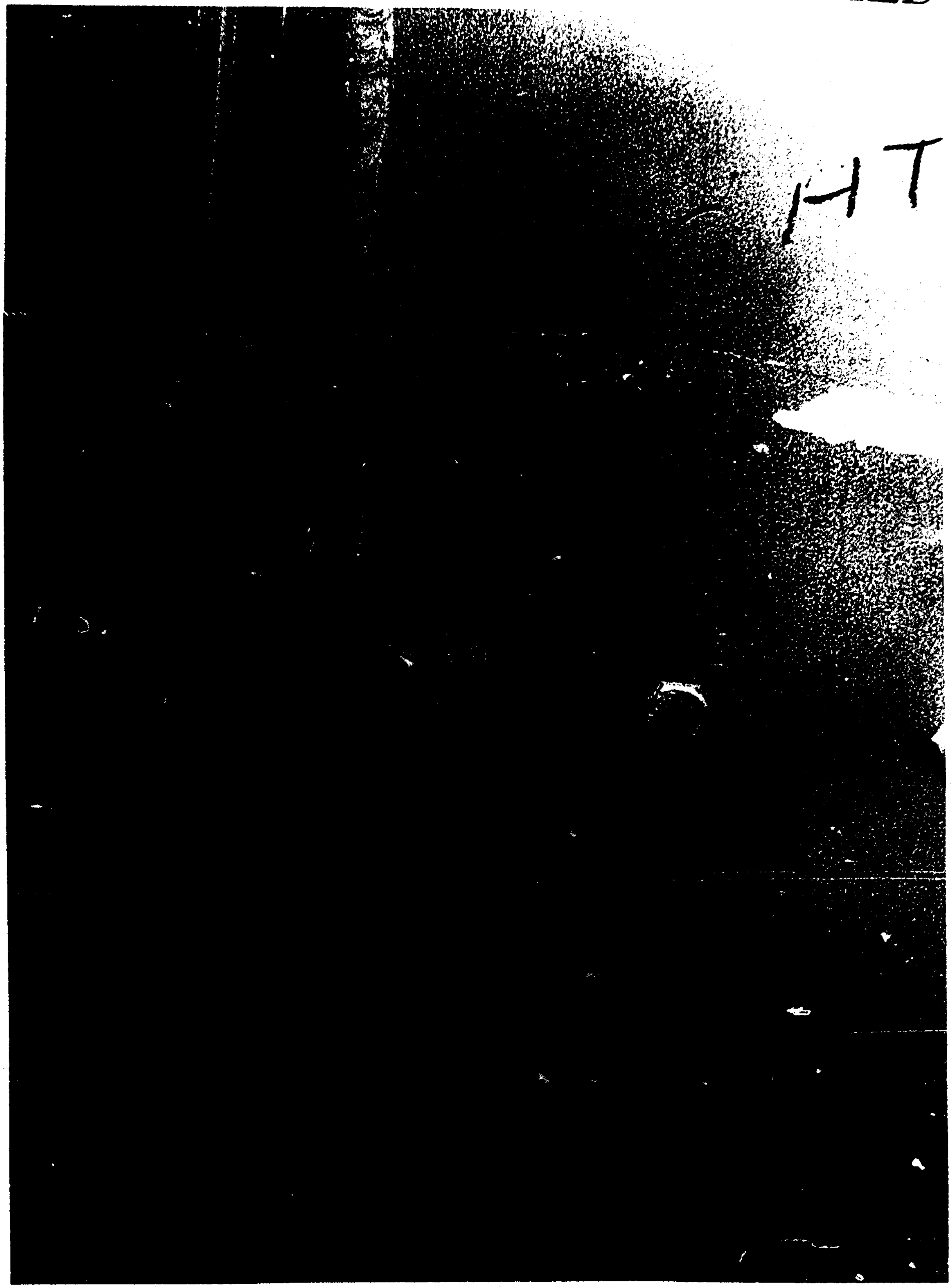

FIG. 8--STRESSCOAT CRACKS ON CYLINDRICAL SURFACE ABOVE RIGHT FIN--
STATIC TEST OF FINS ON BARO RESEARCH TEST VEHICLE

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UNCLASSIFIED

TN-243
REF. SYM: 1612(159)

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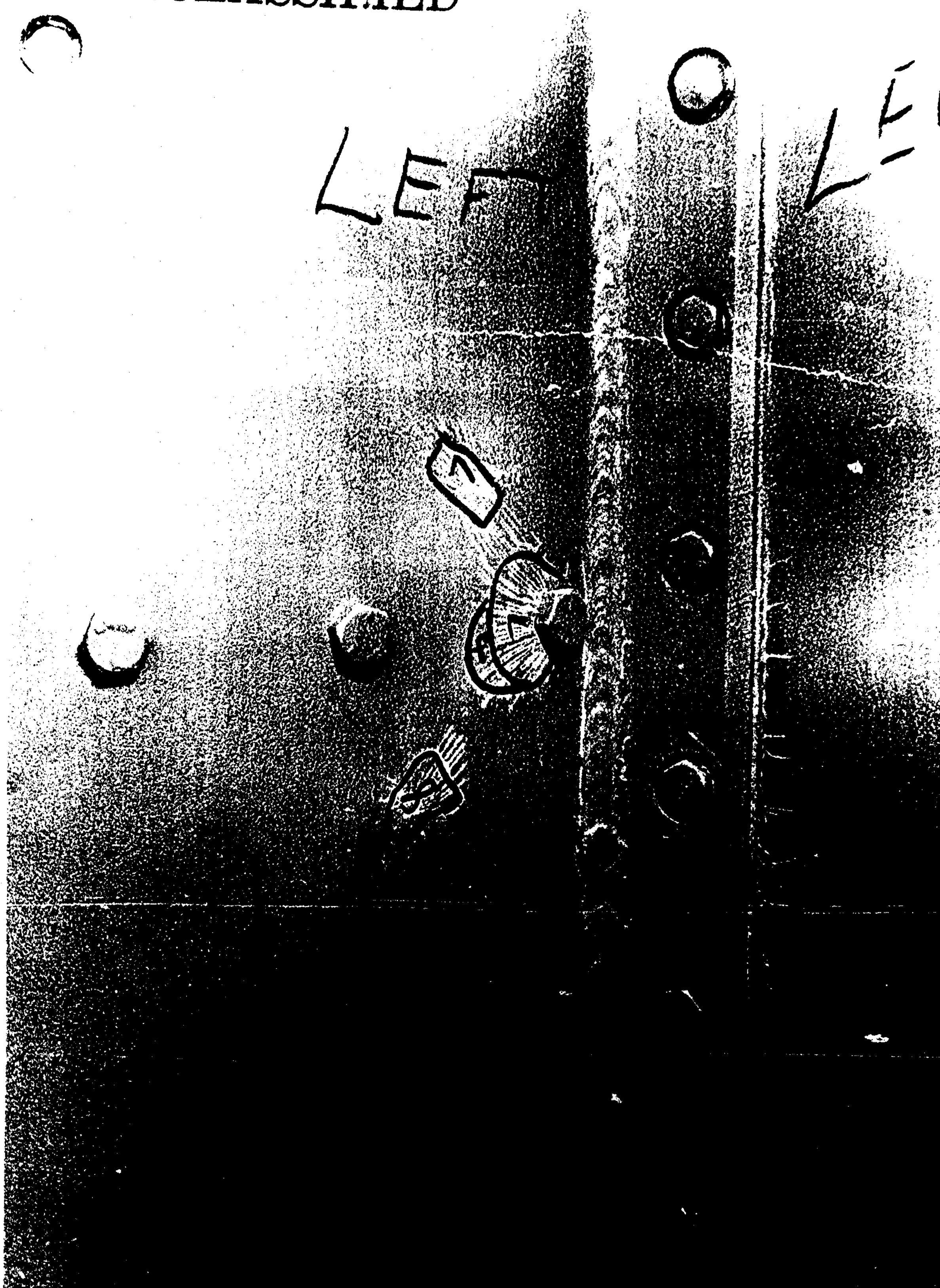

FIG. 9--STRESSCOAT CRACKS ON CYLINDRICAL SURFACE ABOVE LEFT FIN--STATIC TEST OF FINS ON BARC RESEARCH TEST VEHICLE

D#54651

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TM-243
REF. SYM: 1612(159)

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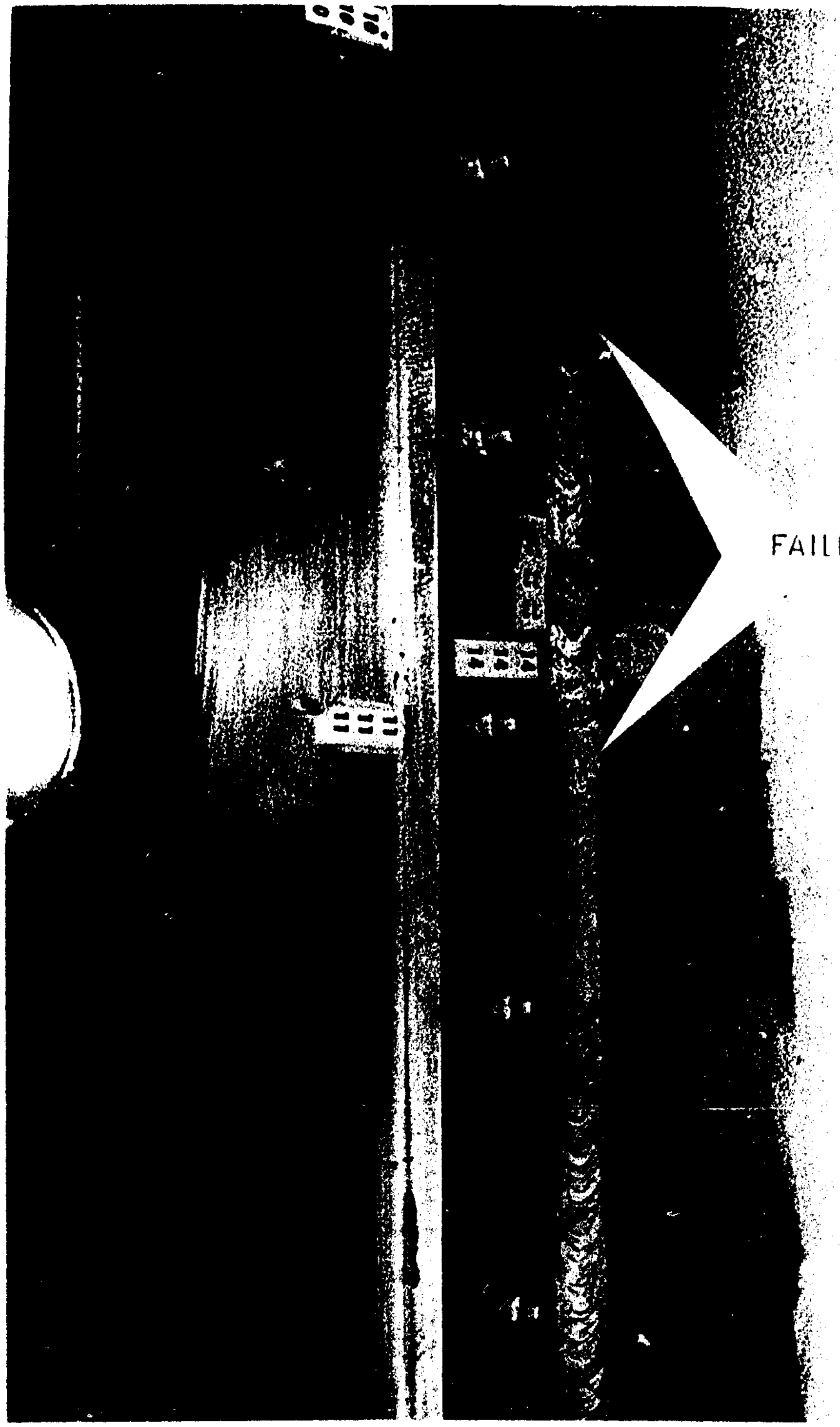

FAILURE CRACK

FIG. 10--FAILURE CRACKS IN WELD JOINT--STATIC TEST OF FI[illegible]
ON BARO RESEARCH TEST VEHICLE

TR-243
REF. [illegible]

D#56274 [redacted]

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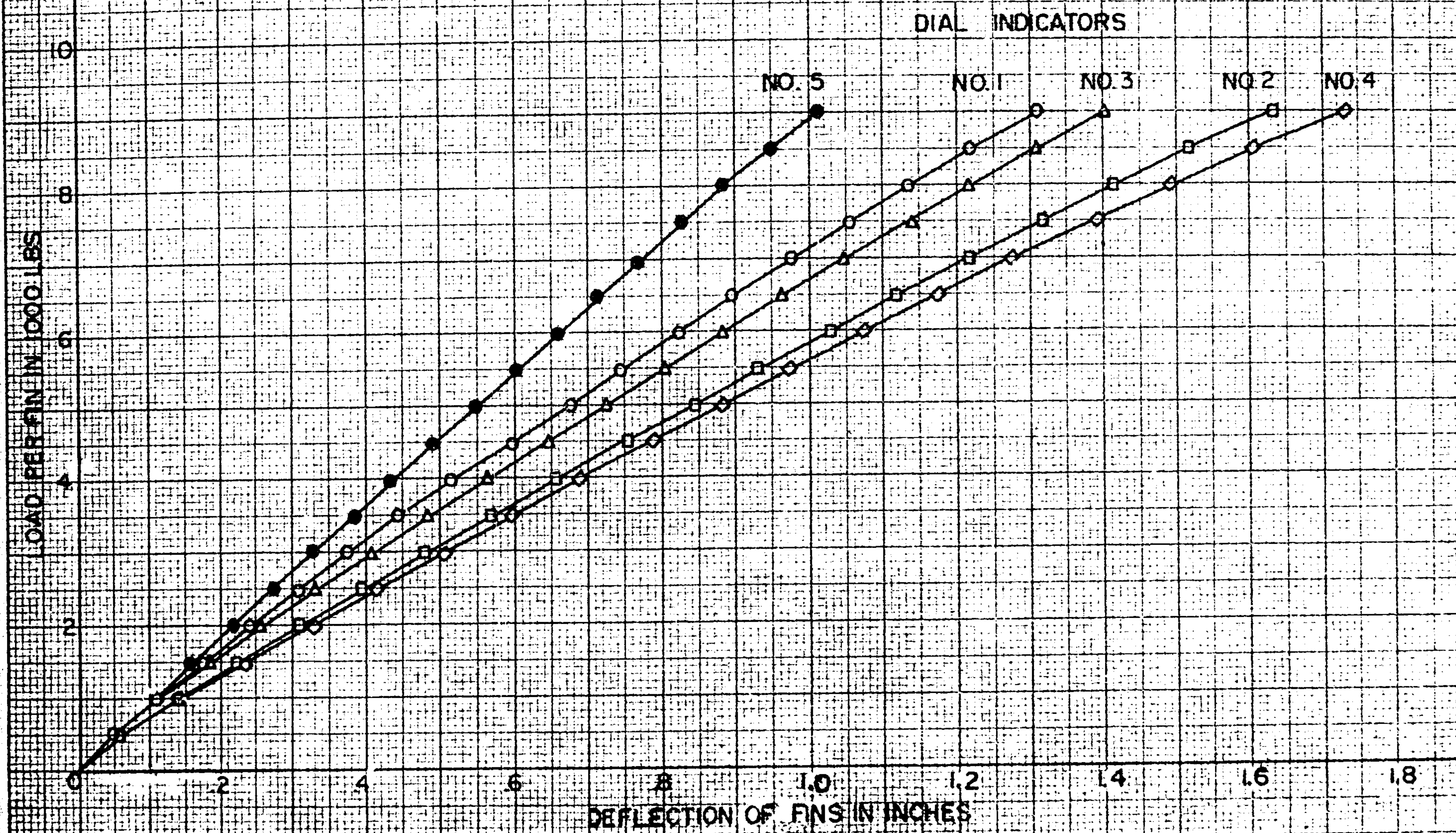

FIG.11 — LOAD VS DEFLECTION CURVES — STATIC TEST OF FINS ON BAROSWITCH RESEARCH TEST VEHICLE

TM-243
REF. SYM. 1612(159)
MSF 12-16-54

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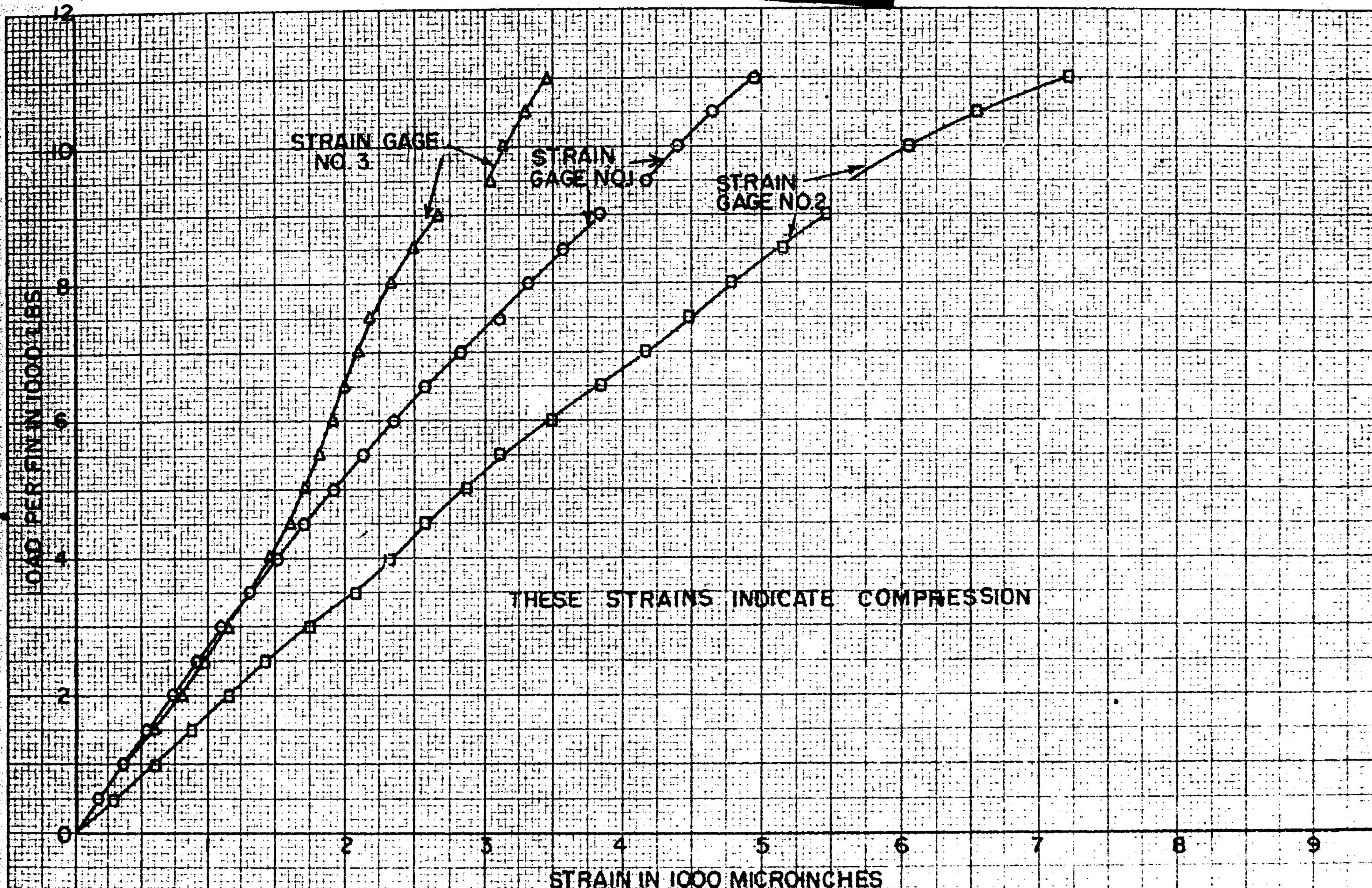

FIG.12 - LOAD VS STRAIN, TOP SURFACE, LEFT FIN - STATIC TEST OF FIN ON BAROSWITCH RESEARCH TEST VEHICLE

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TM-243
REF. SYM. 1612(159)
MSF 12-15-54

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[redacted]

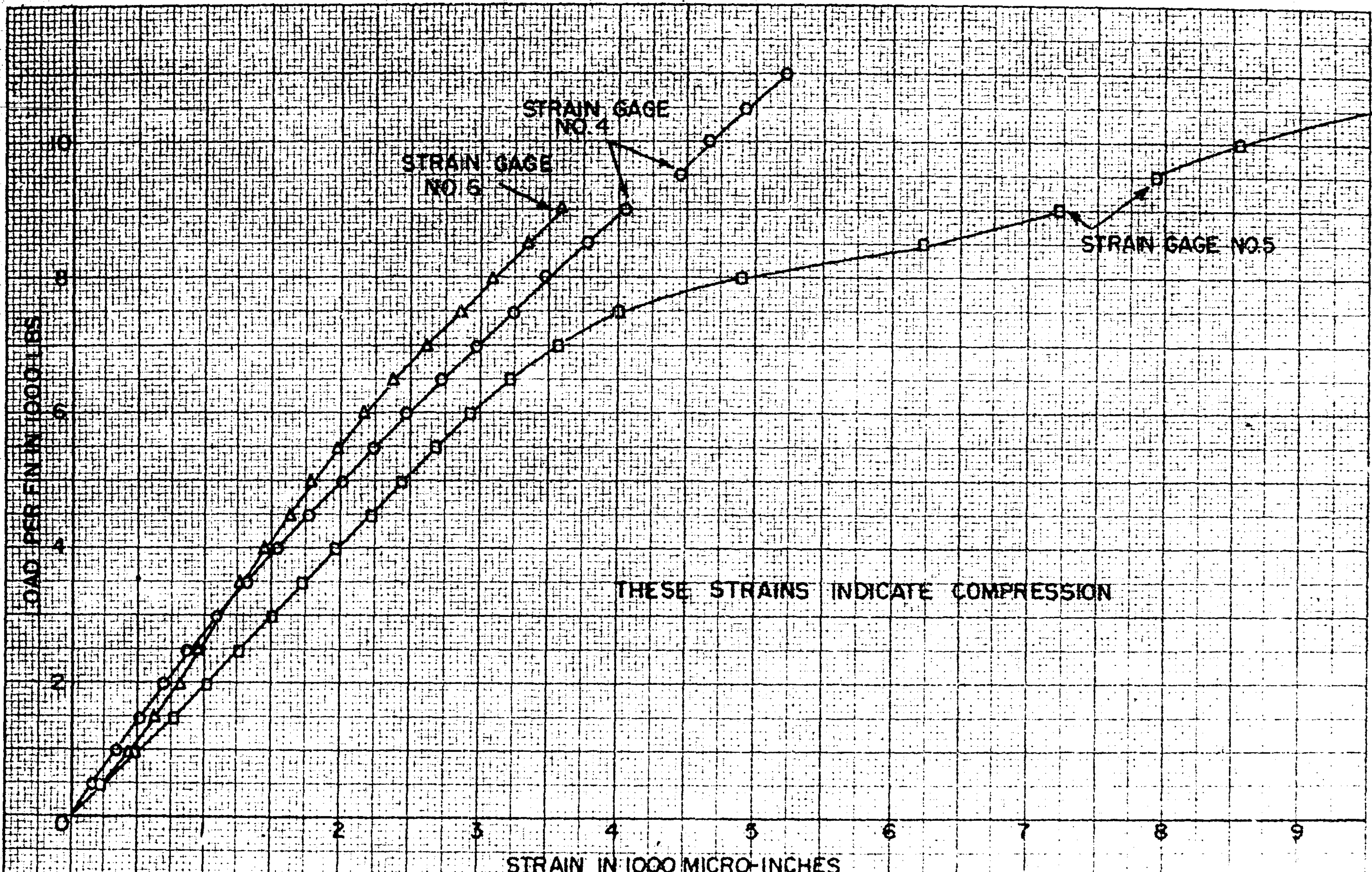

FIG.13 — LOAD VS STRAIN, TOP SURFACE, RIGHT FIN — STATIC TEST OF FINS ON BAROSWITCH RESEARCH TEST VEHICLE

 [redacted]

TM-243
REF. SYM. 1612 (159)
MSF 12-16-54

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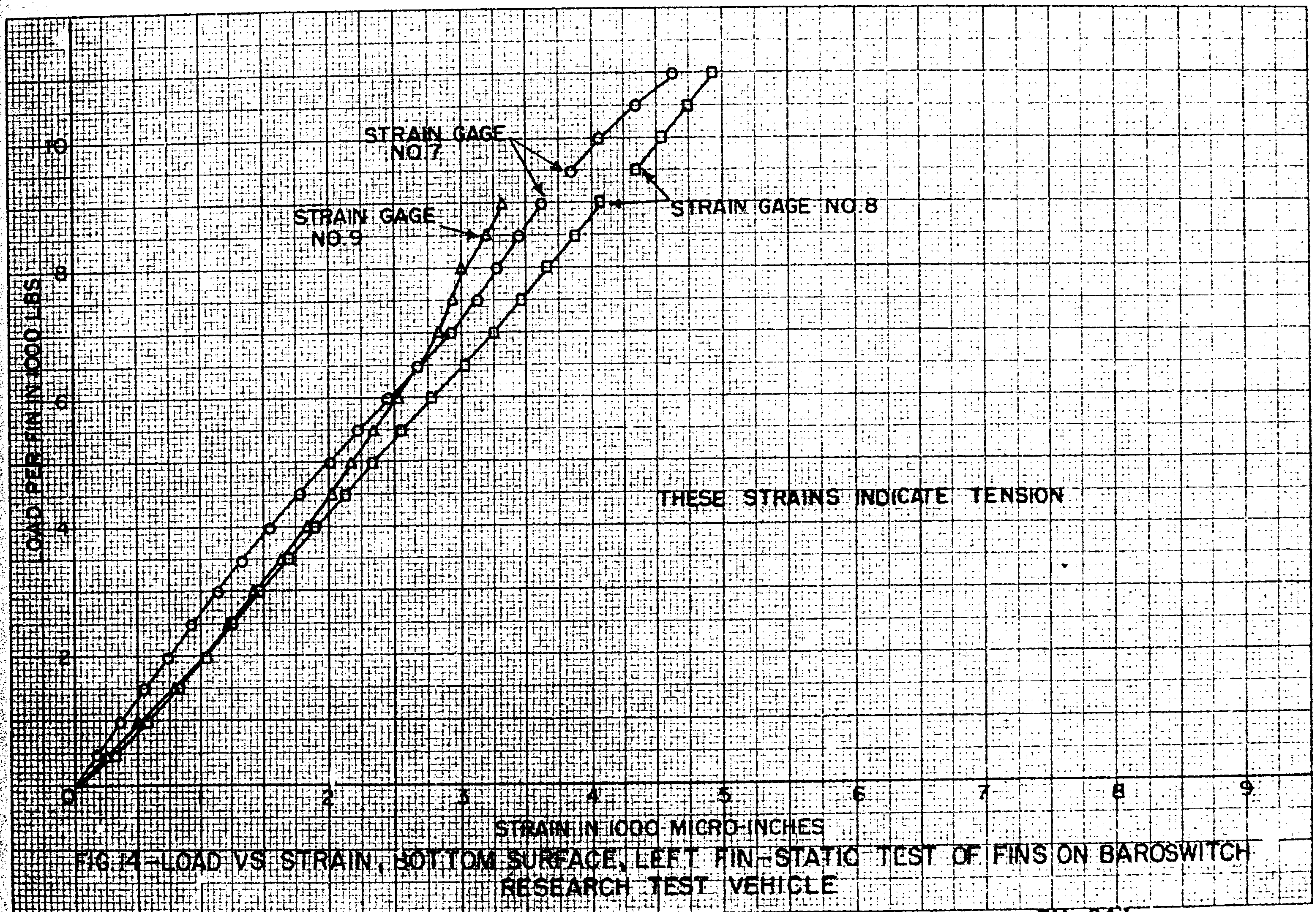

FIG.14—LOAD VS STRAIN, BOTTOM SURFACE, LEFT FIN—STATIC TEST OF FINS ON BAROSWITCH RESEARCH TEST VEHICLE

UNCLASSIFIED [redacted]

TM-243
REF. SYM. 1612(159)
MSF 12-16-54

1801

359-11 KEUFFEL & ESSER CO.
10 × 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

UNCLASSIFIED

[redacted]

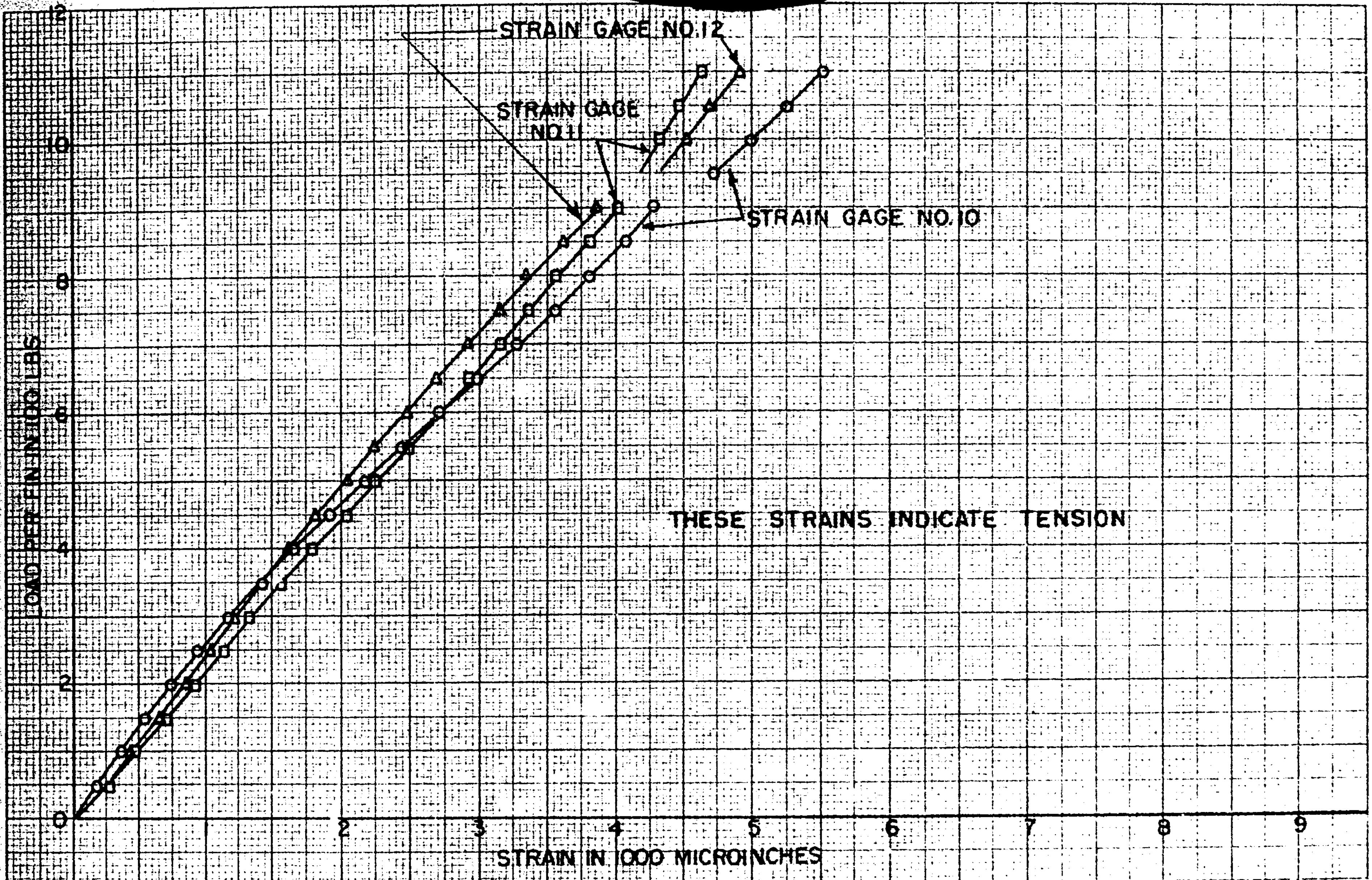

FIG 15 - LOAD VS STRAIN, BOTTOM SURFACE RIGHT FIN - STATIC TEST OF FINS ON BAROSWITCH RESEARCH TEST VEHICLE

1802

TM-243
REF SYM.1612(159)
MSF 12-15-54

UNCLASSIFIED [redacted]

[redacted]

359-11 KEUFFEL & ESSER CO.
10 X 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

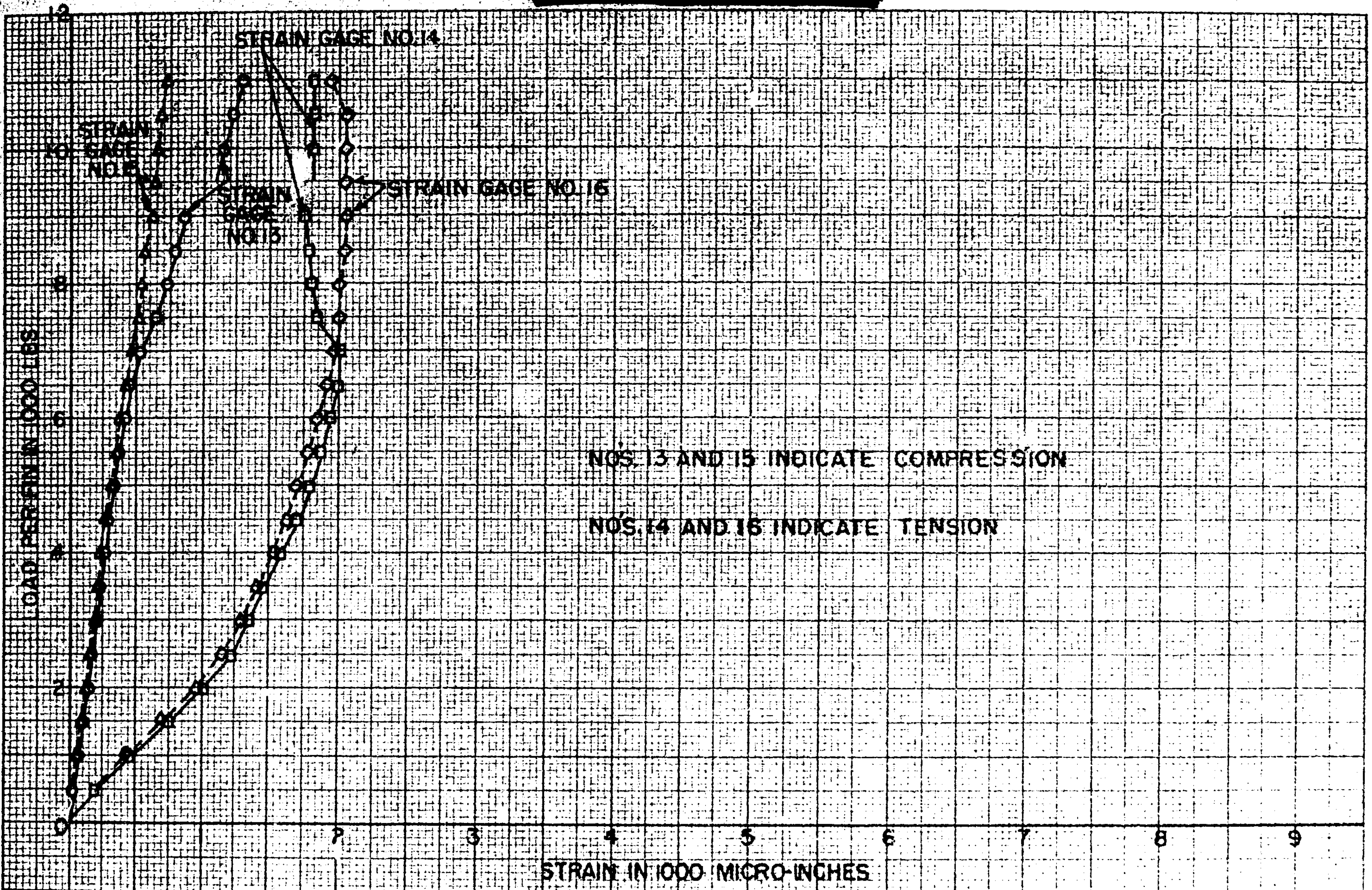

FIG.16- LOAD VS STRAIN, BOTTOM SURFACE, RIGHT AND LEFT FIN HOLDER - STATIC TEST OF FINS ON BAROSWITCH RESEARCH TEST VEHICLE

-26-

 [redacted]

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REF. SYM. 1612 (159)