REPORT NUMBER 145

MARCH 1964

STRUCTURAL TEST RESULTS

XV-5A

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM

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Report Number 145
March 1964

STRUCTURAL TEST RESULTS

XV-5A Lift Fan
Flight Research Aircraft Program

Advanced Engine and Technology Department
General Electric Company
Cincinnati, Ohio 45215

CONTENTS PART A

SECTION I

INTRODUCTION

This report contains the test procedures and the results of the structural proof test program for the U.S. Army XV-5A Lift Fan Research Aircraft. Part A of this report describes the detailed test procedures followed while the test results are contained in Part B.

SECTION II

SUMMARY:

The detailed static test procedures described in this report cover the 23 proof tests and the one ultimate test to be accomplished on the XV-5A aircraft. The procedures include airplane support systems, loading arrangements and methods of load application, along with detailed load reacting structures and load cylinder arrangements. Tables are presented by which load cylinders may be calibrated prior to each test.

Instrumentation details are provided showing location of both strain and deflection measuring equipment and times during which specific measurements are to be made. Data recording devices are also indicated.

The tests are identified in the Table of Contents.

SECTION III

TEST ARTICLE DESCRIPTION:

The Proof Test article shall consist of the complete aircraft minus the following equipment:

1. Seats
2. Canopy
3. Engine compartment doors (above and below wing)*
4. Flaps
5. Fairing over parachute compartment
6. Gas generators
7. Wing fan and duct assembly, both sides
8. Nose fan assembly
9. Nose fan louvers
10. Pitch fan thrust modulator doors
11. Wing fan inlet doors, both sides
12. Electrical equipment which could be damaged during test.
13. Horizontal tail incidence control actuator
14. Aileron power control actuator
15. Right and left hand tail pipes
16. Pitot tube and air sensing devices
17. Left forward nose gear door
18. Firewall which splits engine compartment at B.L. 0.0.
19. Engine inlet fairings
20. Side panels on engine compartment above wing*
21. Wing tip fairings (does not include aileron tips).
22. Starter bracket installation (143P023)
23. Nose fan duct (aft of F.S. 214.0)

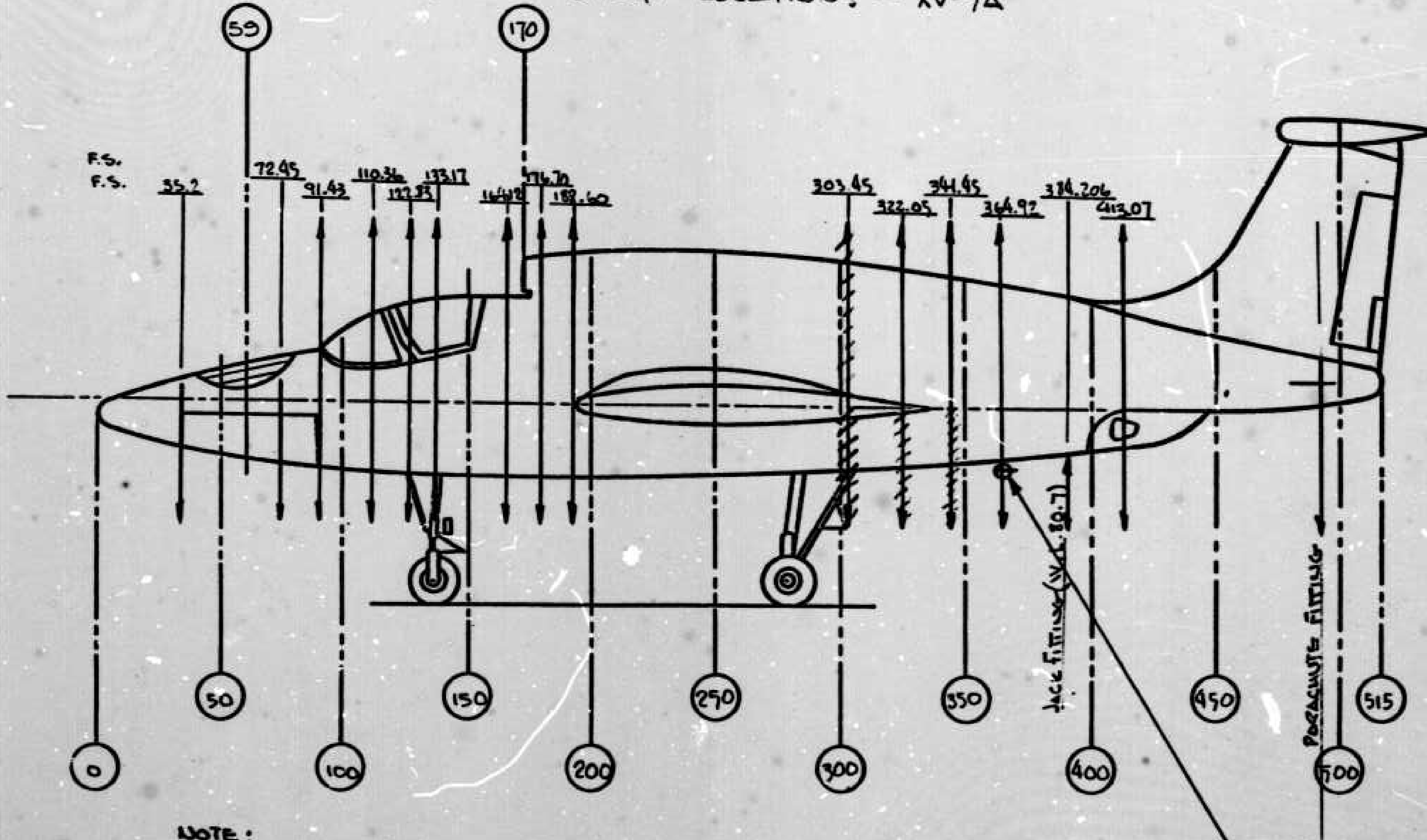
* If the upper engine compartment doors and the engine compartment side fairings are available, they should be installed during Tests 10, 11, and 16.

The test article will be delivered for test with shear loading straps installed at the fuselage stations shown in Figure III-1. Tension pads will be installed on the aircraft at the specified locations during the fabrication phase also. (Note: Tension pads on the main landing gear doors will be installed during test.)

The measurements group will be responsible for installation of all flight and static test instrumentation. Where possible, all internal strain gage installations will be made during airplane fabrication.

Strain gage locations are described in Table I, and deflection gage locations are shown in Table II.

SHEAR STRAP LOCATIONS - XV-5A



NOTE:
ARROWS SHOW DIRECTION LOAD MAY BE APPLIED TO STRAPS.

FIGURE III-1

TABLE I
STRAIN GAGE MEASUREMENTS

Code	Gage Location	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Horizontal Stabilizer:				
S-101	Axial Actuator Load	Axial	1-144	X	X
S-102	L.H. Fwd. Upper Spar Cap, B.L.6	"	1-121		X
S-103	L.H. Fwd. Lower Spar Cap, B.L.6	"	1-121		X
S-104	L.H. Center Spar, Upper Cap, B.L.6	"	"		X
S-105	L.H. Center Spar, Lower Cap, B.L.6	"	"		X
S-106	L.H. Aft Spar, Upper Cap, B.L. 6	"	"		X
S-107	L.H. Aft Spar, Lower Cap, B.L. 6	"	"		X
S-108	L.H. Rib, Upper Cap, Sta. 501, B.L. 4	"	"		X
S-109	L.H. Rib, Lower Cap, Sta. 501, B.L. 4	"	"		X
S-110	L.H. Center Spar, Upper Cap, B.L. 30	"	"		X
S-111	L.H. Center Spar, Lower Cap, B.L. 30	"	"		X
S-112	L.H. Rear Spar, Upper Cap, B.L.30	"	"		X
S-113	L.H. Rear Spar, Lower Cap, B.L.30	"	"		X
	Vertical Fin:				
S-201	Vertical Fin Spar (L.H. Cap at W.L. 200)	Axial	1-124	X	X
S-202	Vertical Fin Spar (R.H. Cap at W.L. 200)	"	"	X	X

Code	Gage Location	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Vertical Fin:				
S-203	Fwd. Spar, L.H. Cap, V.S. Sta 13.4	Axial	1-121		X
S-204	Fwd. Spar, R.H. Cap, V.S. Sta. 13.4	"	"		X
S-205	Center Spar, L.H. Cap, V.S. Sta. 13.4	"	"		X
S-206	Center Spar, R.H. Cap, V.S. Sta. 13.4	"	"		X
S-207	Aft Spar, L.H. Cap, V.S. Sta. 13.4	"	"		X
S-208	Aft Spar R.H. Cap, V.S. Sta. 13.4	"	"		X
	Forward Fuselage:				
S-301	Upper Longeron, F.S. 91, L.H.	Axial	1-141		X
S-302	Upper Longeron, F.S. 165, L.H	"	"		X
S-303	Upper Longeron, F.S. 214, L.H	"	"		X
S-304	Lower Longeron, F.S. 91, L.H.	"	"		X
S-305	Lower Longeron, F.S. 165,L.H.	"	"		X
S-306	Lower Longeron, F.S. 214,L.H.	"	"		X
	Aft Fuselage:				
S-401	Upper Long. F.S. 287, L.H.	Axial	1-141		X
S-402	Upper Long. F.S. 287, R.H.	"	"		X
S-403	Upper Long. F.S. 316, R.H.	"	"		X
S-404	Lower Long. F.S. 300, L.H.	"	1-144	X	X
S-405	Lower Long. F.S. 300, R.H.	"	1-141		X
S-406	Lower Long. F.S. 316 R.H.	"	"		X

Code	Gage Location	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Aft Fuselage:				
S-407	Lower Long. F.S. 400 L.H.	Axial	1-141		X
S-408	Lower Long. F.S. 400 R.H.	"	"		X
S-409	Top Long. F.S. 315	"	"		X
S-410	Top Long. F.S. 380	"	"		X
S-411	Frame Skin Flg., FS389.7, W.L. 90, B.L. 22.5	"	"		X
S-412	Frame Skin Flg., FS 387.7, W.L.113 , B.L. 23.2	"	"		X
S-413	Frame Skin Flg., FS 377.25, W.L. 119, B.L. 22,5	"	"		X
S-414	Frame Skin Flg., FS 377.25, W.L. 150, B.L. 0	"	"		X
S-415	Side Skin Shear, W.L. 100, F.S. 287, L.H.	Shear	1-121-R3C		X
S-416	Frame Flanges FS 287, W.L. 96 B.L. 11.3	Axial	1-141		X
S-417	Frame Flanges FS 287, W.L. 105 B.L. 11.3	"	"		X
S-418	Frame Flanges FS 287, W.L. 131.4 B.L. 15.5	"	"		X
S-419	Frame Flanges FS 287, W.L. 133.5 B.L. 15.5	"	"		X
	Center Fuselage:				
	Ref. Dwg - 143F009, Sheet 1				
S-501	Space frame member 8-28S	Axial	1-141B		X
S-502	" " " 9-28S	"	"		X
S-503	" " " 25-30S	"	"		X
S-504	" " " 26-29S	"	"		X
S-505	" " " 9-31S	"	"		X

Code	Gage Location	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Center Fuselage:				
	Ref. Dwg - 143F009, Sheet 1				
S-506	Space Frame Member 25-31S	Axial	1-141B		X
S-507	Space Frame Member 26-31S	"	"		X
S-508	Space Frame Member 11-31S	"	"		X
S-509	" " " 8-13S	"	"		X
S-510	" " " 11-14S	"	"		X
S-511	" " " 11-263	"	"		X
S-512	" " " 8-25S	"	"		X
S-513	Bulkhead Frame, AL., F.S.214.00 (1-25)	"	1-141		X
	CANCELLED PER [illegible] BETWEEN [illegible] & [illegible]				
~~S-514~~	~~Front Wing Spar, Lwr Cap (25-26)~~	~~"~~	~~"~~		~~X~~
S-515	Bulkhead Frame, AL., F.S.214.00 (2-26)	"	"		X
S-516	Bulkhead Frame, AL., F.S.214.00 (1-2)	"	"		X
S-517	Space Frame Member 10-31S	"	1-141B		X
S-518	" " " 4-25S	"	"		X
S-519	" " " 5-26S	"	"		X
S-520	" " " 3-25S	"	"		X
S-521	" " " 6-26S	"	"		X
S-522	" " " 9-13S	"	"		X
S-523	" " " 10-14S	"	"		X
S-524	" " " 4-39S	"	"		X
S-525	" " " 5-40S	"	"		X
S-526	" " " 9-43S	"	"		X

Code	Gage Location	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Center Fuselage:				
	Ref. Dwg - 143F009, Sheet 1				
S-527	Space Frame Member 10-44S	Axial	1-141B		X
S-528	Space Frame Member 2-4S	"	"		X
S-529	" " " 9-14S	"	"		X
S-530	" " " 17-35S	"	"		X
S-531	" " " 17-36S	"	"		X
S-532	Front Wing Spar, Upper Cap., F.S. 214.00	"	1-141		X
S-533	Front Wing Spar, End Stiff., B.L. 24.0	"	"		X

Code	Gage Location	F.S.	B.L.	W.L.	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Wing: **Fwd. Spar Ftg:**							
S-601	L.H. Upper Cap	214.3	25.50	5.10	Axial	1-141		X
S-602	L.H. Upper Cap	215.0	25.50	6.00	"	"		X
S-603	L.H. Lower Cap	215.3	26.175	-2.00	"	"		X
S-604	L.H. Lower Cap	215.3	26.175	-3.50	"	"		X
	Fwd. Spar Caps:							
S-605	L.H. Upper	214.0	40.0	5.6	"	1-144	X	X
S-606	L.H. Lwr.	214.0	40.0	-3.6	"	"	X	X
S-607	L.H. Upper	214.9	61.0	6.0	"	1-141		X
S-608	L.H. Lwr.	214.9	61.0	-4.0	"	"		X
S-609	L.H. Upper	226.0	88.5	6.7	"	"		X
S-610	L.H. Lwr.	226.0	88.5	-3.5	"	"		X
	Fwd. Spar Splice							
S-611	L.H. Upper	232.9	112.1	6.3	"	"		X

Code	Gage Location	F.S.	B.L.	W.L.	Meas.	No. of Gages and Type	Flt. Test	Static Test
	Wing:							
	Fwd. Spar Splice: continued......							
S-612	L.H. Lower	233.3	112.9	-2.7	Axial	1-141		X
	Fwd. Spar Caps:							
S-613	R.H. Upper	214.0	40.0	5.6	"	1-144	X	X
S-614	R.H. Lower	"	"	-3.6	"	"	X	X
	Fwd. Spar Web:							
S-615	L.H. ℄	↑	28.8	1.7	Shear	1-121R3C		X
S-616	L.H. Lwr. Lug	Rear	"	0	"	"		X
S-617	L.H. ℄	Face	39.8	1.0	"	1-124-R3C	X	X
S-618	L.H. ℄	of	59.0	1.10	"	1-121-R3C		X
S-619	L.H. ℄	Web	88.5	1.35	"	"		X
S-620	L.H. ℄	↓	112.3	1.8	"	"		X
S-621	R.H. ℄		39.8	1.0	"	1-124-R3C	X	X
	L.H. Main Rib:							
S-622	Front Spar Attach., upper	235.0	100.75	8.2	Axial	1-141		X
S-623	Front Spar Attach., lower	235.0	100.75	-4.9	"	"		X
S-624	F.S. attach, L.E., upper	223.7	100.75	5.8	"	"		X
S-625	F.S. attach, L.E., lower	"	"	-2.6	"	"		X
S-626	Web at F.S.	228.7	100.75	1.75	Shear	1-121-R3C		X
S-627	Web at R.S.	295.3	100.75	1.10	"	"		X
	Rear Spar, L.H.							
S-628	Ftg., upper cap	296.8	25.5	5.0	Axial	1-141		X
S-629	" " "	297.5	25.5	5.7	"	"		X
S-630	Ftg., lower cap	297.8	26.175	-2.0	"	"		X
S-631	" " "	297.8	"	-3.5	"	"		X

Code	Gage Location	F.S.	B.L.	W.L.	Meas.	No. of Gages and Type	Flt. Test	Static Test
	WING: cont'd **Rear Spar, L.H.**							
S-632	Upper Cap	297.2	29.0	6.2	Axial	1-141		X
S-633	Lower Cap	296.8	29.0	-2.5	"	"		X
S-634	" "	297.5	29.0	-4.0	"	"		X
S-635	Upper Cap	297.0	39.6	5.6	"	1-144	X	X
S-636	Lower Cap	"	"	-3.4	"	"	X	X
S-637	Upper Cap	296.5	61.0	6.2	"	1-141		X
S-638	Lower Cap	"	"	-4.0	"	"		X
S-639	Upper Cap	"	99.0	6.2	"	"		X
S-640	Lower Cap	"	100.2	-4.0	"	"		X
S-641	Splice, Upper Cap	297.2	111.8	6.0	"	"		X
S-642	" Lower "	"	112.5	-2.3	"	"		X
	Rear Spar, R.H.							
S-643	Ftg., R.H., Upper	296.5	39.6	5.6	"	1-144	X	X
S-644	" " Lower	"	"	-3.4	"	"	X	X
	Rear Spar Webs, L.H							
S-645	Top	↑	29.0	3.2	Shear	1-121R3C		X
S-646		Rear	"	1.5	"	"		X
S-647	W.L.O.	Face	"	0	"	"		X
S-648	Bottom	of	30.4	-1.0	"	"		X
S-649		Web	39.6	1.1	"	1-124R3C	X	X
S-650		│	57.5	1.1	"	1-121-R3C		X
S-651		│	100.25	1.1	"	"		X
S-652		│	112.3	1.8	"	"		X
S-653		↓	39.0	1.1		1-124R3C	X	X

Code	Gage Location	F.S.	B.L.	W.L.	Meas.	No. of Gages and Type	Flt. Test	Static Test
	<u>WING: cont'd</u> <u>Leading Edge, L.H.</u>							
S-654	Stringer	190.0	28.1	.5	Axial	1-141		X
S-655	Rib Cap, Upper	211.3	57.0	5.4	"	"		X
S-656	" " Lower	211.3	57.0	-3.5	"	"		X
S-657	Upper Skin	209.0	25.5	5.50	Shear	1-124-R30	X	X
S-658	Lower Skin	"	"	-3.8	"	"	X	X
S-659	Upper Skin	202.9	63.8	1.4	"	1-121-R30		X
S-660	Lower Skin	204.5	"	-1.0	"	"		X
	<u>Leading Edge, R.H.</u>							
S-661	Upper Skin	209.0	25.5	5.5	Shear	1-124-R30	X	X
S-662	Lower Skin	"	"	-3.8	"	"	X	X
	143P 035-53 <u>Far Supt. Links:</u>					(600°F)		
S-663	L.H. Link, Upper end			S	Axial	1-620	X	~~X~~
S-664	R.H. Link, Upper end			S	"		X	~~X~~
	<u>Fwd. Spar Ftg.</u>							
S-665	R.H. Upper Cap	214.3	25.50	5.10	Axial	1-141		X
S-666	R.H. Upper Cap	215.0	25.50	6.00	"	"		X
S-667	R.H. Lower Cap	215.3	26.175	-2.00	"	"		X
S-668	R.H. Lower Cap	215.3	26.175	-3.50	"	"		X
	<u>Fwd. Spar Caps</u>							
S-671	R.H. Upper Cap	214.9	61.0	6.0	"	"		X
S-672	R.H. Lower Cap	214.9	61.0	-4.0	"	"		X
	<u>Fwd. Spar Web:</u>							
S-673	R.H.	Rear face of web.	28.8	1.7	Shear	1-121-R30		X
S-674	R.H. Lwr. Lug.		28.8	0	Shear	"		X
S-676	R.H.		59.0	1.10	Shear	"		X

TABLE II

Deflection Gages

The following list defines the deflection measurements which will be made during the tests indicated. The measurements will be made through the use of autosyn units which will be supplied by the Convair Test Facility. Unless otherwise specified, all deflections are referenced to the floor of the test building.

Test #1, Nose Landing Gear Door & Uplock Mechanism

Deflection Gage	Location	Direction
D1	F.S. 87.0, B.L. 0.0, Adjacent to N.L.G. door	Vertical
D2	F.S. 88.0, B.L. 0.5R, Forward inboard corner, forward N.L.G. door	Vertical
D3	F.S. 118.5, B.L. 0.5R, Aft inboard corner, forward N.L.G. door	Vertical
D4	F.S. 119.5, B.L. 0.0, Center of forward edge, aft N.L.G. door	Vertical
D5	F.S. 119.5, B.L. 8.5R, Fuselage skin adjacent to forward edge of aft N.L.G. door	Vertical

Test #2, Elevator Test

D10	Rear spar horizontal tail, B.L. 18.0	Vertical
D11	Rear spar horizontal tail, B.L. 53.0	Vertical
D12	Elevator hinge line, B.L. 18.0	Vertical
D13	Elevator hinge line, B.L. 53.0	Vertical
D14	Elevator trailing edge, B.L. 18.0	Vertical
D15	Elevator trailing edge, B.L. 53.0	Vertical

Test #3, Nose Landing Gear - Ground Turning

D20	Nose wheel axle centerline	Lateral
D21	Back side (centerline) of N.L.G. oleo, W.L. 71.0 with gear extended	Lateral

Test #4, Nose Landing Gear - Springback

D30	N.L.G. axle centerline	Longitudinal
D31	Front side, N.L.G. trunnion at F.S. 136.5, W.L. 74.0, B.L. 7.5	Longitudinal
D32	N.L.G. oleo - drag link joint, W.L. 59.5 with gear extended	Longitudinal

Test #5, Forward Engine Mounts - Bulkhead 214

D40	Top fuselage F.S. 214, W.L. 163, B.L. 11.5R	Vertical

Deflection Gage	Location	Direction
D41	Top fuselage F.S. 214, W.L. 163, B.L. 11.5L	Vertical
D42	Lower fuselage, F.S. 214, W.L. 72, B.L. 0.0	Vertical
Test #6, Wing Fan Forward Trunnion		
D50	Back of load fitting STW-0001 on centerline of fan trunnion	Longitudinal
D51	Bottom of fitting STW-0001 on centerline of fan trunnion	Vertical
D52	Upper spar cap, front spar at B.L. 25.0	Vertical
D53	Upper spar cap, front spar at B.L. 25.0	Longitudinal
D54	B.L. 0.0, W.L. 100, bulkhead 214	Vertical
Test #7, Wing Fan Fore & Aft Trunnions		
D60	Upper spar cap, rear spar at B.L. 25.0	Vertical
D61	Bottom of load fitting STW-0002	Vertical
Test #8, Aileron		
D70	Wing rear spar B.L. 112	
D71	Wing rear spar B.L. 146	
D72	Aileron hinge line B.L. 112	
D73	Aileron hinge line B.L. 146	
D74	Aileron trailing edge B.L. 112	
D75	Aileron trailing edge B.L. 146	
Test #9, Wing (gages installed on bottom side of wing)		
D80	Panel point 100, L.H. wing	Vertical
D81	Panel point 100, R.H. wing	Vertical
D82	Panel point 102, L.H. wing	Vertical
D83	Panel point 102, L.H. wing	Longitudinal
D84	Panel point 102, R.H. wing	Vertical
D85	Panel point 102, R.H. wing	Longitudinal
D86	Panel point 106, L.H. wing	Vertical

Deflection Gage	Location	Direction
D87	Panel point 108, L.H. wing	Vertical
D88	Panel point 113, L.H. wing	Vertical
D89	Panel point 114, L.H. wing	Vertical
D90	Panel point 115, L.H. wing	Vertical
D91	Panel point 119a, L.H. wing	Vertical
D92	Panel point 122a, L.H. wing	Vertical
D93	Front spar attach point, L.H. wing	Vertical
D94	Front spar attach point, L.H. wing	Longitudinal
D95	Front spar attach point, R.H. wing	Vertical
D96	Front spar attach point, R.H. wing	Longitudinal
D97	Rear spar attach point, L.H. wing	Vertical
D98	Rear spar attach point, R.H. wing	Vertical

Test #10, Fuselage & Horizontal Tail (gages are installed on bottom of fuselage D110 through D119

Deflection Gage	Location	Direction
D110	F.S. 0.0, B.L. 0.0	Vertical
D111	F.S. 35, B.L. 0.0	Vertical
D112	F.S. ~~91~~ 87.25, B.L. 0.0	Vertical
D113	F.S. 150, B.L. 0.0	Vertical
D114	F.S. 214.75, B.L. 0.0	Vertical
D115	F.S. 296.5, B.L. 0.0	Vertical
D116	F.S. 350, B.L. 0.0	Vertical
D117	F.S. 400, B.L. 0.0	Vertical
D118	F.S. 450, B.L. 0.0	Vertical
D119	F.S. ~~500~~ 482, B.L. 0.0	Vertical
D120	F.S. 496, B.L. ~~0.0~~ 3.0 (center spar, H. tail)	Vertical
D121	F.S. 496, B.L. 35(L) (center spar H. tail)	Vertical

Deflection Gage	Location	Direction
D122	F.S. 496, B.L. ~~70~~ 73(L) (center spar H. tail)	Vertical
D123	F.S. 496, B.L. ~~70~~ 73(R) (center spar H. tail)	Vertical
D124	F.S. 513.6, B.L. ~~0.0~~ 3.0 (rear spar H. tail)	Vertical
D125	F.S. 514, B.L. 35(L) (rear spar H. tail)	Vertical
D126	F.S. 515, B.L. 70(L) (rear spar H. tail)	Vertical

Test #11, Fuselage, Horizontal & Vertical Stabilizers

D130	F.S. 0.0, W.L. 100, B.L. 0.0	Vertical
D131	F.S. 0.0, W.L. 100, B.L. 0.0	Lateral
D132	F.S. 35, W.L. 100 (skin)	Vertical
D133	F.S. 35 W.L. 100 (skin)	Lateral
D134	F.S. 91, W.L. 100 (skin)	Vertical
D135	F.S. 91, W.L. 100 (skin)	Lateral
D136	F.S. 150, W.L. 100 (skin)	Vertical
D137	F.S. 150, W.L. 100 (skin)	Lateral
D138	Front spar at jig support, right side	Lateral
D139	Front spar at jig support, right side	Vertical
D140	Front spar at jig support, left side	Lateral
D141	Front spar at jig support, left side	Vertical
D142	Rear spar at jig support, right side	Vertical
D143	Rear spar at jig support, left side	Vertical
D144	F.S. 300, W.L. 100 (skin)	Vertical
D145	F.S. 300, W.L. 100 (skin)	Lateral
D146	F.S. 450, W.L. 100 (right side skin)	Vertical
D147	F.S. 450, W.L. 100 (right side skin)	Lateral
D148	F.S. 450, W.L. 100 (left side skin)	Vertical
D149	F.S. 497, W.L. 201 (vert. tail skin right side)	Lateral

Deflection Gage	Location	Direction
D150	F.S. 483, W.L. 172 (right side vert. tail)	Lateral

Test #12 and 13, Engine Mounts

D160	Engine mount load fitting, F.S. 257, B.L. 2.4(L), W.L. 145	Vertical
D161	Engine mount load fitting, F.S. 257, B.L. 2.4(R), W.L. 145	Vertical
D162	Engine mount load fitting, F.S. 257, B.L. 20.5(R), W.L. 145	Vertical
D163	Engine mount load fitting, F.S. 257, B.L. 2.4(R), W.L. 145	Longitudinal
D164	Engine mount load fitting, F.S. 257, B.L. 2.4(L), W.L. 145	Longitudinal
D165	Engine mount load fitting, F.S. 257, B.L. 20.5(R), W.L. 145	Longitudinal
D166	Front spar at jig support (right side)	Vertical
D167	Front spar at jig support (left side)	Vertical
D168	Front spar at jig support (right side)	Longitudinal
D169	Front spar at jig support (left side)	Longitudinal
D170	Rear spar at jig support (left side)	Vertical
D171	Rear spar at jig support (left side)	Longitudinal
D172	Rear spar at jig support (right side)	Vertical
D173	Rear spar at jig support (right side)	Longitudinal

Test #14, Windshield

		Sta.	B.L.	W.L.	
D180	Panel point 103	112.7	27.5	128.0	Normal to surface
D181	Panel point 105	105.2	25.5	127.1	" " "
D182	Panel point 111	108.7	6.0	136.8	" " "
D183	Panel point 112	108.7	-6.0	136.8	" " "
D184	Panel point 204	91.1	0.0	125.0	" " "
D185	Panel point 205	96.4	0.0	129.3	" " "

Deflection Gage	Location	Sta.	B.L.	W.L.	Direction
D186	Panel point 206	101.7	0.0	133.0	Normal to surface
D187	Pa.el point 208	96.4	-12.0	129.3	" " "
D188	Panel point 209	101.7	-12.0	133.0	" " "

TEST No. 15, MAIN LANDING GEAR - SPRINGBACK

D190	F.S. 0.0, B.L. 0.0, lower skin	Vertical
D191	F.S. 90.0, B.L. 0.0, lower skin	Vertical
D192	F.S. 150, B.L. 0.0, lower skin	Vertical
D193	F.S. 340, B.L. 0.0, Lower skin	Vertical
D194	F.S. 340, B.L. 0.0, lower skin	Longitudinal
D195	F.S. 276, B.L. 51.5(R) W.L. 42.0	Vertical
D196	F.S. 276, B.L. 51.5(R) W.L. 42.0	Longitudinal
D197	F.S. 276, B.L. 51.5(L) W.L. 42.0	Vertical
D198	F.S. 276, B.L. 51.5(L) W.L. 42.0	Longitudinal

Test #16, Main Landing Gear, Drift Landing

D210	F.S. 276.0, B.L. 51.5(R) W.L. 4[illegible].0	Vertical
D211	F.S. 276.0, B.L. 51.5(R) W.L. 42.0	Lateral
D212	F.S. 276.0, B.L. 51.5(L) W.L. 42.0	Vertical
D213	F.S. 276.0, B.L. 51.5(L) W.L. 42.0	Lateral

Test #17, Main Landing Rear Door

D220	Top of outer door, F.S. 300, B.L. 24, W.L. 93	Normal to surface
D221	Hinge between doors, F.S. 300, B.L. 20, W.L. 80.6	" " "
D222	Lower hinge, F.S. 300, B.L. 1.06, W.L. 76	" " "
D223	Keel centerline, F.S. 300, B.L. 0.0, W.L. 76	Vertical
D224	Keel centerline, F.S. 300, B.L. 0.0, W.L. 76	Lateral

Test #18, Flap (off aircraft)

D230	Flap leading edge, B.L. 62	Vertical
D231	Flap trailing edge, B.L. 62	Vertical

Deflection Gage	Location	Direction
Test #19, Rudder (off aircraft)		
D240	Leading edge, midspan	Vertical
D241	Trailing edge, midspan	Vertical
Test #20, Canopy (off aircraft)		
D250	Panel point 5 (reference static test program)	Normal to surface
D251	Panel point 8	" " "
D252	Panel point 12	" " "
D253	Panel point 15	" " "
D254	Panel point 17 (reference static test program)	" " "
D255	Panel point 19	" " "
D256	Panel point 34	" " "
D257	Panel point 36	" " "
D258	Panel point 38	" " "
Test #21, Control System		
D270	Control stick	Longitudinal
D271	Control stick	Lateral
D272	L.H. rudder pedal	Longitudinal
D273	R.H. rudder pedal	Longitudinal

SECTION IV

GENERAL TEST PROCEDURES:

1. All load applications shall, as nearly as possible, conform to the load distributions described in Reference 1.
2. All hydraulic loading cylinders shall be connected to a central regulating unit for even load distributions.
3. All test loads are limit loads with the exception of those specified for the canopy test.
4. Unless otherwise specified, limit loads will be applied to the test article in the following percent increments: 20-40-20-60-20-80-20-90-20-100-20-0.
5. Strain gage and/or deflection measurements will be recorded at each increment unless otherwise specified.
6. In the event the item being tested shows signs of yielding or failing completely, the loads shall be reduced immediately and the test not resumed until appropriate repairs are made and/or the Project Structures Engineer gives approval to proceed. When testing is resumed, the loading cycle will start again from zero load.
7. Unless otherwise specified, the 100% limit load will not be held for a time to exceed three minutes. During this time, the structure will be inspected for adverse characteristics, strain gage and deflection measurements recorded and pictures taken. Inspection of any structure under load will be limited to those areas which can be seen without danger to personnel.
8. Strain gage and deflection measurements will be taken at the locations and times specified herein.
9. The landing gear will be retracted during all tests unless otherwise specified.

10. The XV-5A Project Engineer will furnish the Test Director with a list of personnel whose presence at each test is necessary. The Test Director will be responsible for notifying these personnel as to the time and place the tests are to be accomplished.

11. Control surfaces will be checked for freedom of motion, as applicable, while the aircraft is under load.

12. The Test Director's judgment concerning safety of personnel during the test shall be considered final.

13. Where possible, all deflection measurements will be made using the Convair remote indicating deflection gages (autosyn units).

SECTION V

AIRPLANE MAJOR TEST JIG DESCRIPTION:

The airplane will be static proof tested in the Convair Static Test Facility. Convair jig structure ("erector set") will be used wherever possible. The airplane will be supported in all but Tests 15, 16 and 17 as shown in Figure IV-1. This jig provides support for the airplane through a total of four attach points on the forward space frame and wing rear spar. The details of the support fittings may be found in Drawings STF-0039, 0049 and 0051. Throughout the remainder of this document, the above jig will be referred to as the "basic airplane test fixture".

The tests involving the main landing gear require a different means of airplane support. The method chosen is shown in Figure V-2. As can be seen, the rear spar supports have been removed and replaced by a beam and tension strap arrangement attached to the airplane jacking fitting at fuselage station 384.2. The details of this fitting and support are described in Drawing STF-0026. This support method will hereafter be referred to as the "alternate airplane test fixture".

In both jig arrangements, the fuselage reference line (water line 100.0) will be level and approximately 103 inches above the floor of the test hangar.

Care has been taken to keep both airplane support systems determinate in nature. This has been accomplished by designing the fittings to withstand loads as follows:

Forward Left Support: This fitting will take loads in all three directions. (Vertical, fore and aft, and side.)

Forward Right Support: This fitting will take fore and aft loads and vertical loads only.

Rear Spar Supports: Vertical loads only. May be reacted, but vertical and side loads may be applied.

Support at F.S. 384.2: Vertical loads only. May be applied or reacted.

The airplane canopy, flaps and rudder will be tested in separate test fixtures off of the test airframe; those fixtures are described in each particular test description and procedure.

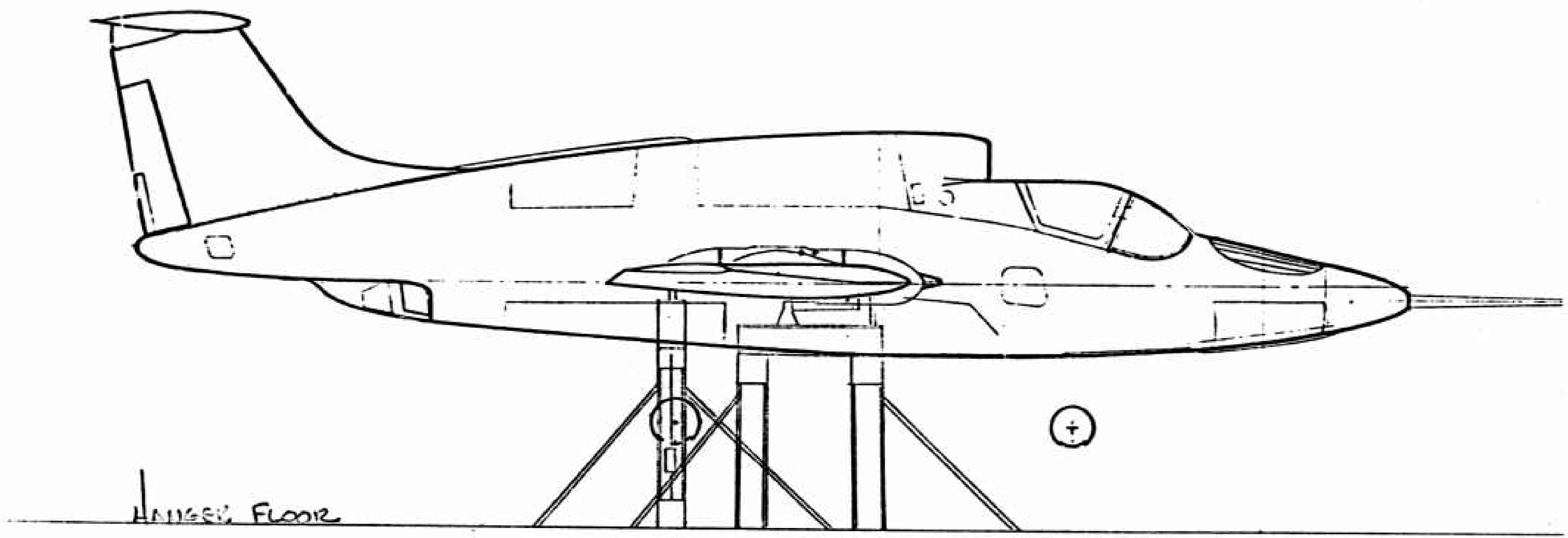


FIGURE V-1

SKETCH OF TEST AIRPLANE IN

BASIC TEST FIXTURE

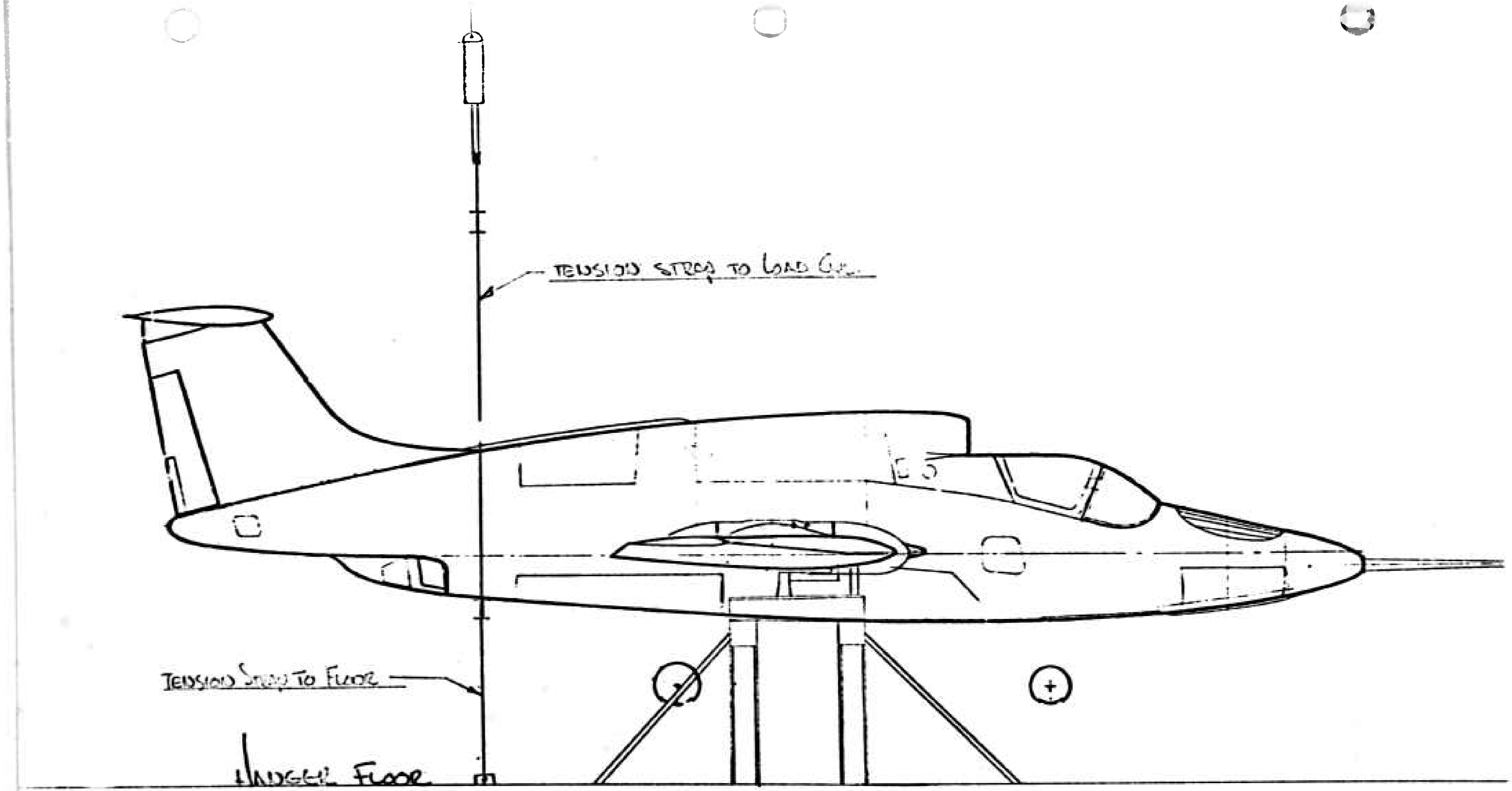


FIGURE II-2

SKETCH OF TEST AIRPLANE

IN ALTERNATE TEST FIXTURE

SECTION VI

TEST #1

Structure Tested: Nose landing gear door and up-lock mechanism.

Test Condition: High speed flight pressures tending to open doors.

Airplane Jig: Basic airplane test fixture (Ref. Section IV).

Test Preparations:

1. The following drawing will be required in setting up for this test:
   a. STL-0005 - Nose landing gear door load panel layout.
2. The aircraft will be delivered for test with the left forward door removed.
3. The nose wheel must be removed for access to the right forward door.
4. The nose landing gear will be in the up and locked position.
5. Install deflection gages D-1 through D-5 inclusive.

Loading:

Shot bags will be used to load the doors. The loads will be evenly distributed on the panels defined by STL-0005. Maximum proof loads on the doors are:

a. Forward door : 200 pounds

b. Aft door : 260 pounds

Loads will be applied simultaneously to both doors. Loading increments in percent are as follows: 20-50-20-80-20-100-20. Loading schedule is presented in Table 1-I.

(Inaccessibility to the aft door may require the exclusive use of five pound bags in that area.)

Data:

Deflection measurements will be recorded at each load increment.

SUBJECT:
SECTION:
ENGINEER:
CHECKER:

TABLE 1-I

MODEL:
PAGE:
REPORT:
DATE:

TABLE 1-I

PANEL LOADS FOR NOSE GEAR DOOR TEST

% LOAD	PANEL No 1	2	3	4	5	6	7	8	9	10
20	10#	10#	10#	10#	10#	10#	10#	10#	10#	10#
50	15	15	15	15	10	10	10	10	10	10
80	30	30	30	30	25	25	25	25	25	25
100	40	40	40	40	35	35	30	35	35	30

NOTE: 1. THE ABOVE LOADS FOR 50, 80 & 100% ARE THE ADDED INCREMENT FROM THE 20% TARE LOAD.

2. ACTUAL PERCENT LOADS FOR AFT DOOR ARE AS FOLLOWS:
20:23; 40:46; 80:81; 100:100.

TOTAL LOAD:

FORWARD RIGHT DOOR: 200#
AFT DOOR: 260#

TEST #2

<u>Structure Tested:</u> Elevator and control attachments.

<u>Test Condition:</u> Maximum pilot effort hinge moment.

<u>Airplane Jig:</u> Basic airplane test fixture (Ref. Section IV).

<u>Test Preparations:</u>

1. The following drawings will be required to set up for this test:
   a. STH-0002A - Elevator Snub Control Cable
   b. STH-0006 - Elevator Load Area Layout
2. The airplane shall be delivered for static test with rigid links (STH-0001 and STH-0002A), installed in place of the horizontal tail incidence actuator and elevator control cables. Check the installations for completeness.
3. Lay out the loading area on the elevator as shown in STH-0006. Outline area and mark C.P. line with tape or other means.
4. Install the following deflection gages D-10 through D-15 inclusive.
5. The test will require the use of 21-25 pound shot bags and 22-5 pount shot bags.
6. The elevator on the left side only will be loaded.

<u>Loading:</u>

Shot bags will be distributed over the elevator in the way and to the levels described in Drawing STH-0006. The loading increments to be followed, in percent limit load, are: 20-50-20-80-20-100-20.

<u>Data:</u>

Record deflection gage readings at each load increment.

TEST #3

Structure Tested: Nose landing gear and local fittings.

Test Condition: Ground turning - main gear in CTOL position, G.W. = 12,500#, c.g. at F.S. 240.0.

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:
   - a. STL-0001 - Nose Landing Gear Load Fitting
   - b. STL-0002 - Landing Gear Oleo Restraint
   - c. STL-0013 - Jig and Whiffletree Layout N.L.G. Test
   - d. STX-0001 - Overhead Load Cylinder Layout in Test Bldg.
   - e. STL-0015 - Dummy Shimmy Damper - N.L.G.
2. Reference STL-0013 for general layout of jig and whiffletrees.
3. Erect the "A" frame shown in STL-0013 at B.L. 162, and F.S. 135.
4. Install the 1 square inch load cylinder on the "A" frame so that a horizontal load may be applied on W.L. 33.0, at F.S. 135.3.
5. Install the dummy shimmy damper, STL-0015.
6. Install nose landing gear oleo restraint as shown in Drawing STL-0002.
7. Install fitting and whiffletree on nose gear axle as shown in STL-0001.
8. Install a 5 square inch load cylinder in the overhead for up loads as shown on STX-0001.
9. Install deflection gages D-20 and D-21.
10. Prepare to record the output of the following strain gages:

S-301	S-304
302	305
303	306

11. Calibrate the Edison unit to the pressures shown in Table 3-I.

Loading:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 3-I.

Data:

Strain gage outputs and deflection measurements will be recorded at each load increment.

SUBJECT:
SECTION:
ENGINEER:
CHECKER:

MODEL:
PAGE: TABLE 3-I
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DATE:

TABLE 3-I

LOAD INCREMENTS & CYLINDER PRESSURES
FOR SIDE LOAD CYLINDER
NOSE LANDING GEAR
TEST NUMBER 3

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	320	320 psi					
40	640	640					
60	960	960					
80	1280	1280					
90	1440	1440					
100	1602	1602					

LOAD INCREMENTS FOR
UP LOAD CYLINDER
TEST No. 3

(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	640#	128 psi					
40	1280	256					
60	1920	384					
80	2560	512					
90	2880	576					
100	3205	641					

TEST #4

Structure Tested: Nose landing gear and local fittings

Test Condition: Spring-back - 3 point landing. c.g. at F.S. 240.0 wt = 9200 lbs.

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:
   a. STL-0014 - General Layout for Nose Gear Test - Springback Condition
   b. STL-0002 - Landing Gear Oleo Restraint
   c. STL-0001 - Nose Landing Gear Load Fitting
2. Move "A" frame used in Test No. 3 to one of the positions shown in STL-0014. Install additional "A" frame and cross member to complete the reaction frame.
3. Install two (2) erector beams 5 feet long as shown in STL-0014 on the floor, with centers at F.S. 91.0 and 165.2.
4. Assemble whiffletrees as shown on Sheet 3 of STL-0014.
5. Install load cylinders for forward gear load and fuselage down loads.
6. The up load on the nose gear will be supplied by the same set-up as used in Test No. 3.
7. Nose landing gear oleo restraint (STL-0002) will remain in place for this test.
8. The following strain gages will be recorded:

S-301	S-304
302	305
303	306

9. Install deflection gages D-30, 31 and 32.

10. Calibrate the Edison unit to the pressures shown in Table 4-I.

11. STL-0015 - Dummy shimmy damper will remain in place for this test.

Loading:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 4-I.

Data:

Record strain gage output and deflections at each load increment.

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LOAD INCREMENTS & CYLINDER PRESSURES FOR

UP LOAD - NOSE LANDING GEAR

TEST NUMBER 4

(5 SQ. IN CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1312 LBS	263 psi					
40	2625	526					
60	3940	788					
80	5250	1050					
90	5910	1180					
100	6566	1313					

FORWARD LOAD - NOSE LANDING GEAR

(2 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	777 lbs	389 psi					
40	1555	777					
60	2330	1165					
80	3110	1555					
90	3500	1750					
100	3883	1942					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

DOWN LOAD AT F.S. 91.0

TEST No 4

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD
20	200 LBS	200 PSI				
40	400	400				
60	600	600				
80	800	800				
90	900	900				
100	1000	1000				

DOWN LOAD AT F.S. 165.2

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD
20	500 LBS.	500 PSI				
40	1000	1000				
60	1500	1500				
80	2000	2000				
90	2250	2250				
100	2500	2500				

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TEST #5

Structure Tested: Forward engine mounts on bulkhead 214.

Test Condition: Rolling pull-out.

Airplane Jig: Basic airplane test fixture (Ref. Section V)

Test Preparations:

1. The following drawings will be required for test set-up:
   a. STP-0005 - Whiffletree Assembly for Down Load on Forward Engine Mounts (F.S. 214).
   b. STX-0001 - Overhead Load Cylinder Layout in Test Building.
2. Install the fittings and whiffletree to the forward engine mounts on bulkhead 214 as shown on STP-0005.
3. Install the following deflection gages: D-40, 41 and 42.
4. Prepare to record the output of the deflection autosyns.
5. Calibrate the Edison to the pressures shown in Table 5-I.
6. Install the hydraulic lines to the load cylinder.

Loading:

Loads will be applied as specified in Section IV, General Test Procedures, and to the levels shown in Table 5-I.

Data:

Record the displacements of the deflection gages at each load increment.

TEST #5

Summary of Load Cylinders:

		Area	Max. Load
1.	Down load at F.S. 221	2 sq. in.	3716#

SUBJECT:		MODEL:
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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

DOWN LOAD FRONT ENGINE

MOUNTS (F.S. 214)

CHANNEL ________

(2. SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	743#	372 psi					
40	1486	744					
60	2230	1113					
80	2970	1482					
90	3340	1670					
100	3716	1858					

TEST #6

Structure Tested: Wing fan forward trunnion and fitting, attachment to front spar, and left wing inboard leading edge.

Test Condition: Transition flight, pitching, $\beta = 40^\circ$ vectored thrust.

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required in setting up for this test:
   a. STW-0004 - Test Set-up for Forward Fan Trunnion Test (No. 6).
   b. STX-0001 - Overhead Load Cylinder Layout in Test Building.
2. Construct two "A" frames as shown on Sheet 2, STW-0004
3. Erect above "A" frames in positions shown on Sheet 1.
4. Assemble load cylinders and whiffletrees for forward and side loads as shown on Sheets 4 and 5.
5. Mount a two square inch cylinder in the low bay at F.S. 217.4, B.L. 610(L). This cylinder will provide the up load to be applied to the front trunnion. Assemble tension strap and fitting STW-0001 as shown on Sheet 3 of STW-0004.
6. Calibrate the Edison unit to the pressures shown in Table 6-I.
7. Prepare to record the output of the following strain gages:

   S-601 through S-608

   S-615 through S-618

   S-621

   S-628 through S-638

   S-645 through S-650

   S-653 through S-658
8. Install the following deflection gages: D-50 through D-54 inclusive.

Loading:

Limit loads will be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 6-I.

Data:

Strain gage output and deflection measurements will be recorded at each load increment.

TEST #6

Summary of Load Cylinders:

		Area	Max. Load
1.	Forward load, front trunnion	5.0 sq. in.	6852#
2.	Side load, front trunnion	1.0 sq. in.	2262#
3.	Up load, front trunnion	2.0 sq. in.	3581#

Area	No.
1.0 sq. in.	1
2.0 sq. in.	1
5.0 sq. in.	1

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WING FAN FORWARD TRUNION

FORWARD LOAD

CHANNEL No ______
(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1370#	274 psi					
40	2740	548					
60	4110	822					
80	5480	1100					
90	6170	1234					
100	6852	1370					

WING FAN FORWARD TRUNION

SIDE LOAD

CHANNEL No ______
(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	452#	452 psi					
40	905	905					
60	1360	1360					
80	1810	1810					
90	2040	2040					
100	2262	2262					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WING FAN FORWARD TRUNNION

UP LOAD

CHANNEL No ______
(2 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	716#	358 psi					
40	1435	718					
60	2150	1075					
80	2860	1430					
90	3220	1610					
100	3581	1790					

CHANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #7

Structure Tested: Wing fan trunnion fittings (fore and aft), spar attachments, and wing inboard leading edge, left side.

Test Condition: Composite condition, hovering flight with roll = 0°

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:
   a. STW-0003 - Loading Summary, Test #7
   b. STW-0004 - Test Set-up for Forward Fan Trunnion Test
   c. STW-0005 - Test Set-up for Forward and Aft Fan Trunnion Test
   d. STX-0001 - Overhead Load Cylinder Layout in Test Building
2. The loading fixtures used in Test #6 will also be used in Test #7. One other tension strap will be added as shown on Sheet 3 of STW-0004, and the load cylinder applying the forward load to STW-0001 shall be changed from a 5 square inch cylinder to a 1 square inch cylinder.
3. Layout of test fixtures is shown in STW-0005.
4. Calibrate Edison unit to give pressures shown in T.ble 7-I.
5. Prepare to record the output of all those strain gages used in Test #6.
6. Install deflection gages D-60 and 61. (Gages D-50 through 54, which were used in Test #6, will also be used in this test.)

Loading:

Limit loads will be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 7-I.

Data:

Strain gage outp ; and deflection measurements will be recorded at each load increment.

Data:

Strain gage output and deflection measurements will be recorded at each load increment.

TEST #7

Summary of Load Cylinders:

		Area	Max. Load
1.	Forward load, forward trunnion	1.0 sq. in.	2720#
2.	Side load, forward trunnion	1.0 sq. in.	2061#
3.	Up load, forward trunnion	2.0 sq. in.	5179#
4.	Up load, aft trunnion	5.0 sq. in.	5420#

Area	No.
1.0 sq. in.	2
2.0 sq. in.	1
5.0 sq. in.	1

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WING FAN FORWARD TRUNION

FORWARD LOAD.

CHANNEL No ______
(1. SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	544 #	544 Psi					
40	1090	1090					
60	1632	1632					
80	2180	2180					
90	2450	2450					
100	2720	2720					

WING FAN FORWARD TRUNION

SIDE LOAD

CHANNEL No ______
(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	412 #	412 psi					
40	824	824					
60	1235	1235					
80	1650	1650					
90	1855	1855					
100	2061	2061					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WING FAN FORWARD TRUNION

UP LOAD

CHANNEL No. ____

(2 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1036 #	518 psi					
40	2070	1035					
60	3110	1555					
80	4150	2075					
90	4660	2330					
100	5179	2590					

WING FAN AFT TRUNION

UP LOAD

CHANNEL No. ____

(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1084	217					
40	2170	435					
60	3250	650					
80	4340	868					
90	4880	976					
100	5420	1084					

TEST #8

Structure Tested: Aileron and aileron actuator fittings.

Test Condition: Maximum load and hinge moment.

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:

   a. STW-0011 - Tension Pad Layout - Aileron

   b. STW-0012 - Whiffletree Layout - Aileron

2. Assemble whiffletree as shown in STW-0012.

3. Assemble whiffletree and the tension pads (STW-0011) on the lower surface of the left aileron.

4. Reference Sheet 2, STW-0012, spot the erector beam as shown and secure to the floor tracks.

5. Install the 10011 or 10011A fitting on the beam such that the cylinder will apply a tension load normal to the lower surface of the aileron. Aileron deflected - trailing edge up 19°. Reference Sheet 2 of STW-0012.

6. Install a 2 square inch Regent load cylinder between whiffletree and floor beam.

7. Calibrate the Edison unit to the pressures shown in Table 8-I. (Weight of tension pads and whiffletrees are negligible in comparison to the applied load and need not be accounted for in load calibrations.)

8. Install the following deflection gages: D-70 through D-75 inclusive.

   Note: The aileron control actuator will be removed and replaced by a rigid link (STW-0031) before delivery for test. Check for completeness of installation prior to test.

Loading:

Loads will be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 8-I.

Data:

Deflection measurements will be recorded at each load increment.

TEST #8

Summary of Load Cylinders:

	Area	Max. Load
1. Down load, aileron	2.0 sq. in.	3125#

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TABLE 8-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR AILERON DOWN LOAD

CHANNEL No ______
(2 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	625 #	312 psi					
40	1250	625					
60	1875	937					
80	2500	1250					
90	2810	1405					
100	3125 #	1562					

CHANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #9

Structure Tested: Basic wing structure.

Test Condition: 4_g symmetrical flight maneuver; positive low angle of attack.

Airplane Jig: Basic airplane test fixture (Ref. Section V).

Test Preparations, Part I:

1. The following drawings will be required to set up for this test:
   a. STW-0015 - "C" Beam for Wing Tip Tension Pad
   b. STW-0016 - Wing Tip Tension Pad Detail
   c. STW-0017 - Wing Tip Bolt
   d. STW-0018 - "C" Beam Assembly
   e. STW-0019 - Inboard Aft Whiffletree
   f. STW-0020 - Inboard Aft Whiffletree Assembly
   g. STW-0021 - Front Spar Outboard Whiffletree Assembly
   h. STW-0022 - 50% Chord Outboard Whiffletree Assembly
   i. STW-0023 - Resultant Outboard Whiffletree Assembly
   j. STW-0024 - Rear Spar Outboard Whiffletree Assembly
   k. STW-0025 - Front Spar Inboard Whiffletree Assembly
   l. STW-0030 - Wing Tension Pad Layout
   m. STX-0001 - Overhead Load Cylinder Layout in Test Bldg.
2. Assemble the whiffletrees for both wings as shown in Drawings STW-0019, 21, 22, 23, 24 and 25
3. Tension pads will be installed on the wing prior to delivery for test.
4. Install wing whiffletrees and counterweight as necessary. Tension pad layout is shown in Drawing STW-0030. (Ref. Drawings STW-0015, 16, 18, 19, 20, 21, 22, 23, 24 and 25 for installation.)
5. Load cylinders (three per wing) will be installed prior to installation of the aircraft in the test jig. (Ref. Drawing STX-0001 and Table 9-I.)

6. Install the following deflection gages: D-80 through D-98 inclusive.

7. Prepare to record the output of strain gages S-601 through 662 inclusive.

8. Calibrate the Edison unit to the pressures shown in Table 9-I.

9. Remove rigid link (STW-0031) restraining the aileron as freedom of control movement will be checked during load application.

Loading:

Limit loads will be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 9-I.

Data:

Record strain gage output and deflection measurements at each load increment.

Test Preparations, Part II:

1. Reinstall the aileron rigid link with a linear potentiometer simulating the control valve. Attach the wiper to the valve bellcrank and prepare to record the displacement of the control system.

Loading:

Loads will be applied from 0 to 100 percent limit load in 20 percent increments.

Data:

The output of the potentiometer will be read continuously or at each load level described above.

TEST #9

Summary of Load Cylinders:

		Area	Max. Load
1.	Outboard wing, left side	10.9 sq. in.	8800#
2.	Outboard wing, right side	10.9 sq. in.	8800#
3.	Inboard leading edge, left side	5.0 sq. in.	3532#
4.	Inboard leading edge, right side	5.0 sq. in.	3532#
5.	Inboard trailing edge, left side	1.0 sq. in.	1350#
6.	Inboard trailing edge, right side	1.0 sq. in.	1350#

Area	No.	
1.0 sq. in.	2	
5.0 sq. in.	2	
10.9 sq. in.	2	(B-24 M.L.G.)

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

OUTBOARD WING LOAD CYL.

LEFT SIDE

CHANNEL No ____
(10.9 SQ. IN. CYL.) (B-24 M.L.G.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1760#	161 psi					
40	3520	322					
60	5280	484					
80	7040	645					
90	7920	726					
100	8800	806					

INBOARD LEADING EDGE

LEFT SIDE

CHANNEL No ____
(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	706#	141 psi					
40	1412	282					
60	2120	424					
80	2825	565					
90	3180	636					
100	3532	706					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

INBOARD TRAILING EDGE

LEFT SIDE

CHANNEL No ______
(1. SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	270#	270 psi					
40	540	540					
60	810	810					
80	1080	1080					
90	1215	1215					
100	1350	1350					

OUTBOARD WING LOAD CYL.

RIGHT WING

CHANNEL No ______
(10.9 SQ. IN. CYL.) (B-24 M.L.G.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1760#	161 psi					
40	3520	322					
60	5280	484					
80	7040	645					
90	7920	726					
100	8800	806					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

INBOARD LEADING EDGE

RIGHT SIDE

CHANNEL No ____
(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	706#	141 psi					
40	1412	282					
60	2120	424					
80	2825	565					
90	3180	635					
100	3532	706					

INBOARD TRAILING EDGE

RIGHT SIDE

CHANNEL No ____
(1. SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	270	270					
40	540	540					
60	810	810					
80	1080	1080					
90	1215	1215					
100	1350	1350					

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TEST #10

Structure Tested: Fuselage and horizontal stabilizer.

Test Condition: Composite condition to provide design loads on both fuselage and horizontal stabilizer which are developed during symmetrical flight.

Airplane Jig: Basic airplane test fixture. (Ref. Section V)

Test Preparation:

1. The following drawings will be required to set up for this test:
   - a. STF-0070 - Forward Fuselage Whiffletree Layout
   - b. STF-0071 - Summary of Load Points, Test #10
   - c. STF-0084 - Whiffletree, Vertical Loads, Aft Fuselage Test #10
   - d. STF-0085 - Load Fixture at F.S. 384, Test #10
   - e. STF-0086 - Parachute Fitting Load Fixture, Test #10
   - f. STH-0004 - Whiffletree Layout - H. Tail
   - g. STH-0003 - H. Tail Tension Pad Layout
   - h. STH-0005 - Load Cylinder Location Layout for H. Tail Loads
   - i. STF-0039 - Assembly Drawing, Rear Spar Support Structure
   - j. STF-0054 - Parachute Fitting - Vertical & Aft Load Fitting
   - k. STX-0001 - Overhead Load Cylinder Installation in Test Bldg.
2. Install the forward fuselage whiffletrees as shown in STF-0070.
3. Overhead load cylinder locations are shown in STX-0001.
4. Install the aft fuselage whiffletrees as shown in STF-0084.
5. Rig the aft spar support structure (STF-0039) such that up loads may be reacted at that fitting.
6. Install the bucket shown in STF-0085 at the jack fitting. At the start of testing, the bucket may be filled with 111 pounds of shot bags and left for the entire test, or load may be added in increments, upon discretion of the Test Director.
7. Install the walking beam for the up load on the parachute fitting as shown in STF-0086.

8. Install the horizontal stabilizer whiffletrees and load cylinders as shown in STH-0004 and STH-0005. (Ref. STH-0003)

9. Calibrate the Edison unit to the pressures shown in Table 10-I.

10. Prepare to record the output of the following strain gages:

    S-101 through S-113 inclusive

    S-201 through S-208 inclusive

    S-301 through S-306 inclusive

    S-401 through S-419 inclusive

    S-501 through S-533 inclusive

11. Install the following deflection gages: D-110 through D-126 inclusive.

12. Prepare to record displacements shown by the deflection gages.

13. Hook up hydraulic lines to all installed cylinders.

14. Install the upper engine compartment doors and side fairings, if available (143F074 and 143F075).

15. Remove the elevator snubber cable (STH-0002A) and rig the control cables so that elevator controls may be cycled at limit load.

Loading:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 10-I.

Data:

Strain gage output and airplane deflections will be recorded at each load increment. At 100 percent limit load, move the elevators from stop to stop to check for control system binding and/or interference.

TEST #10

Summary of Load Cylinders:

		Area	Max. Load
1.	Forward fuselage whiffletree (F.S. 68.0)	5.0 sq. in.	6916#
2.	Forward fuselage whiffletree (F.S. 121.0)	1.0 sq. in.	2780
3.	Forward fuselage whiffletree (F.S. 169)	2.0 sq. in.	4860
4.	Aft fuselage whiffletree (F.S. 356.1)	1.0 sq. in.	1953
5.	Parachute fitting load cylinder (F.S. 536.5)	2.0 sq. in.	3068
6.	Horizontal stabilizer down load (right side)	2.0 sq. in.	3550
7.	Horizontal stabilizer down load (left side)	2.0 sq. in.	3550

Area	No.
1.0 sq. in.	2
2.0 sq. in.	4
5.0 sq. in.	1

TABLE 10-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE WHIFFLETREE

DOWN LOAD AT F.S. 68

CHANNEL No ______
(5 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1382#	276 psi					
40	2770	554					
60	4150	830					
80	5540	1108					
90	6230	1245					
100	6916	1383					

FORWARD FUSELAGE WHIFFLETREE

UP LOAD AT F.S. 121

CHANNEL No ______
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	555	555					
40	1110	1110					
60	1665	1665					
80	2220	2220					
90	2500	2500					
100	2780	2780					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE WHIFFLETREES

DOWN LOAD AT F.S. 169

CHANNEL No ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	971 #	485 psi					
40	1942	971					
60	2920	1460					
80	3890	1945					
90	4370	2185					
100	4860	2430					

AFT FUSELAGE WHIFFLETREES

UP LOAD AT F.S. 356

CHANNEL No ______
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	391 #	391 psi					
40	782	782					
60	1170	1170					
80	1561	1561					
90	1760	1760					
100	1953	1953					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

PARACHUTE FITTING

UP LOAD AT F.S. 536

CHANNEL No ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	614 #	307 psi					
40	1228	614					
60	1840	920					
80	2450	1225					
90	2760	1380					
100	3068	1534					

HORIZONTAL STABILIZER

DOWN LOAD - RIGHT SIDE

CHANNEL No ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	710 #	355 psi					
40	1420	710					
60	2130	1065					
80	2840	1420					
90	3190	1595					
100	3550	1775					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

HORIZONTAL STABILIZER

DOWN LOAD - LEFT SIDE

CHANNEL No ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	710#	355 psi					
40	1420	710					
60	2130	1065					
80	2840	1420					
90	3190	1595					
100	3550	1775					

CHANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #11

Structure Tested: Fuselage, vertical and horizontal tail.

Test Condition: Sideslip (dynamic overswing) condition.

Airplane Jig: Alternate airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:

   a. STF-0072 (Attached) - Summary of Load Points Test 11

   b. STF-0065 - Whifflebeam Sta. 296 & 360

   c. STF-0070 - Forward Fuselage Whiffletree Layout

   d. STF-0039 - Assembly Drawing, Rear Spar Support Structure

   e. STF-0026 - Yoke Assembly, Jack Fitting

   f. STF-0080 - Pad Layout, Side Load, Fuselage

   g. STF-0081 - Whiffletree, Side Load, Fuselage

   h. STF-0082 - Whiffletree, Vertical Load, Forward Fuselage

   i. STF-0083 - Whiffletree, Vertical Load, Layout

   j. STL-0009 - (Sheet 2) Side Load on N.L.G. Oleo

   k. STV-0003 - Rudder Hinge Pickups - Vertical Tail

   l. STV-0004 - Whiffletree Layout, Vertical Tail

   m. STV-0002 - Vertical Tail Tension Pad Layout

   n. STH-0004 - Whiffletree Layout, Horizontal Tail

2. Install forward fuselage whiffletrees from F.S. 35.2 to 91.43 as shown in STF-0070.

3. Install the whiffletree for up loads on shear straps at F.S. 110, 123 and 133 (R) as shown on STF-0082, Sheet 1.

4. Install the down load whiffletree at F.S. 133 (L), 164 and 176, as shown in STF-0082, Sheet 2.

5. Install up load whiffletree at F.S. 188 as shown in STF-0082, Sheet 3.

6. A load reaction strap is required at the jack fitting (F.S. 384) strap location and installation is shown on STF-0026.

7. Attach to each shear strap at F.S. 413, 97# of lead shot. (Use buckets to contain shot bags.)

8. Install STF-0054-1 and -3 at the parachute fitting and install a one square inch load cylinder as shown in STF-0072, Sheet 4.

9. Install a one square inch cylinder to the left horizontal tail semi-span only. Install in the same position as the cylinder used in Test No. 10.

10. Install the forward fuselage whiffletrees for side load as shown in STF-0081. Pad layout is shown in STF-0080.

11. Set up a 10 foot "A" frame at F.S. 311 as shown in STF-0072 and install the two square inch load cylinder and whiffletree (STF-0065) for side loads on the wing rear spar (STF-0039) and at F.S. 366.

12. A side load reaction strap must be installed at F.S. 384 and attached to a 10 foot "A" frame as shown on STF-0072.

13. Erect a 15 foot "A" frame at F.S. 456 as shown on STF-0072.

14. Install the one square inch load cylinder and vertical tail whiffletrees shown in STV-0004. Vertical tail pad layout is shown in STV-0002.

15. Install a 10 foot "A" frame at F.S. 486 as shown in STF-0072.

16. Install side load fitting STF-0053, tension strap and a .75 inch O.D. cylinder (Bimba) for side load. Attach Bimba ram to "A" frame of 15. above.

17. Calibrate the Edison Unit to the pressures shown in Table 11-I.

18. Install hydraulic lines to all load cylinders.

19. Prepare to record the output of the following strain gages:

    S-101 through S-113 inclusive
    S-201 through S-208 inclusive
    S-301 through S-306 inclusive
    S-401 through S-419 inclusive
    S-501 through S-533 inclusive

20. Install the following deflection gages: D-130 through -150 inclusive.

21. Prepare to record deflection gage readings.

22. Install upper engine compartment doors and side fairings if available (143F074 and 143F075).

Loading:

Loads shall be applied as indicated in Section IV, General Test Procedures, and to the levels indicated in Table 11-I.

Data:

Strain and deflection gage readings shall be recorded at each load increment. At 100 percent limit load, swing the rudder from stop to stop to check for control system binding and/or interference.

TEST #11

Summary of Load Cylinders:

-- Vertical Loads --

		Area	Max. Load
1.	Forward Fuselage, Station 72 (down)	5.0 sq. in.	6434#
2.	Forward Fuselage, Station 123 (up)	2.0 sq. in.	3344#
3.	Forward Fuselage, Station 161 (down)	1.0 sq. in.	1882#
4.	Forward Fuselage, Station 188 (up)	1.0 sq. in.	1095#
5.	Wing Rear Spar, Station 296 (up)	5.0 sq. in.	(*)
6.	Wing Rear Spar, Station 296 (up)	5.0 sq. in.	(*)
7.	Parachute Fitting, Station 486 (down)	1.0 sq. in.	2831#
8.	Horizontal Tail (left side) (down)	1.0 sq. in.	1930#

-- Side Loads --

9.	Forward Fuselage, Station 63.8 (left)	1.0 sq. in.	1423#
10.	Forward Fuselage, Station 135 (left)	.813 (Bimba)	534#
11.	Wing Rear Spar, Station 296.5 (right)	2.0 sq. in.	3301#
12.	Vertical Tail, Station 456 (left)	1.0 sq. in.	2761#
13.	Parachute Fitting, Station 486 (right)	.393 (Bimba)	286#

(*) Max. load will depend upon rear spar support jig weight, Ref. STF-0039.

Area (sq. in.)	No.	
.393	1	(Bimba)
.813	1	(Bimba)
1.0	6	
2.0	2	
5.0	3	

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE WHIFFLETREE

DOWN LOAD AT F.S. 72

CHANNEL NO ______
(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1288 #	257 psi					
40	2575	515					
60	3860	772					
80	5150	1030					
90	5790	1158					
100	6436	1287					

FORWARD FUSELAGE WHIFFLETREE

UP LOAD AT F.S. 123

CHANNEL NO ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	667 #	335 psi					
40	1334	670					
60	2000	1000					
80	2670	1335					
90	3000	1500					
100	3344	1672					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE WHIFFLETREES

DOWN LOAD AT F.S. 161.

CHANNEL NO ____
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	376 #	376 psi					
40	752	752					
60	1130	1130					
80	1503	1503					
90	1695	1695					
100	1882	1882					

FORWARD FUSELAGE WHIFFLETREES

UP LOAD AT F.S. 188

CHANNEL NO ____
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	219 #	219 psi					
40	438	438					
60	657	657					
80	876	876					
90	985	985					
100	1095	1095					

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SUBJECT: SECTION: ENGINEER: CHECKER:	TABLE 11 -I	MODEL: PAGE: 3 OF 7 REPORT: DATE:

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE SIDE LOAD WHIFFLETREE

F.S. 63.8, LOAD TO LEFT.

CHANNEL No ______
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	285#	285 psi					
40	570	570					
60	855	855					
80	1140	1140					
90	1280	1280					
100	1423	1423					

SIDE LOAD – NOSE LANDING GEAR

F.S. 135, LOAD TO LEFT

CHANNEL No ______
(.813 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	107#	132 psi					
40	214	263					
60	321	395					
80	428	526					
90	480	590					
100	534	656					

SUBJECT:		MODEL:
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ENGINEER:		REPORT:
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INCREMENTAL LOADS & CYLINDER PRESSURES FOR:

WING REAR SPAR, STATION 296

DOWN - RIGHT SIDE

CHANNEL No ______
(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20							
40							
60							
80							
90							
100							

WING REAR SPAR, STATION 296

DOWN - LEFT SIDE

CHANNEL No ______
(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20							
40							
60							
80							
90							
100							

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LOAD INCREMENT & CYLINDER PRESSURE FOR:

WING REAR SPAR WHIFFLETREE

SIDE LOAD TO RIGHT

CHANNEL No ______ F. S. 311

(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	660#	330 psi					
40	1320	660					
60	1980	990					
80	2640	1320					
90	2970	1485					
100	3301	1650					

VERTICAL TAIL WHIFFLETREE

SIDE LOAD TO LEFT

F. S. 456

CHANNEL No ______

(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	552#	552 psi					
40	1104"	1104					
60	1655	1655					
80	2205	2205					
90	2480	2480					
100	2761	2761					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:
PARACHUTE FITTING DOWN LOAD
F. S. 486.

CHANNEL No ____
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	566#	566 psi					
40	1130	1130					
60	1696	1696					
80	2260	2260					
90	2550	2550					
100	2831	2831					

CHANNEL No ____
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20							
40							
60							
80							
100							

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LOAD INCREMENT. & CYLINDER PRESSURES FOR:

HORIZONTAL STABILIZER

DOWN LOAD - (LEFT SIDE)

CHANNEL No ______
(1.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	386 #	386 psi					
40	772	772					
60	1160	1160					
80	1540	1540					
90	1735	1735					
100	1930	1930					

PARACHUTE FITTING

SIDE LOAD TO RIGHT

F.S. 486

CHANNEL No ______
(.393 SQ. IN. CYL.) (B11-1EA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	57 #	145 psi					
40	114	290					
60	172	438					
80	229	584					
90	257	655					
100	286	728.					

TEST #12

<u>Structure Tested:</u> Engine mounts and space frame.

<u>Test Condition:</u> Rolling pullout.

<u>Airplane Jig:</u> Basic airplane test fixture (Ref. Section V)

<u>Test Preparations:</u>

1. Drawings applicable to this test:

   a. STC-0001 (Sheet 1) Windshield Test Jig Layout

   b. STP-0002 - Aft Engine Mount Whiffletree Assembly

   c. STP-0004 - Whiffletree - Aft Engine Mount

   d. STP-0006 - Engine Mount Load Fittings

   e. STP-0007 - Engine Mount Whiffletree Assembly (F.S. 256)

   f. STP-0008 - Engine Mount Loading Assembly (F.S. 234)

   g. STP-0008-1 - Engine Mount Load Strap

   h. STP-0015 - Summary of Load Points & Jig Setup for Test #12

   i. STX-0001 - Overhead Load Cylinder Layout in Test Building

2. The airplane will be delivered for test with the following engine support fittings installed:

Forward Mount:	14F135, 143P018, BRE-4458 and BRE-4995
Side Mount:	143P019
Main Mount:	143P005
Divider Duct Mount:	143P035

3. Erect the framework at F.S. 93.7 as shown on Sheet 1 of STC-0001. (Note the change of crossbeam vertical position for this test which is shown on Sheet 2 of STP-0002.)

4. Install engine mount whiffletree shown in STP-0002. (Up and forward loads)

5. Install loading setup for scroll support fitting shown in STP-0007.

6. Install cross duct support loading setup as shown on Sheet 3 of STP-0006.

7. Erect the "A" frame and install the loading hardware for the sideload at F.S. 234 as shown in Drawing STP-0008.

8. Install deflection gages D-160 through D-173 inclusive.

9. Prepare to record the output of the following strain gages: S-501 through S-531 inclusive.

10. Prepare to record the displacements of the deflection gages.

11. Install hydraulic lines to all load cylinders.

12. Calibrate the Edison unit to the pressures shown in Table 12-I.

Loading:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 12-I.

Data:

Record strain gage output and deflections at each load increment.

TEST #12

Summary of Load Cylinders:	Area	Max. Load
1. Forward load on main eng. mts.	5 sq. in.	7381#
2. Up load on eng. mt. (F.S. 257.10, BL.1 OR)	.44 sq. in. (Bimba)	318#
3. Down load scroll attach point	.44 sq. in. (Bimba)	354#
4. Side load at F.S. 234	1 sq. in.	936#

Area	No.
.44sq.in. (Bimba)	2
1 sq. in.	1
5 sq. in.	1

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INCREMENTAL LOADS & CYLINDER PRESSURES FOR:

FORWARD LOADS ON MAIN ENGINE

MOUNTS (F.S. 257.10)

CHANNEL No ______

(5. SQ IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1880 #	376 psi					
40	3760	752					
60	5640	1129					
80	7500	1500					
100	9381	1875					

UP LOAD ON MAIN ENGINE

MOUNT (F.S. 257.1, B.L. 1.02)

CHANNEL No ______

(.44 SQ IN CYL.) (BIMBA)

% LOAD	LOAD	CALC PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	64 #	145 psi					
40	127	290					
60	191	434					
80	254	578					
90	286	650					
100	318	724					

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INCREMENTAL LOADS & CYLINDER PRESSURES FOR:

CHANNEL No ______
(1 SQ IN. CYL)

% LOAD	LOAD	CALC. PRESSURES	ACT. PRESSURES		TEST PRESSURES	TEST LOAD	
20							
40							
60							
80							
100							

DOWN LOAD SCROLL ATTACH POINT

CHANNEL No ______
(.44 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURES	ACT. PRESSURES		TEST PRESSURES	TEST LOAD	
20	71 #	161 psi					
40	142	322					
60	213	[illegible]					
80	283	643					
90	319	725					
100	354	805					

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CHECKER:

TABLE 12-I

MODEL:

REPORT:
DATE:

INCREMENTAL LOADS & CYLINDER PRESSURE, FOR:

SIDE LOAD AT F.S. 2?4.

CYLINDER NO. ______
(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC PRESSURE	ACTUAL PRESSURES		TEST PRESSURE	TEST LOAD	
20	187 #	187 PSI					
40	374	374					
60	561	561					
80	748	748					
100	936	936					

TEST #13

Structure Tested: Engine mount and space frame.

Test Condition: Hovering Flight.

Airplane Jig: Basic airplane test fixture. (Ref. Section V)

Test Preparations:

1. The following drawings will be required for this test:

   a. STP-0016 - Summary of Load Points for Test #13

   b. STP-0003 - Aft Engine Mount Whiffletree Assembly

   c. STP-0004 - Whiffletree Beams - Aft Engine Mount

   d. STP-0006 - (Sheet 2) Engine Mount Load Fittings

   e. STP-0007 - Engine Mount Whiffletree Assembly

2. Install the fittings for up loads on the main engine mounts as shown in STP-0003.

3. Change the .44 square inch bimba cylinder of STP-0007 to a 2.0 square inch cylinder.

4. Change cross duct down load hardware from STP-0006, Sheet 3, to that shown on STP-0006, Sheet 2.

5. Remove the side load hardware from the mount at F.S. 234.

6. The same deflection gages will be used on this test as on the previous test (#12). (D-160 through D-173 inclusive)

7. The same strain gages used on Test #12 will also be read on this test.

8. Calibrate the Edison to those pressures shown in Table 13-I.

9. Install hydraulic lines to all load cylinders.

Loading:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 13-I.

Data:

Record strain gage output and deflections at each load increment.

TEST NO. 13

Load Cylinder Summary

		Area	Max. Load
1.	Up load main engine mt. (B.L. 2.4L)	2.0 sq.in.	3300#
2.	Up load main engine mt. (B.L. 11.4R)	5.0 sq.in.	6400#
3.	Down load cross ducts	10.9 sq.in.	8800#
4.	Down load scroll support ftg.	5.0 sq.in.	6251#

Area	No. Required
2.0	1
5.0	2
10.9	1

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TABLE 13-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR

UP LOAD ON MAIN ENG. MT.

AT F.S. 257.1, B.L. 2.4 L

CHANNEL No ______

(2.0 SQ.IN.CYL)

% LOAD	LOAD	CALC. PRESSURE	ACT. PRESS.		TEST PRESSURE	TEST LOAD	
20	660 #	330 psi					
40	1320	660					
60	1980	990					
80	2640	1320					
90	2970	14[illegible]					
100	330[illegible]	[illegible]0					

UP LOAD ON MAIN ENG. MT.

B.L. 11.4 R

CHANNEL No ______

(5.0 SQ.IN. CYL)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1280 #	256 psi					
40	2560	512					
60	3840	768					
80	5120	1024					
90	5760	1152					
100	6400	1280					

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TABLE 13-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

DOWN LOAD ON CROSS DUCT

SUPPORTS

CHANNEL NO ________
(10.9 SQ. IN. CYL)

% LOAD	LOAD	CALC. PRESSURES	ACT. PRESSURES		TEST PRESSURE	TEST LOAD	
20	1760#	161 psi					
40	3520	322					
60	5280	484					
80	7050	646					
100	8800	806					

DOWN LOAD ON SCROLL

SUPPORT FTG.

CHANNEL NO ________
(5.0 SQ. IN.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1250 #	250 psi					
40	2500	500					
60	3750	750					
80	5000	1000					
90	5625	1125					
100	6251	1250					

TEST #14

Structure Tested: Windshield

Test Condition: Maximum flight dynamic pressures, sideslip angle (B) = 5°.

Airplane Jig: Basic test fixture (Ref. Section V).

Test Preparations:

1. The drawing required for this test set up is STC-0001, Sheets 1 through 16 inclusive.

2. Erect the jig structure for load reaction as shown on Sheet 1 of STC-0001.

3. Typical installation of straps to tension pads is shown on Sheet 16 of STC-0001. All loads must be applied normal to the local windshield surface.

4. The attached photographs and Table 14-I define pad locations and show pad numbers. Assemble whiffletrees and a 1 square inch Regent cylinder with pads 101, 102, 103, 104 and 105. This layout is shown on Sheet 2 and Sheet 11 of STC-0001.

5. Assemble whiffletrees and 1-1/2 inch diameter Bimba load cylinder with pads 106, 107, 108 and 109. This layout is shown on Sheets 3 and 12 of STC-0001.

6. Assemble whiffletrees and 1-1/2 inch diameter Bimba load cylinder with pads 110, 111, 112 and 113. This layout is shown on Sheets 4 and 13 of STC-0001.

7. Assemble whiffletrees and 1-1/2 inch diameter Bimba load cylinder with pads 114, 115 and 116. This layout is shown on Sheets 5 and 14 of STC-0001.

8. Assemble whiffletrees and 1-1/2 inch diameter Bimba load cylinder with pads 117, 118, 119 and 120. This layout is shown on Sheets 6 and 15 of STC-0001.

9. Pads number 201 through 207 are for compression loads and therefore will require extreme care in seeing that the load cylinders are not canted in any direction which would result in an unstable load cylinder instal-

lation. Load cylinders must be installed so that the applied loads are normal to the windshield surface. Install the compression whiffletree and the 1-1/16 inch Bimba load cylinder on pads 207 and 208. A single 3/4 inch diameter Bimba load cylinder with appropriate end fittings is installed on pad 209. The installation and location of this setup is shown on Sheet 1 of STC-0001.

10. Install the compression whiffletree and 1-1/16 inch diameter Bimba load cylinder with pads 204 and 205. The installation is shown on Sheet 8 of STC-0001.

11. Install the compression whiffletree and 1-1/16 inch diameter Bimba load cylinder on pads 201 and 202 as shown on Sheet 9 of STC-0001.

12. Install the compression whiffletree and 3/4 inch diameter Bimba load cylinder on pads 203 and 206. Installation is shown on Sheet 10 of STC-0001.

13. Install deflection gages D-180 through D-188 inclusive, and prepare to record displacements.

14. Calibrate the Edison unit to the pressures shown in Table 14-II.

15. Install hydraulic lines to all cylinders.

16. No strain gage measurements will be required.

Loading:

Loads shall be applied in increments as specified in the General Test Procedure (Section IV) and to the levels shown in Table 14-II.

Data:

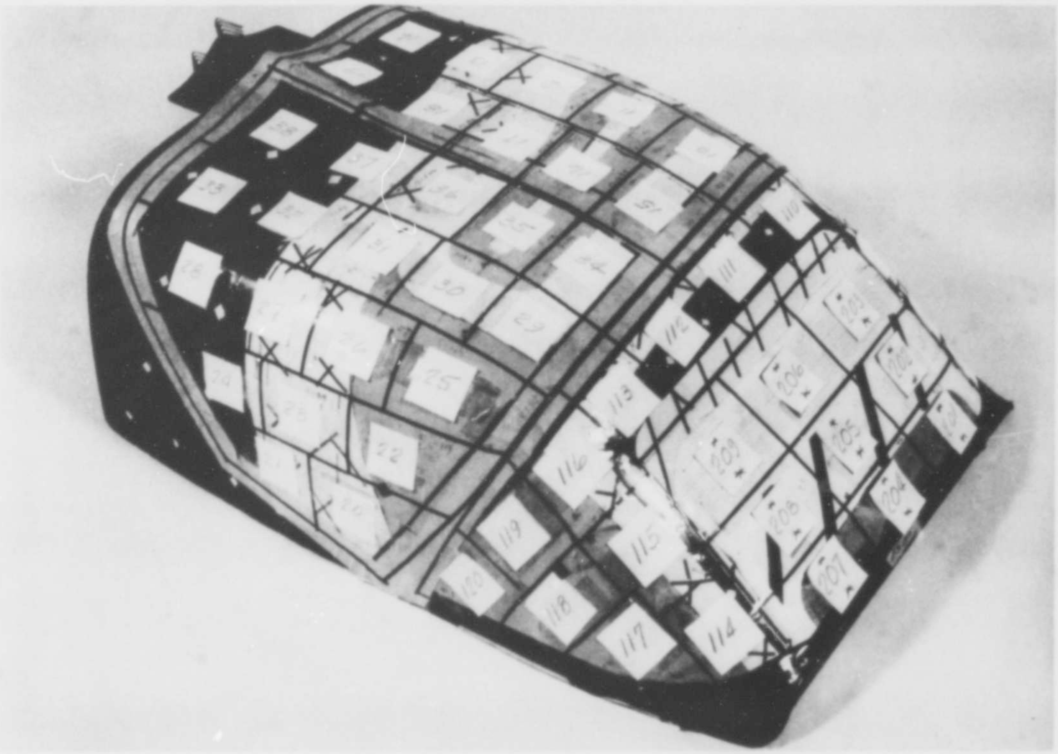
Record displacements, as indicated by deflection gages, at each load increment. No strain gages are used in this test.

Test #14

Summary of Load Cylinders:

		Area	Max. Load
1.	Pads 101, 102, 103, 104 and 105	1 sq. in. (Regent)	2190#
2.	Pads 106, 107, 108, 109	1.6 sq. in. (Bimba)	935#
3.	Pads 110, 111, 112, 113	1.6 sq. in. (Bimba)	800#
4.	Pads 114, 115 and 116	1.6 sq. in. (Bimba)	770#
5.	Pads 117, 118, 119 and 120	1.6 sq. in. (Bimba)	1060#
6.	Pads 201 and 202 (Compression)	.89 sq. in. (Bimba)	580#
7.	Pads 203 and 206 (Compression)	.44 sq. in. (Bimba)	237#
8.	Pads 204 and 205 (Compression)	.89 sq. in. (Bimba)	690#
9.	Pads 207 and 208 (Compression)	.89 sq. in. (Bimba)	810#
10.	Pad 209 (Compression)	.44 sq. in. (Bimba)	250#
11.	Side load - windshield frame	.81 sq. in. (Bimba)	616#

Area (Sq. in.)	No.
1.6 (Tension) Bimba	4 (6" stroke)
1.0 (Tension) Regent	1
.89 (Compression) Bimba	3 (6" stroke)
.44 (Compression) Bimba	2 (6" stroke)
.81 (Tension) Bimba	1 (36" stroke)



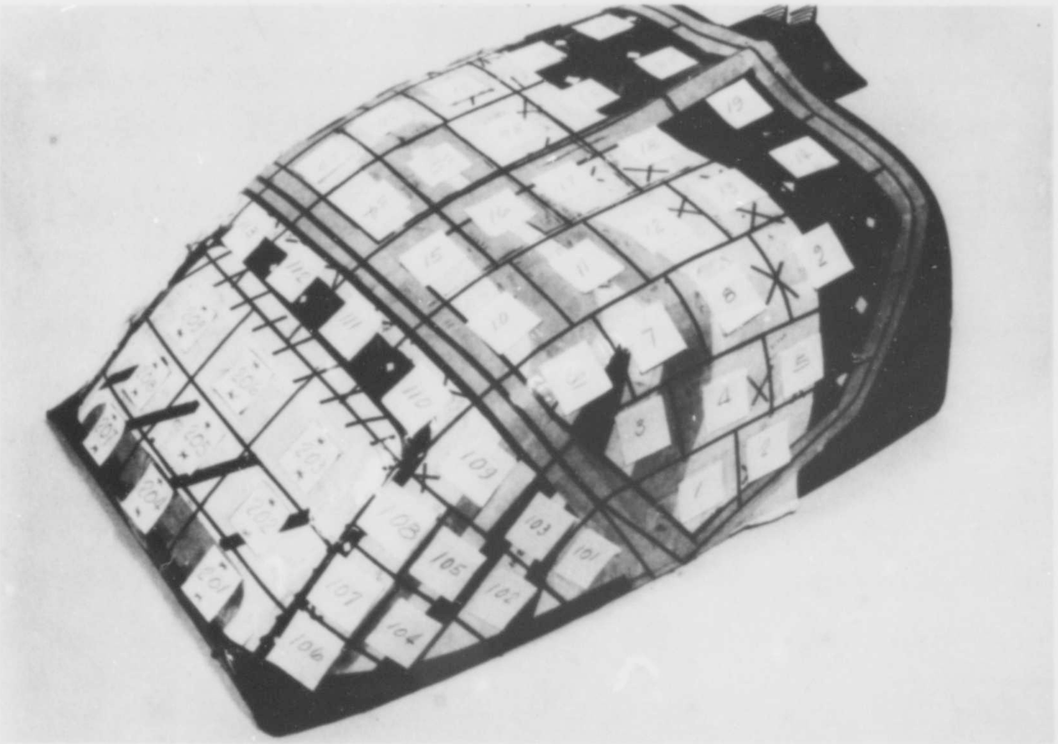


TABLE 14-I

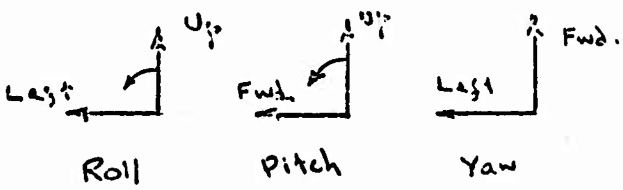
PAD LOADS FOR WINDSHIELD STATIC TEST

TENSION PADS (EXTERNALLY APPLIED)

PAD NO.	LOCATION F.S.	B.L.	W.L.	PITCH DEG. FWD.	YAW DEG. LEFT	ROLL DEG. LEFT	LIMIT PAD LOAD
101	115.7	29	121.5	—	90	90	450
102	105.2	23	122.6	—	85	90	550
(103)	112.7	27.5	123.0	—	85	90	470
104	100.5	26.0	122.5	—	80	90	440
(105)	105.2	25.5	127.1	—	80	85	500
106	97.4	22	122	60	45	45	200
107	99.8	21.4	127.4	55	45	45	135
108	104.9	21.5	131.6	45	45	45	150
109	109.7	23.3	133.8	30	50	50	450
110	108.7	15	136.5	30	-3	-3	240
(111)	108.7	6	136.8	30	0	0	210
(112)	108.7	-6	136.8	30	0	0	210
113	108.7	-15	136.5	30	-2	-2	140
114	95.7	-22	122.2	60	-45	-45	260
115	101.7	-22	129.1	50	-45	-45	260
116	107.2	-22	134.5	30	-45	-45	250
117	100.5	-26	122.5	—	-85	-85	240
118	106.7	-27	124.7	—	-90	-90	280
119	112.2	-27.5	128.0	—	-90	-85	280
120	115.7	-29	121.5	—	-90	-90	260

NOTES

(1) Load directions are given with reference to pitch, yaw, and roll axes:



(2) Pad locations and vectors are approximate. Loads should be applied normal to surface.

(3) 308# side loads acting left to be applied simultaneously as concentrated loads at L.H. and R.H. shear blocks on windshield frame. (308# per side)

COMPRESSION PADS (EXTERNALLY APPLIED)

PAD NO.	LOCATION F.S.	B.L.	W.L.	PITCH DEG. FWD.	YAW DEG. LEFT	ROLL DEG. LEFT	LIMIT PAD LOAD
201	91.1	12	125	40	0	0	360
202	96.4	12	129.3	40			220
203	101.7	12	133	35			67
(204)	91.1	0	125	40			380
(205)	96.4	6	129.3	40			310
(206)	101.7	0	133	35			170
207	91.1	-12	125	40			470
([illegible])	96.4	-12	129.3	40			340
([illegible])	101.7	-12	133	35	0	0	250

CIRCLED NUMBERS INDICATE DEFLECTION POINTS

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WINDSHIELD TEST - TENSION PADS

#101, 102, 103, 104, 105

CHANNEL No ______
(1.0 Sq. In. CYL.) (REGENT)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	438 #	438 psi					
40	876	876					
60	1312	1312					
80	1850	1850					
90	1970	1970					
100	2190	2190					

TENSION PADS

#106, 107, 108, 109

CHANNEL No ______
(1.61 Sq. In. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	187 #	116 psi					
40	374	232					
60	561	348					
80	748	464					
90	841	523					
100	935	580					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:
WINDSHIELD TEST - TENSION PADS
110, 111, 112, 113

CHANNEL NO ______
(1.61 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	160	99 psi					
40	320	198					
60	48	298					
80	640	398					
90	720	447					
100	800	497					

TENSION PADS
114, 115, 116.

CHANNEL NO ______
(1.61 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	154#	95 psi					
40	308	191					
60	462	287					
80	616	382					
90	693	430					
100	770#	478					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:
WINDSHIELD TEST - TENSION PADS
117, 118, 119, 120

CHANNEL No ______
(1.61 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD
20	212#	131 psi				
40	424	263				
60	636	372				
80	848	526				
90	953	592				
100	1060	658				

TENSION PADS
201 & 202
(COMPRESSION)

CHANNEL No ______
(.89 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD
20	116#	131 psi				
40	232	261				
60	348	691				
80	464	521				
90	521	586				
100	580#	652				

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TABLE 14-II

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

WINDSHIELD TEST - TENSION PADS

203, 206

(COMPRESSION)

CHANNEL No ______

(.44 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	48 #	109 psi					
40	95	216					
60	142	323					
80	190	432					
90	213	484					
100	237	540					

TENSION PADS

204, 205

(COMPRESSION)

CHANNEL No ______

(.89 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	138 #	155 psi					
40	276	310					
60	414	465					
80	552	621					
90	621	698					
100	690	775					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:
WINDSHIELD TEST - TENSION PADS
207 & 208
(COMPRESSION)

CHANNEL No ______
(.89 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	162 #	182 psi					
40	324	364					
60	486	546					
80	647	727					
90	729	819					
100	810	910					

TENSION PAD #209
(COMPRESSION)

CHANNEL No ______
(.44 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	50 #	113 psi					
40	100	227					
60	150	341					
80	200	455					
90	225	512					
100	250	568					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR
WINDSHIELD TEST —
WINDSHIELD FRAME SIDE LOAD

CHANNEL No ______
(.81 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	123 #	152 psi					
40	246	304					
60	370	457					
80	492	608					
90	555	685					
100	616	761					

CHANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #15

Structure Tested: Main landing gear and local fittings; fuselage forward of F.S. 316.0, including fuselage center section or space frame.

Test Condition: Two wheel, tail down landing - dynamic springback.

Airplane Mounting Fixture: Alternate airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required in setting up for this test:
   a. STL-0011 - Load Points for Test #15
   b. STL-0006 - Main Landing Gear Load Fitting
   c. STL-0002 - Landing Gear Oleo Restraint
   d. STF-0070 - Forward Fuselage Whiffletree Layout
   e. STF-0078 - Axial Load Member Support Structure
   f. STF-0076 - Axial Load Fitting - Beam Reaction
   g. STF-0077 - Axial Load Member Assembly
   h. STF-0079 - Whiffletree Beams for Axial Loads F.S. 145
   i. STL-0008 - Jig Layout for Forward Loads - M.L.G.
   j. STL-0010 - Load Setup for M.L.G., Test #15
   k. STP-0010 - Main Engine Mount Assembly for Ir rtia Relief, Test #15
   l. STF-0039 - Rear Spar Support Assembly
   m. STF-0026 - Yoke Assembly - Jack Fitting
   n. STF-0055 - Parachute Fitting Load Setup, Test #15
   o. STL-0011 - Summary of L ad Points and Jig Layout for Test #15
2. Remove load cylinders and tension straps used for the windshield test (#14).
3. Drawing STL-0011 - Summarizes jig layout and load points for this test.
4. Install STL-0006 (load fittings to M.L.G. axle) and STK-0002 (main landing gear oleo restraint). The main landing gear shall be locked in the conventional landing position. (FWD)
5. Install forward fuselage whiffletrees to the existing shear straps as shown in STF-0070.

6. Erect the jigwork shown in STF-0078 and STF-0079.

7. Install the axial load fitting, STF-0075, and beam reaction fitting shown in STF-0076. Weld 0076 on installation.

8. Install the load member shown in assembly drawing STF-0077.

9. Install the 10 foot long I-beam as shown in STL-0008.

10. Install load cylinders for forward and up loads on the main landing gear as shown in STL-0010.

11. Install engine mount load fittings and whiffletrees as shown in STP-0010.

12. Install 2 load cylinders to provide down loads at the rear spar. This installation is shown in STF-0039. Cylinder size and load will depend upon the dead weight characteristics of the rear spar support assembly.

13. The aft end of the airplane is supported by the yoke assembly shown in STF-0026. Up load reaction at this point must be measured during this test which will require the installation of a load link between STF-0026 and the floor. This installation is shown on page 2 of STF-0026.

14. Erect 2 ten foot "A" frames and crossbeam as shown in STF-0055.

15. Install load cylinder and tension straps for parachute fitting loads as shown in STF-0055.

16. Install hydraulic lines to all cylinders.

17. Prepare to record strain gage output from the load link at F.S. 384 (jack fitting).

18. Calibrate the Edison unit to the pressures and loads shown in Table 15-I.

19. Install the following deflection gages: D-190 through D-198 inclusive.

20. Prepare to record the output of strain gages S-301 through S-306 inclusive.
    S-401 through S-419 "
    S-501 through S-533 "

21. Prepare to record the displacement measurements of the installed deflection gages.

Loading:

Loads will be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 15-I.

Data:

Record strain gage outputs and deflections at each load increment.

Test #15

SUMMARY OF LOAD CYLINDERS

		Size	Max. Load
1.	Fuselage W/T, F. Sta. 62	1 sq. in.	1,754#
2.	Fuselage W/T, F. Sta. 150.8	10.9 sq. in.	8,342#
3.	Axial load cyl. F. Sta. 95 (R)*	2.0 sq. in.	3,680#
4.	Fwd. load M.L.G. (Right)	5.0 sq. in.	8,373#
5.	Fwd. load M.L.G. (Left)	5.0 sq. in.	8,373#
6.	Up Load M.L.G. (Right)	10.9 sq. in.	12,781#
7.	Up Load M.L.G. (Left)	10.9 sq. in.	12,781#
8.	Up and Aft load engine mounts (R)	2.0 sq. in.	3,242#
9.	Down load engine mounts at F.S.Ta.257.1	5.0 sq. in.	4,300#
10.	Down load, rear spar, wing root, F.S. 296.5(R)	(5.0 sq. in.)*	2,834#*
11.	Down load, rear spar, wing root, F.S. 296.5(L)	(5.0 sq. in.)*	2,834#*
12.	Parachute fitting aft and down load (R)	2.0 sq. in.	3,350#

*Load & cylinder sizes are dependent upon dead weight reactions of STF-0039.

Area	Total
1 sq. in.	1
2.0 sq. in.	3
5.0 sq. in.	5*
10.9 sq. in.	3

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD FUSELAGE WHIFFLETREE

LOAD CYLINDER AT F.S. 62.0

CHANNEL No ______

(1 SQ. IN. CYL)

%LOAD	LOAD	CALC. PRESSURE	ACT. PRESSURE		TEST PRESSURE	TEST LOAD	
20	351#	351 psi					
40	702	702					
60	1052	1052					
80	1402	1402					
90	1578	1578					
100	1754	1754					

FORWARD FUSELAGE WHIFFLETREE

LOAD CYLINDER AT F.S. 150.7

CHANNEL No ______

(10.9 SQ. IN. CYL.)

%LOAD	LOAD	CALC. PRESSURE	ACT. PRESSURE		TEST PRESSURE	TEST LOAD	
20	1670#	153 psi					
40	3340	306					
60	5000	458					
80	6670	612					
90	7500	687					
100	8842	764					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:
FUSELAGE AXIAL LOAD CYLINDER
AT F.S. 95.

CHANNEL № ______
(2.0 SQ.IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACT. PRESSURE		TEST PRESSURE	TEST LOAD	
20	735#	368 psi					
40	1470	735					
60	2210	1205					
80	2950	1475					
90	3310	1655					
100	3680	1840					

FORWARD LOAD ON M.L.G.
RIGHT SIDE

CHANNEL № ______
(5.0 SQ.IN.CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACT. PRESSURE		TEST PRESSURE	TEST LOAD	
20	1675#	335 psi					
40	3350	670					
60	5020	1005					
80	6700	1340					
90	7540	1505					
100	8373	1675					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

FORWARD LOAD ON M.L.G.

LEFT SIDE

CHANNEL No. ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1675 #	335 psi					
40	3350	670					
60	5020	1005					
80	6700	1340					
90	7540	1540					
100	8373	1675					

UP LOAD ON M.L.G.

RIGHT SIDE

CHANNEL No. ______

(10.9 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	2550 #	234 psi					
40	5110	469					
60	7650	701					
80	10200	935					
90	11480	1050					
100	12,781	1170					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

UP LOAD ON M.L.G.

LEFT SIDE

CHANNEL No ______

(10.9 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	2550 #	234 psi					
40	5110	469					
60	7650	701					
80	10200	935					
90	11,480	1050					
100	12,781	1170					

UP & AFT LOAD ON ENGINE MOUNTS

CHANNEL No ______

(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	650 #	325 psi					
40	1300	650					
60	1950	975					
80	2600	1300					
90	2920	1460					
100	3242	1620					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

DOWN LOAD ON ENGINE MOUNTS

F.S. 257.10

CHANNEL No ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	860 #	172 psi					
40	1720	354					
60	2580	516					
80	3440	688					
90	3870	775					
100	4300	860					

DOWN LOAD - REAR SPAR

F.S. 296.5 - RIGHT SIDE

CHANNEL No ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	567 #	113 psi					
40	1135	227					
60	1700	340					
80	2270	454					
90	2545	510					
100	2834	567					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

DOWN LOAD - REAR SPAR

F.S. 257.1 - LEFT SIDE

CHANNEL No. ______

(5.0 SQ. IN CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	567	113 psi					
40	1135	227					
60	1700	340					
80	2270	454					
90	2545	510					
100	2834	567					

PARACHUTE FITTING

AFT LOAD

F.S. 586.0

CHANNEL No. ______

(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	670 *	335 psi					
40	1340	670					
60	2010	1.005					
80	2680	1340					
90	3020	1510					
100	3350	1775					

TEST #16

Structure Tested: Main landing gear, local fittings and fuselage center section.

Test Condition: Drift landing.

Airplane Mounting Fixture: Alternate airplane test fixture (Ref. Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:
   a. STF-0077 - Axial Load Member Assembly
   b. STP-0010 - Main Engine Mount Assembly for Inertia Relief
   c. STL-0009 - Load Points and Hardware Layout for Drift Landing Test
   d. STL-0008 - Jig Layout for Applying Forward Loads to M.L.G.
   e. STL-0007 - Side Loading Layout - M.L.G.
2. Remove whiffletrees from F.S. 35.2 to 188.6 inclusive.
3. Remove axial load member shown in drawing STF-0077.
4. Remove engine mount load fittings shown in drawing STP-0010.
5. Remove parachute load fitting STF-0055.
6. Remove load cylinders and tension straps which apply forward loads to the main landing gear.
7. Change the load cylinders which apply up loads to the main landing gear from 10.9 sq. in. to 5.0 sq. in. cylinders.
8. Retain load cell and tension strap installation at the jack fitting (F.S. 384).
9. Fittings STL-0002 (Oleo restraint), and STL-0006 (M.L.G. load fittings), which were used in Test #15 will also be used in this test. Load points and methods of load application for this test are shown in drawing STL-0009, Sheets 1 through 8 (attached). "A" frame locations are summarized on Sheet 1 of STL-0009. The main landing gear will be locked in the conventional landing position.

10. Erect the 5 foot "A" frame at F.S. 135, and install the loading hardware as shown on sheet 2, STL-0009. Load is applied to the strut through the use of a web strap around the oleo piston. Care must be taken to insure that the strap does not slip so as to allow the load to be applied below the reference waterline. (54.4)

11. Install whiffletree beams to fuselage shear straps as shown on sheet 3 of STL-0009.

12. Attach tension straps from the fuselage whiffletrees to the load cylinders which are shown in the cylinder installation drawing - sheet 4 of STL-0009.

13. Install a 12-inch wide flange beam, 10 feet long as shown in STL-0008. (fittings included)

14. Install whiffletree, tension straps and cylinder, as shown on sheet 5 of STL-0009, for forward loads on the main landing gear. (landing gear fittings STL-0006)

15. Install a 12-inch wide flange beam 15 feet long at F.S. 275.4. This beam makes 2 "A" frames as shown on drawing STL-0007 and STL-0009, sheet 1.

16. Install loading hardware on above beam per drawing STL-0007.

17. Erect the "A" frame at F.S. 297 and install load cylinders and tension straps as shown on sheet 6 of STL-0009.

18. Erect the "A" frame at F.S. 366 and install load cylinders and tension straps at F.S. 365 and 366 as shown on sheet 7 of STL-0009.

19. Install STF-0053 (parachute side load fitting)

20. Erect the "A" frame at F.S. 486 and install the load cylinder and tension strap as shown on sheet 8 of STL-0009.

21. Calibrate Edison unit to the pressures shown in Table 16-I.

22. Install hydraulic lines to all installed cylinders.

23. Prepare to record the output from the following strain gages: S-501 through S-533 inclusive

24. Install and prepare to record displacements from deflection gages D-210 and D-213 inclusive.

25. Install upper engine compartment doors and side fairings if available. (143F074 and 143F075)

LOADING:

Loads shall be applied in increments as specified in Section IV, General Test Procedures, and to the levels shown in Table 16-I.

DATA:

Record strain gage output and deflections at each load increment.

TEST #16

SUMMARY OF LOAD CYCLES		SIZE	MAX. LOAD
1.	Nose landing gear (side load)	1 sq. in.	1266#
2.	F.S. 157.4 (down load)	5 sq. in.	3560#
3.	F.S. 152.5 (down load)	1 sq. in.	2841#
4.	M.L.G. (forward load)	.811 sq. in. (Bimba)	692#
5.	F.S. 297 (side load)	2.0 sq. in.	3453#
6.	M.L.G. (up load - rt. side)	5.0 sq. in.	6060#
7.	M.L.G. (up load - left side)	5.0 sq. in.	6060#
8.	F.S. 297 (up load)	5.0 sq. in.*	3883#*
9.	F.S. 297 (down load)	5.0 sq. in.*	6654#*
10.	F.S. 366 (side load)	2.0 sq. in.	3079#
11.	F.S. 365 (down load)	1 sq. in.	1779#
12.	F.S. 365 (up load)	1 sq. in.	615#
13.	F.S. 486 (side load)	.811 sq. in. (Bimba)	489#
14.	M.L.G. (side load - rt. M.L.G.)	2.0 sq. in.	4858#
15.	M.L.G. (side load - left M.L.G.)	2.0 sq. in.	3643#

*Cylinder size and load will be determined after STF-0039 is weighed.

AREA (sq. in.)	NO.
0.811 (Bimba)	2
1.0	4
2.0	4
5.0	5

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TABLE 16-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

SIDE LOAD NOSE LANDING GEAR

CHANNEL Nº ______ TEST Nº 16

(1 SQ. IN. CYL.)

%LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	253 #	253 psi					
40	506	506					
60	760	760					
80	1010	1010					
90	1138	1138					
100	1266	1266					

F.S. 157.4 (RIGHT SIDE)

DOWN LOAD

CHANNEL Nº ______

(5 SQ. IN. CYL.)

%LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	712 #	142 psi					
40	1425	285					
60	2140	428					
80	2850	570					
90	3200	641					
100	3560	712					

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TABLE 16-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

F. S. 152.5 (LEFT SIDE)

DOWN LOAD

CHANNEL № ______

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	568#	568 psi					
40	1137	1137					
60	1705	1705					
80	2270	2270					
90	2560	2560					
100	2841	2841					

MAIN LANDING GEAR

FORWARD LOAD

HANNEL № ______

(.81 SQ. IN. CYL.) (BIMBA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	138#	170 psi					
40	277	342					
60	415	512					
80	554	685					
90	623	770					
100	692	854					

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TABLE 16-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

F.S. 297 (RIGHT SIDE) (REAR SPAR)

SIDE LOAD

CHANNEL No ________

(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	690 #	345 psi					
40	1380	690					
60	2070	1035					
80	2760	1380					
90	3110	1555					
100	3453	1726					

MAIN LANDING GEAR
UP LOAD (RIGHT SIDE)

CHANNEL No ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1210 #	242 psi					
40	2420	485					
60	3640	728					
80	4850	970					
90	5450	1090					
100	6060	1210					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

MAIN LANDING GEAR

UP LOAD (LEFT SIDE)

CHANNEL NO ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1210 #	242 psi					
40	2420	485					
60	3640	728					
80	4850	970					
90	5450	1090					
100	6060	1210					

F.S. 297.0 (RT. SIDE)

UP LOAD

CHANNEL NO ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	780 #	156 psi					
40	1560	312					
60	2335	467					
80	3110	622					
90	3495	700					
100	3883	778					

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TABLE 16-I.

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

F.S. 297 (LEFT SIDE - REAR SPAR)

DOWN LOAD

CHANNEL No ______

(5.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1330#	266 psi					
40	2660	532					
60	4000	800					
80	5320	1062					
90	6000	1200					
100	6654	1331					

F.S. 366. (RT. SIDE)

SIDE LOAD

CHANNEL No ______

(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	616#	308 psi					
40	1232#	616					
60	1850	925					
80	2460	1230					
90	2750	1375					
100	3079	1540					

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LOAD INCREMENTS & CYLINDER PRESSURES FOR:

F. S. 365 (RT. SIDE)

DOWN LOAD

CHANNEL Nº ____
(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURES	ACTUAL PRESSURES		TEST PRESSURES	TEST LOADS	
20	356#	356 psi					
40	712	712					
60	1070	1070					
80	1425	1425					
90	1600	1600					
100	1779	1779					

F. S. 365 (LEFT SIDE)

UP LOAD

CHANNEL Nº ____

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURES	ACTUAL PRESSURES		TEST PRESSURES	TEST LOADS	
20	123#	123 psi					
40	246	246					
60	369	369					
80	492	492					
90	554	554					
615	615	615					

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TABLE 16-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

F.S. 486 (LEFT SIDE)

(SIDE LOAD)

CHANNEL No ______

(.811 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	98#	121 psi					
40	196	142					
60	294	362					
80	391	482					
90	440	543					
100	489	603					

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TABLE 16-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR MAIN LANDING GEAR SIDE LOAD

RIGHT HAND M.L.G.

CHANNEL No ______
(2.0 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	970#	485 psi					
40	1940	970					
60	2920	1460					
80	3890	1945					
90	4370	2185					
100	4858	2430 psi					

SIDE LOAD ON
LEFT HAND MAIN LANDING GEAR

CHANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	730#	365 psi					
40	1460	730					
60	2180	1090					
80	2920	1460					
90	3280	1640					
100	3643	1822					

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TEST #17

Structure Tested: Main landing gear door (left side) and associated locks and linkages.

Test Condition: Opening pressures on door in high speed flight.

Airplane Mounting Fixture: Basic airplane test fixture (Reference Section V).

Test Preparations:

1. The following drawings will be required to set up for this test:
   (a) STL-0012 - Schematic Layout of M.L.G. Door Load Fixtures
   (b) STL-0004 - Main Landing Gear Door Whiffletree Layout
   (c) STL-0003 - Main Landing Gear Door Tension Pad Layout
2. Landing gear will be up and the doors will be closed and locked.
3. Install the 5-foot "A" frame and the 5 foot long erector beam as shown in STL-0012.
4. Assemble whiffletrees as shown in drawing STL-0004.
5. Install whiffletrees and load cylinders as shown in STL-0012. (Loads will be applied normal to the surfaces of the doors). Tension pad layout is shown in drawing STL-0003.
6. Install deflection gages D-220 through 224 inclusive.
7. Calibrate the Edison unit to the pressures shown in Table 17-I.
8. Loads will be applied to both doors simultaneously.

Loading:

Limit loads will be applied as specified in Section IV, General Test Procedures, and to the levels shown in Table 17-I.

Data:

Deflections of the door and/or fuselage will be recorded at each load increment.

SUBJECT:		MODEL:
SECTION:		PAGE:
ENGINEER:		REPORT:
CHECKER:	TABLE 17-I	DATE:

LOAD INCREMENTS & CYLINDER PRESSURES FOR DOWN LOAD - M.L.G. DOOR

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	180 LBS	180 psi					
40	360	360					
60	540	540					
80	720	720					
90	808	808					
100	897	897					

SIDE LOAD ON M.L.G. DOOR

(1 SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	175 LBS	175 psi					
40	350	350					
60	525	525					
80	700	700					
90	785	785					
100	873	873					

TEST #18

Structure Tested: Wing flap, hinges and actuator fitting.

Test Condition: Flap fully deflected, V = 180 knots.

Test Fixture: Off aircraft test, (Reference STW-0010)

Test Preparations:

1. Erect the jig structure shown in STW-0010.
2. Install flap as shown in STW-0010. (Note inclination of flaps.)
3. Install a load cell to measure the actuator link load.
4. Install deflection gages D-230 and D-231.
5. Load distribution will be simulated through the use of shot bags. The following will be required:

   54 - 25# bags

   66 - 5# bags

Loading: Loading will be in the following percent limit load increments:

20 - 40 - 20 - 80 - 20 - 100 - 20

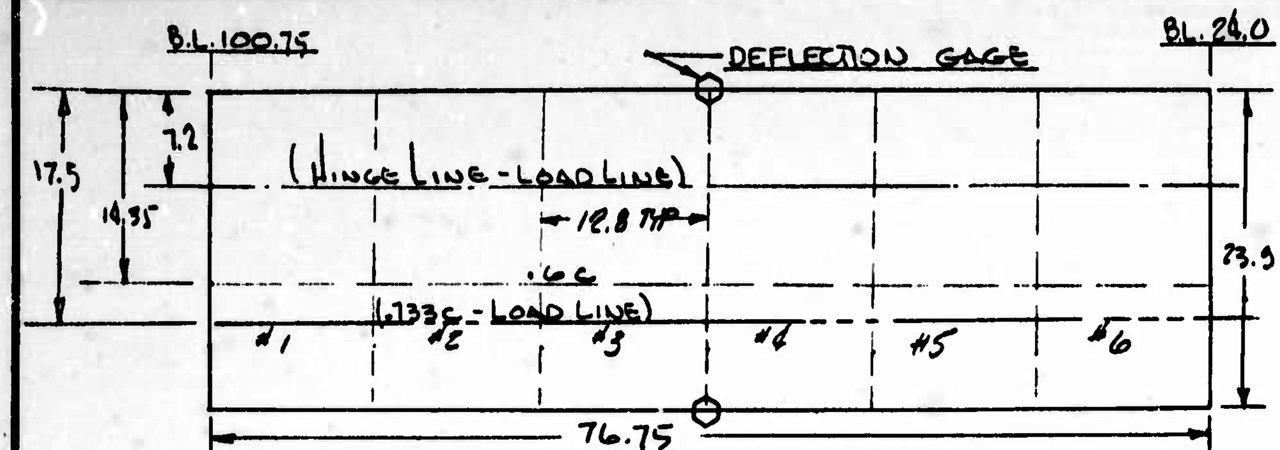
The load locations and magnitudes are shown in Table 18-I.

Data: Record deflections and load cell output at each load increment.

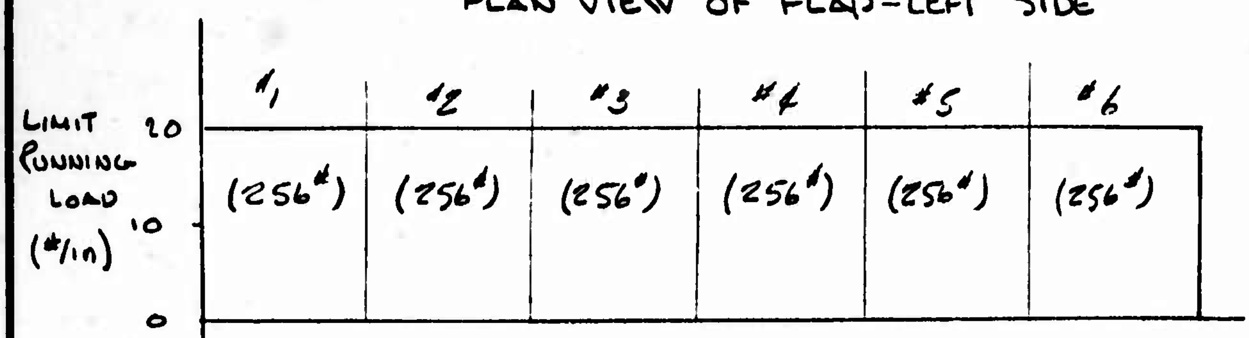
SUBJECT:
SECTION:
ENGINEER:
CHECKER:

TABLE 18-I

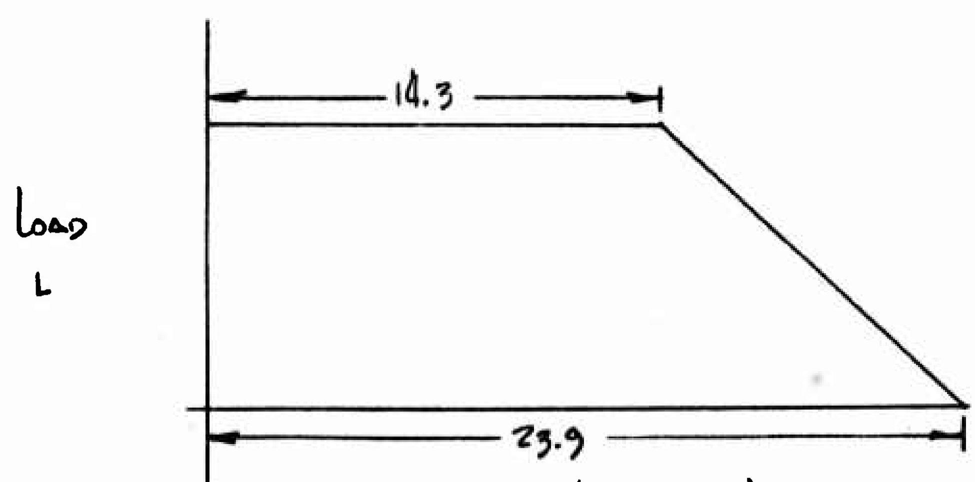
MODEL:
PAGE: 1 OF 2
REPORT:
DATE:



PLAN VIEW OF FLAP-LEFT SIDE



SPANWISE RUNNING LOAD (100% LIMIT)



TYPICAL CHORDWISE LOAD DISTR.

TABLE 18-I

FLAP LOADING TABLE

	PANEL #1		#2		#3		#4		#5		#6	
%LOAD	.3c	.73c	.3c	.73c	.3c	.73c	.3c	.73c	.3c	.73c	.3c	.73c
21.5	40	15	40	15	40	15	40	15	40	15	40	15
39.1	35	10	35	10	35	10	35	10	35	10	35	10
80.2	115	35	115	35	115	35	115	35	115	35	115	35
100	150	50	150	50	150	50	150	50	150	50	150	50

NOTE:

1. LOADS FOR 40, 80 & 100% LOADS ARE "Δ" INCREASES FROM 20% TARE LOAD.
2. SHOT BAGS ARE TO BE STACKED VERTICALLY - NOT NORMAL TO FLAP LOWER SURFACE
3. THE .3c & .73c LINES FORM THE ℄'s OF THE APPLIED SHOT BAGS
4. LOAD INCREMENTS SHOWN ARE AS CLOSE TO 20.40, & 80% LIMIT LOADS AS THIS TYPE LOADING ALLOWS.

TEST #19

Structure Tested: Rudder, hinge fittings and control rod.

Test Condition: Maximum pilot effort rudder hinge moment for rudder induced sideslip.

Test Fixture: Separate off-aircraft test. Jig shown in STV-0001.

Test Preparations:

1. Erect the jig as shown in STV-0001.

2. Install the rudder in the jig, chord plane horizontal. The following additional parts will be required for the installation:

   (a) 143T022

   (b) DT-28AH (Shafer bearing installed at the bottom of the rudder).

3. Install the following deflection gages: D-140 and D-141.

4. The following shot bags will be required:

   47 - 25# bags

   23 - 5# bags

Loading: Load distribution will be simulated through the use of shot bags placed on the surface as described in Table 19-I. The following percent limit loading schedule will be followed:

20 - 50 - 20 - 80 - 20 - 100 - 20

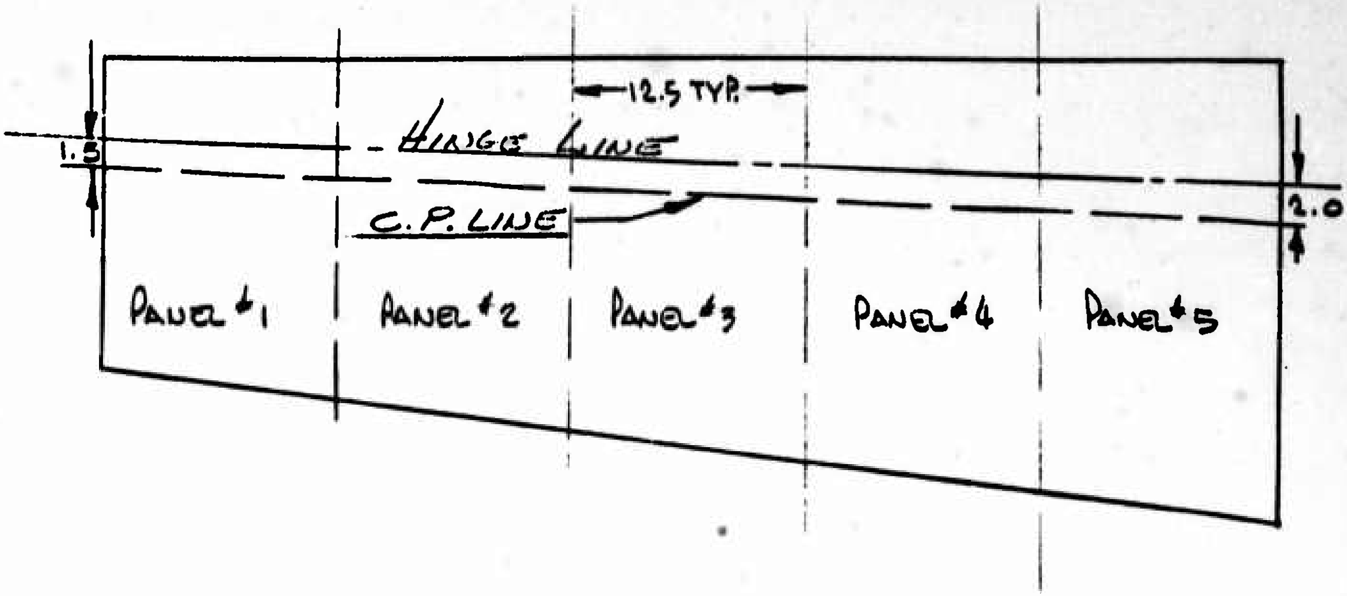
Data: Record deflections at each load increment.

SUBJECT: STATIC TEST
SECTION:
ENGINEER: dP
CHECKER:

MODEL: 143
PAGE:
REPORT:
DATE:

TABLE 19-I

RUDDER LOADING SCHEDULE



PANEL No	% LIMIT LOAD INCREMENT 20	50	80	100
1	60#	90#	180#	240#
2	55	80	165	215
3	50	75	150	200
4	45	65	145	190
5	45	65	145	190
TOTAL LOAD	255#	630#	1040#	1290#

NOTE:

1. INCREMENTAL LOADS OF 50, 80, & 100% ARE 'Δ' LOADS TO BE ADDED TO THE 20% TARE LOAD.
2. DISTRIBUTE THE LOAD OVER EACH PANEL SUCH THAT THE LOAD CENTER IS ON THE C. P. LINE & EVENLY DISTRIBUTED.

TEST #20

<u>Structure Tested:</u> Canopy and frame.

<u>Test Condition:</u> Maximum flight dynamic pressures on canopy, sideslip angle (β) = 5°

<u>Test Fixture:</u> The test will be conducted off the aircraft. The jig is shown in STC-0002.

<u>Test Preparations:</u>

1. Erect the jig structure shown in STC-0002.
2. Install the canopy in the test fixture. (Care must be taken to insure that the shear pins on the forward lower canopy are engaged and that the canopy down locks are engaged. There is only a slight (5 to 10 pounds) preload in the canopy latches.)
3. Attach whiffletrees, tension straps and load cylinders to canopy tension pads. (Pad arrangement is shown in the attached photographs and in Table 20-I.)
4. Install deflection gages D-250 through D-258 inclusive.
5. Each latch mechanism will have a load cell installed to measure latch loads. Prepare to record the output of each load cell.

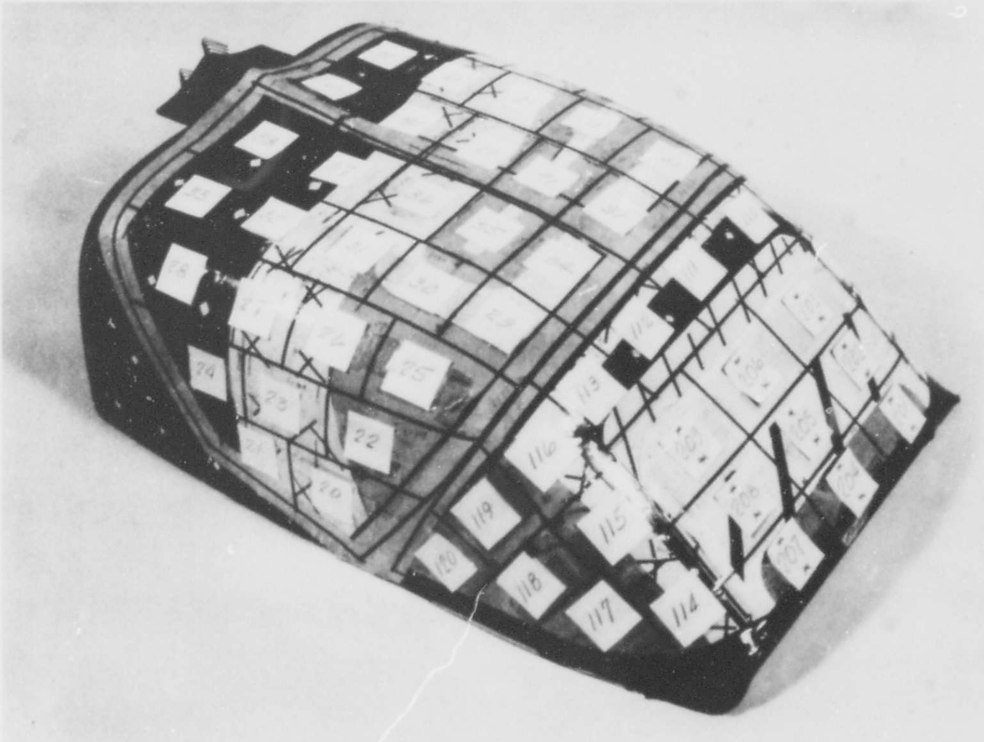
<u>Loading:</u>

The loads imposed in this test will be canopy ultimate loads (limit loads x 1.5) which are shown in Table 20-I. The loads will be applied in the following percent ultimate load increments: 20 - 40 - 20 - 55 - 20 - 66.6 - 20 - 80 - 20 - 90 - 20 - 100 - 20.

<u>Data:</u>

Deflection measurements will be taken at each load increment up to and including 66.6% ultimate load. Beyond this point the deflection gages may be removed if failure of the test article could result in damage to costly instrumentation.

Reactions at each latch mechanism will be recorded at each load increment.


24
25
22
20
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120
118
117
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115
116
113
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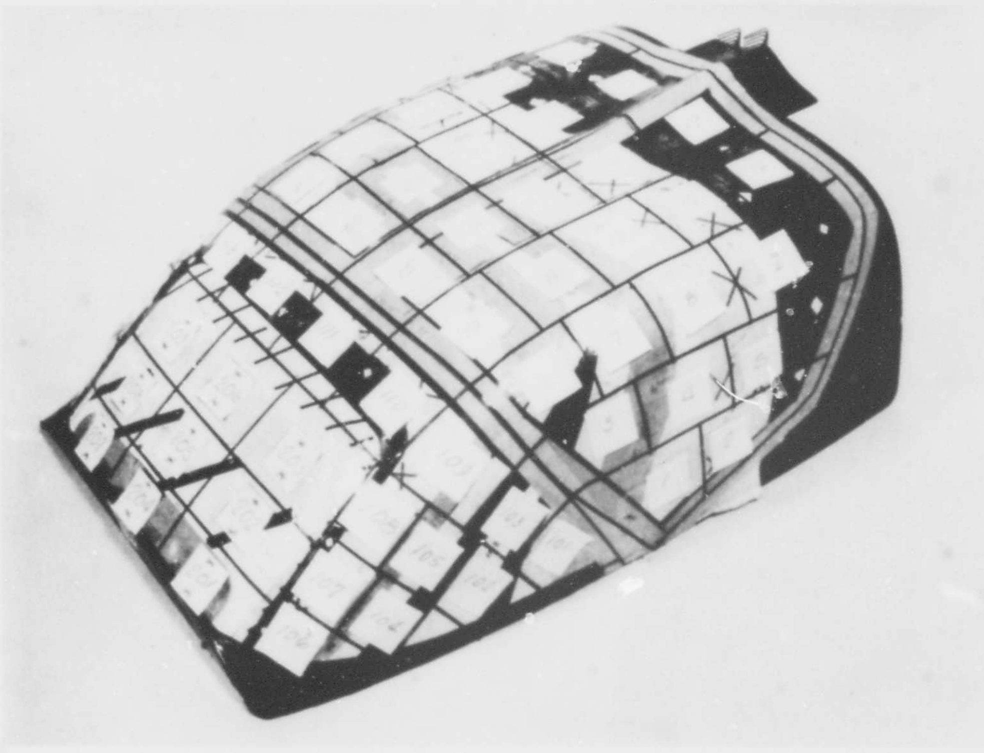


SUBJECT:
SECTION:
ENGINEER:
CHECKER:

TABLE 20-I
CANOPY ULTIMATE TEST LOADS

MODEL: XV-5A
PAGE:
REPORT:
DATE:

PAD Nº	LOCATION F.S.	LOCATION B.L.	LOCATION W.L.	APPROX. DIRECTION DEG. FORWARD	APPROX. DIRECTION DEG. PORT	ULT. LOAD (LBS)
1	132	PORT SIDE	124	0	+90	705
2	141	—	125	—	—	345
3	127	—	132	—	—	765
4	136	—	132	—	—	435
5	146	—	132	0	+90	405
6	123	+24	138	+15	+45	750
7	130	+24.5	139	0	—	705
8	139	+24.5	139	—	—	555
9	150	+24.5	139	0	+45	405
10	121	+15.5	TOP PORT SIDE	+11	+6	735
11	129	—	—	+3	+5	750
12	137	—	—	0	—	495
13	148	—	—	0	—	300
14	156	+15.5	—	0	+5	225
15	121	+5.5	—	+13	0	795
16	127	—	—	+5	—	750
17	136	—	—	0	—	450
18	145	—	—	0	—	345
19	155	+5.5	—	0	0	225
20	132	STAR'D SIDE	123	0	-90	495
21	139	STAR'D SIDE	124	0	-90	280

PAD Nº	LOCATION F.S.	LOCATION B.L.	LOCATION W.L.	APPROX. DIRECTION DEG. FORWARD	APPROX. DIRECTION DEG. PORT	ULT. LOAD (LBS)
22	126	STAR'D SIDE	132	0	-90	465
23	136	—	132	—	—	330
24	145	—	132	0	-90	250
25	124	-24	138	+12	-45	495
26	132	-24.5	139	0	—	435
27	140	-24.5	139	—	—	345
28	151	-24.5	139	0	-45	120
29	121	-15.5	TOP STARBOARD SIDE	+11	-6	570
30	127	—	—	+3	-5	570
31	136	—	—	0	—	315
32	145	—	—	—	—	165
33	155	-15.5	—	0	-5	98
34	121	-5.5	—	+13	0	720
35	127	—	—	+5	—	705
36	136	—	—	0	—	435
37	145	—	—	—	—	250
38	155	-5.5	—	0	0	190

TEST #21

Structure Tested: Elevator, aileron, and rudder control systems.

Test Condition: Maximum pilot effort.

Airplane Jig: None required. Test is to be accomplished during installed systems tests.

A. General Test Preparations:

1. The following drawings will be required to set up for this test:

   a. STW-0026 - Dummy Actuator, Aileron, for Controls Test

   b. STZ-0001 - Controls Test Layout

   c. STZ-0002 - Controls Test Fittings

   d. STZ-0003 - Controls Test Reaction Fitting (cockpit bulkhead)

   e. STZ-0004 - Rudder Tension Regulator Restraint Fitting

   f. STZ-0005 - Elevator Restraint Fitting

2. Install restraint fittings on ailerons, rudder and elevator as shown in the drawings above.

3. Install the load reaction fitting on the cockpit aft bulkhead as shown in STZ-0003.

4. Erect external jigwork for the side stick loads shown in STZ-0001.

5. Install the load fittings and Bimba load cylinders as shown in STZ-0001.

B. Elevator Test:

Loading: Apply the limit pilot effort fore and aft loads to the control stick. (200 pounds), in increments specified in Section IV, General Test Procedures.

Data: Record stick deflections at the point of load application. Deflections to be with respect to the airplane. Data to be recorded at each increment.

C. <u>Rudder:</u>

<u>Loading:</u> Apply the limit pilot effort load to the right rudder pedal (300 pounds), in increments specified in Section IV, General Test Procedures.

<u>Data:</u> Record pedal deflections at the point of load application. Deflections to be with respect to the airplane. Data to be taken at each load increment.

<u>Repeat the above for the left rudder pedal.</u>

D. <u>Aileron:</u>

<u>Loading:</u> Apply the limit pilot effort side force to the control stick (100 pounds), in increments specified in Section IV, General Test Procedures.

<u>Data:</u> Record stick deflections at the point of load application. Deflections to be with respect to the airplane. Data to be recorded at each load increment.

<u>Loads and deflections to left and right are required.</u>

TEST #22

Structure Tested: Wing fan doors and actuating hardware (installed on fan).

Test Condition: High speed flight (F-1) N = +4.0, Mach No. .8, Q = 850 psf - Maximum wing fan door loading with the doors closed.

Airplane Jig: Off airplane test. Jig is shown in drawing STW-0050.

Test Preparations:

1. The following drawings will be required to set up for this test:
   a. STW-0050
   b. STW-0060
   c. STW-0070
   d. STW-0075
2. The wing fan will be delivered for test with the complete fan door installation made including door actuating cylinders.
3. Tension pads will be installed on the fan doors as shown in the test program.
4. Remove the fan assembly from the shop handling fixture and install it in the test fixture STW-0050. The fan will be mounted horizontally as it would be in the aircraft.
5. Install the whiffletrees shown in STW-0060 with the tension pads as indicated.
6. A 3000 psi hydraulic source is required for fan door hydraulic power.
7. A 28 volt DC, 20 amp, electrical source is required for door latch power.
8. Install hydraulic power to the fan door actuators as shown in STW-0070.
9. Install electrical power to door latch mechanism as shown in STW-0075.
10. The tests shall be conducted with 3000 psi hydraulic pressure supplied to the fan door actuators and 28 volts applied to the latch mechanisms even though the latches will not be operated during this test sequence.
11. Load measuring bolts will have been installed on the "record player" (G.E. Part No. 412001-300-2). Eight (8) bolts are installed and their output must be

measured. Prepare to record the data on the Gilmore recorder.

12. Prepare to record the output of strain gages S____ through S____.

13. Prepare to measure and record structural deflections at points D____ through D____. (18 pts)

Loading and Data: The following test procedure will be used:

Part I

A. Apply 3000 psi hydraulic pressure to the tension side of the door actuator cylinders (4).

B. Apply the simulated airloads on the doors in the increments specified in Section IV, General Test Procedures, and to the levels shown in Table 22-I.

C. Record strain gage output and deflections at each load increment.

Part II

A. Apply 3000 psi hydraulic pressure to the tension side of the outboard forward and inboard aft actuators only.

B. Same as Part IB.

C. Same as Part IC.

Part III

A. Apply 3000 psi hydraulic pressure to the tension side of the outboard aft and the inboard forward actuators only.

B. Same as Part IB.

C. Same as Part IC.

SUBJECT: ______
SECTION: ______
ENGINEER: ______
CHECKER: ______

MODEL: ______
PAGE: ______
REPORT: ______
DATE: ______

TABLE 22-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:

UP LOAD ON WING FAN DOORS

TEST Nº 22

CHANNEL Nº ______
(5.15 SQ. IN. CYL.) (TENSION AREA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	1000 #	195 psi					
40	2000	388					
60	3000	583					
80	4000	777					
90	4500	875					
100	5000	971					

IANNEL Nº ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #23

Structure Tested: Wing fan doors and actuating hardware (installed on fan).

Test Condition: Transition flight, $n_z = 2.0$, $q = 45.9$ psf, $\alpha = 18^o$, wing fan doors closed.

Airplane Jig: Off airplane test. Jig is shown in drawing STW-0050.

Test Preparations:

1. The following drawing will be required to set up for this test:
   a. STW-0060 - Whiffletree layout
2. The fan assembly will remain in the same jig and in the same attitude as used in the previous test.
3. The hydraulic power and electrical power setup and data gathering devices will remain unchanged from the previous test.
4. Install the whiffletrees shown in STW-0061.
5. All strain gages used in the preceeding test will also be used in this test.

Loading:

Part I

With the doors closed and latched, and with 3000 psi hydraulic pressure applied to the tension side of all door actuator cylinders, apply simulated airload to the door. The loads will be applied in increments as specified in Part IV, General Test Procedures, and to the levels shown in Table 23-I.

B. Record deflection and strain gage data at each load increment.

C. At 100 percent limit load, unlatch the doors and after structure has stabilized record deflections and strain measurements.

D. Relatch the doors.

Part II

A. Dump the pressure from the outboard forward and inboard aft actuators. Record deflections and strain gage outputs.

B. Unlatch the doors and after the structure has stabilized record strain gage outputs and deflections.

C. Relatch the doors.

Part III

A. Repressurize the tension side of the outboard forward and inboard aft actuators and dump the pressure on the outboard aft and inboard forward actuators. Record deflection and strain gage outputs.

B. Unlatch the doors and after the structure has stabilized record strain gage outputs and deflection measurements.

C. Remove all deflection measuring devices.

Part IV

A. At 100 percent limit load and with 3000 psi, hydraulic pressure applied to the tension side of the door actuators unlatch the doors. Gradually reduce the actuator pressure until the doors begin to lift from their seated positions and record the pressure.

B. Allow the doors to raise 3 to 4 inches maximum at their outboard edges, then increase the actuator pressure, close and relatch the doors.

Part V

At 100 percent limit load and with 3000 psi, hydraulic pressure applied to the outboard forward and inboard aft door actuators only, unlatch the doors. Gradually reduce the actuator pressure until the doors begin to lift from their seated positions and record the pressure.

B. Allow the doors to raise to 3 or 4 inches maximum at their outboard edges, then increase the actuator pressure, close and relatch the doors.

Part VI

A. At 100 percent limit load and with 3000 psi hydraulic pressure applied to the outboard aft and inboard forward door actuators only, unlatch the doors. Gradually reduce the actuator pressure until the doors begin to lift from their seated positions and record the pressure.

B. Allow the doors to raise 3 or 4 inches maximum at their outboard edges, then increase the actuator pressure, close and relatch the doors.

SUBJECT:
SECTION:
ENGINEER:
CHECKER:

MODEL:
PAGE:
REPORT:
DATE:

TABLE 23-I

LOAD INCREMENTS & CYLINDER PRESSURES FOR:
UP LOAD ON WING FAN DOORS
TEST 23

CHANNEL No ______
(2.54 SQ. IN. CYL.) (TENS. AREA)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	
20	330#	130 psi					
40	660	260					
60	990	390					
80	1320	520					
90	1480	544					
100	1650	650					

IANNEL No ______
(SQ. IN. CYL.)

% LOAD	LOAD	CALC. PRESSURE	ACTUAL PRESSURE		TEST PRESSURE	TEST LOAD	

TEST #24

<u>Structure Tested:</u> Wing fan doors and actuating hardware (installed on fan).

<u>Test Condition:</u> Transition flights, wing fan door open, yaw right.

<u>Airplane Jig:</u> Off airplane test. Jig is shown in drawing STW-0050.

<u>Test Preparation:</u>

1. The following drawing will be required in setting up for this test:

   a. STW-0050

2. Remove all whiffletrees from the previous tests.

3. Remove all tension pads from the fan doors.

4. Remove the 28-volt power system.

5. Rotate the fan assembly to the position shown in drawing STW-0050.

6. Prepare and record the output of strain gages S_____ through S_____.

7. Prepare to record the deflections at points D_____ through D_____.

8. The fan doors will be open for this test and 3000 ~~spi~~ psi hydraulic pressure will be applied to the fan door actuators as in previous tests.

<u>Loading and Data:</u>

I

A. With all four door actuators pressurized to 3000 psi (compression side), load the doors to 25% load with shot bags.

B. Record strain gage output and deflections.

C. Increase load to 50% load.

D. Record strain gage output and deflections.

E. Increase load to 75% load.

F. Record strain gage output and deflections.

G. Increase load to 100% limit load.

H. Record strain gage output and deflections.

Part II

A. With 100% limit load being applied to the doors, gradually reduce the hydraulic pressure of the outboard aft and inboard forward actuators to zero pressure.

B. Record strain gage output and deflections.

C. Gradually return the pressure of all actuators to 3000 psi.

Part III

A. With 100% limit load being applied to the doors, gradually reduce the hydraulic pressure on the outboard forward and inboard aft actuators to zero pressure.

B. Record strain gage output and deflections.

C. Gradually return the pressure of all actuators to 3000 psi.

D. Remove the door load.

Part B

STATIC TEST RESULTS

CONTENTS Part B

LIST OF FIGURES

REFERENCES

1. Ryan Report 63B048 dated 2 May 1963
   Structural Proof Test Program
   U. S. Army XV-5A Lift Fan Research Aircraft

2. Ryan Report 64B024 dated 26 February 1964
   Preliminary Static Test Procedures

3. Ryan Report 63B096 dated 26 June 1963
   Structural Analysis of Wing Basic Components
   U. S. Army XV-5A Lift Fan Research Aircraft

4. Ryan Report 63B131 dated 6 December 1963
   Structural Analysis of Center Fuselage and Engine Mounts
   U. S. Army XV-5A Lift Fan Research Aircraft

5. Ryan Internal Report MR 63-9
   Elevated Temperature and Notch Strength Properties of
   18 NiCoMo (250) MarAge Steel

1.0 INTRODUCTION

This part of the report contains the results of the structural proof test program for the U.S. Army XV-5A Lift Fan Research Aircraft.

Twenty-five separate tests were conducted in the program to demonstrate structural integrity of the airframe for flight and ground loads.

2.0 SUMMARY

The XV-5A static tests were conducted in accordance with the Structural Proof Test Program (Ref. 1) and the Static Test Procedure.

The objective of the program was to demonstrate by minimum testing the structural integrity of the airframe. This objective was accomplished. Most of the tests were conducted without any difficulty; that is, limit load was reached without any permanent set or adverse deflections. In a few tests, however, such as those on the windshield and main landing gear door, structure was found to be below required strength or stiffness. In all such cases sufficient revisions were made and any necessary retesting was conducted satisfactorily. Detailed accounts of action taken are included in the test summaries.

The instrumentation was planned primarily to indicate any permanent set or excessive deflection and was not sufficient to provide significant correlation of test results with calculated. However, some comparisons are presented in the summaries of these tests where sufficient data was available.

In certain tests additional instrumentation was required, and in each case it is noted in the discussion of that test.

The deflection data has been corrected, where possible, to give displacements with respect to the airplane.

Strain gages were installed at critical points in the airframe for the purpose of verifying that yield strain was not reached during tests. Readings from these gages were plotted only for strains exceeding 1000 micro-inches per inch at limit load. In all cases the stresses corresponding to these strains were considerably lower than material yield strengths, and in most cases they were lower than those calculated in the stress analysis. Figure 1 shows the configuration of the test vehicle, and Figure 2 shows the test vehicle in the test jig.

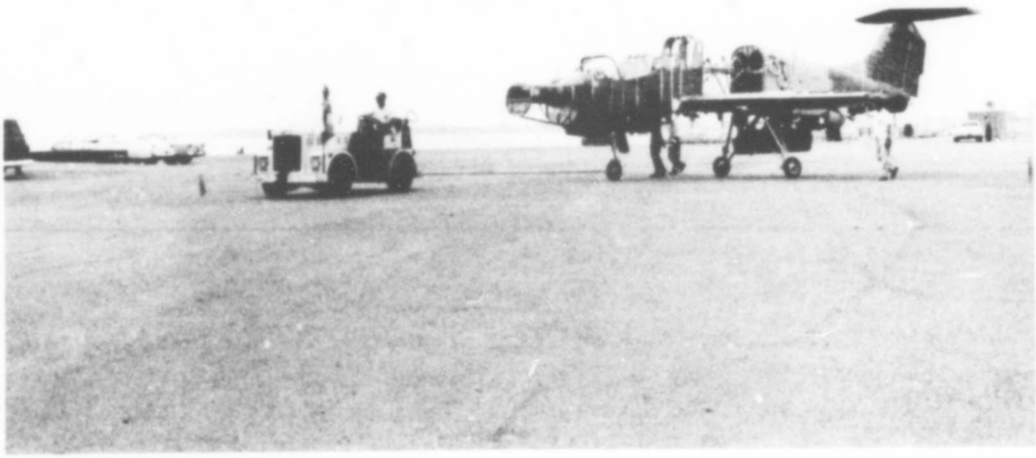


Figure 1 View of General Test Vehicle

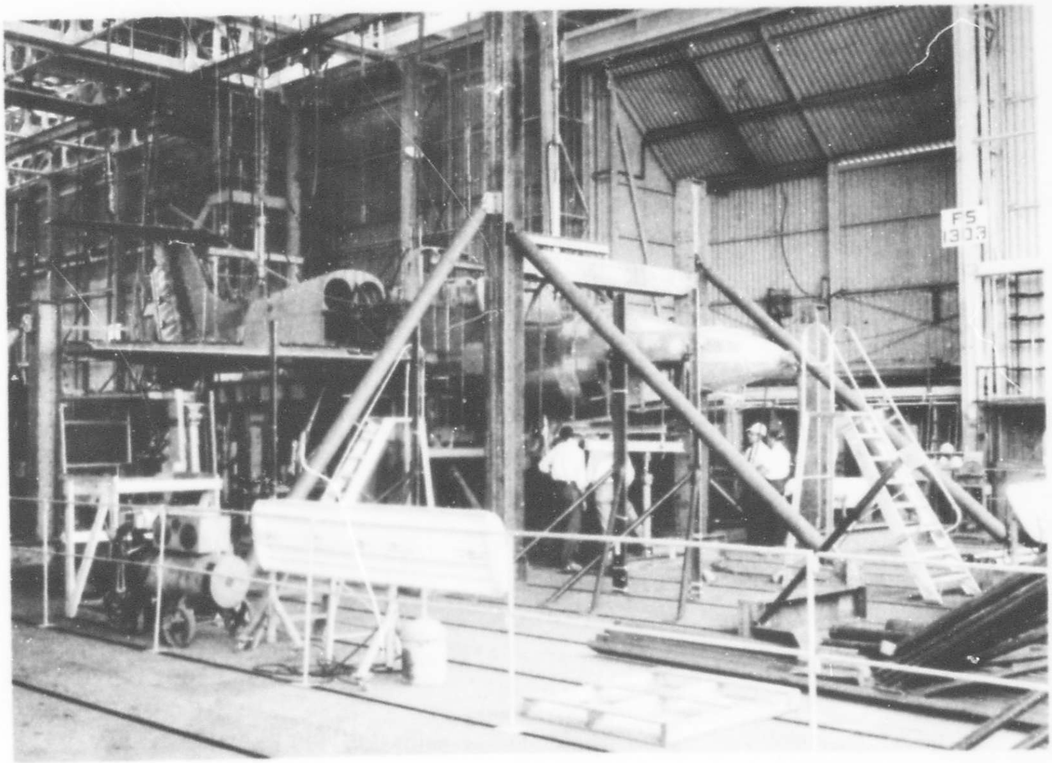


Figure 2 View of Test Vehicle in Test Jig Facility

3.0 TEST RESULTS

3.1 TEST NO. 1 - NOSE LANDING GEAR DOOR AND UP-LOCK MECHANISM

3.1.1 Test Condition

Limit Load on A/C with Pressures Tending to Open Gear Doors.
V = 500 knots @ S. L.

3.1.2 Introduction

The test was conducted according to the procedures outlined with two deviations:

a. The R. H. forward door and the aft door were loaded separately due to inadequate room for placement of shot bags if done simultaneously.

b. Four additional deflection gages were installed (D-7, D-8, D-9, D-10). Location of these gages are called out in Figure 4.

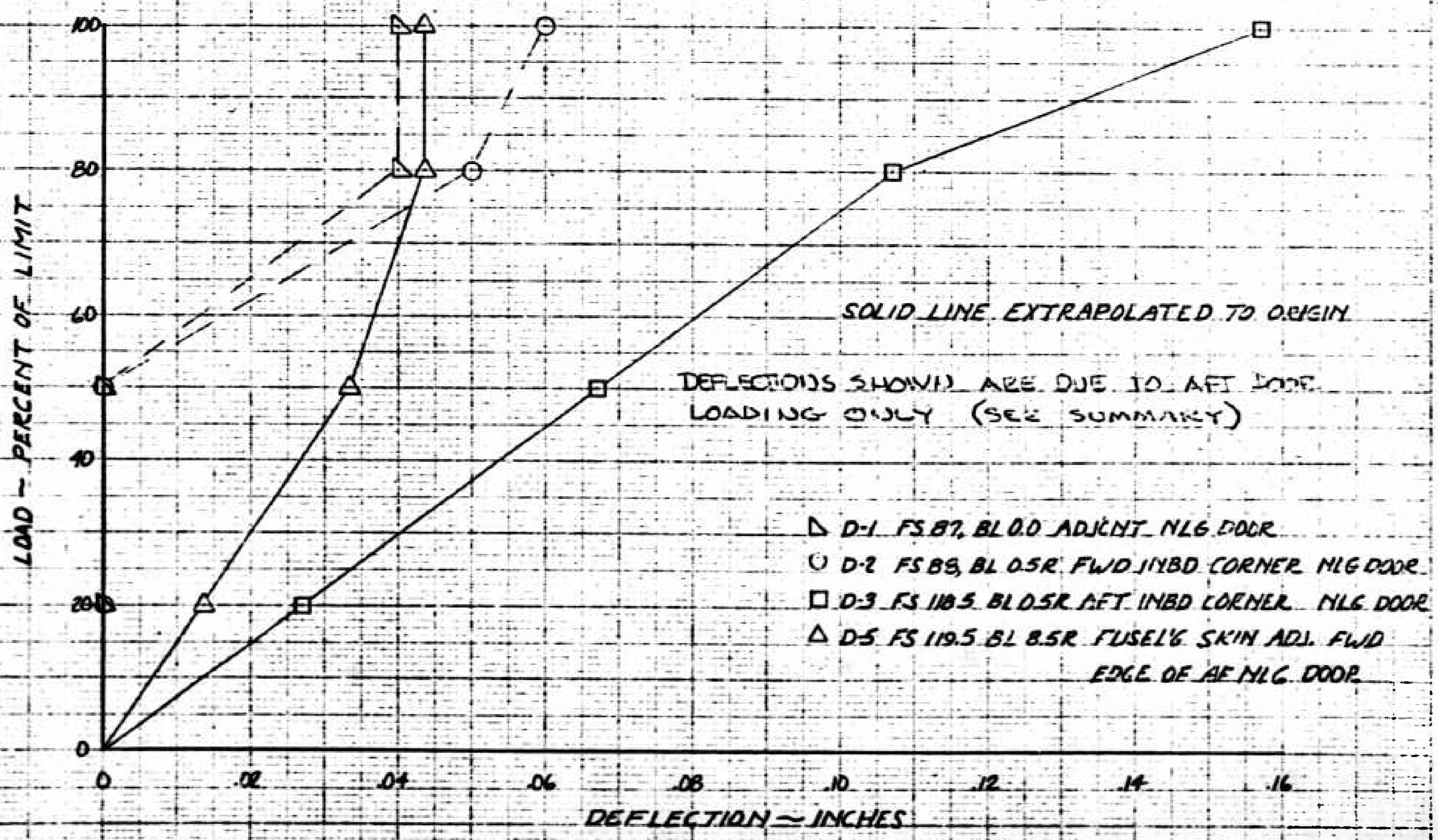
3.1.3 Summary

The tests were begun by loading the forward right hand door with shot bags. At 60% load the door was deforming excessively and the tests were stopped. The aft door was then loaded as prescribed in the procedures. The loading went to 100% limit load. The deflection data pertaining to this test are shown in Figures 3 and 4. It will be noted that forward door deflections are indicated also. This is because the forward doors overlap the aft door and tend to support its forward edge.

Due to the high deflections encountered, rework of both forward and aft doors was accomplished and a retest of the new configuration was made.

In this test the loads were applied through a tension pad-whiffletree scheme with both doors being loaded simultaneously. The resulting deflection curves are shown in Figures 5 and 6. Figures 7 and 8 show the loading arrangement.

FIGURE 3
TEST NO 1
NOSE LANDING GEAR DOOR
FWD DOOR



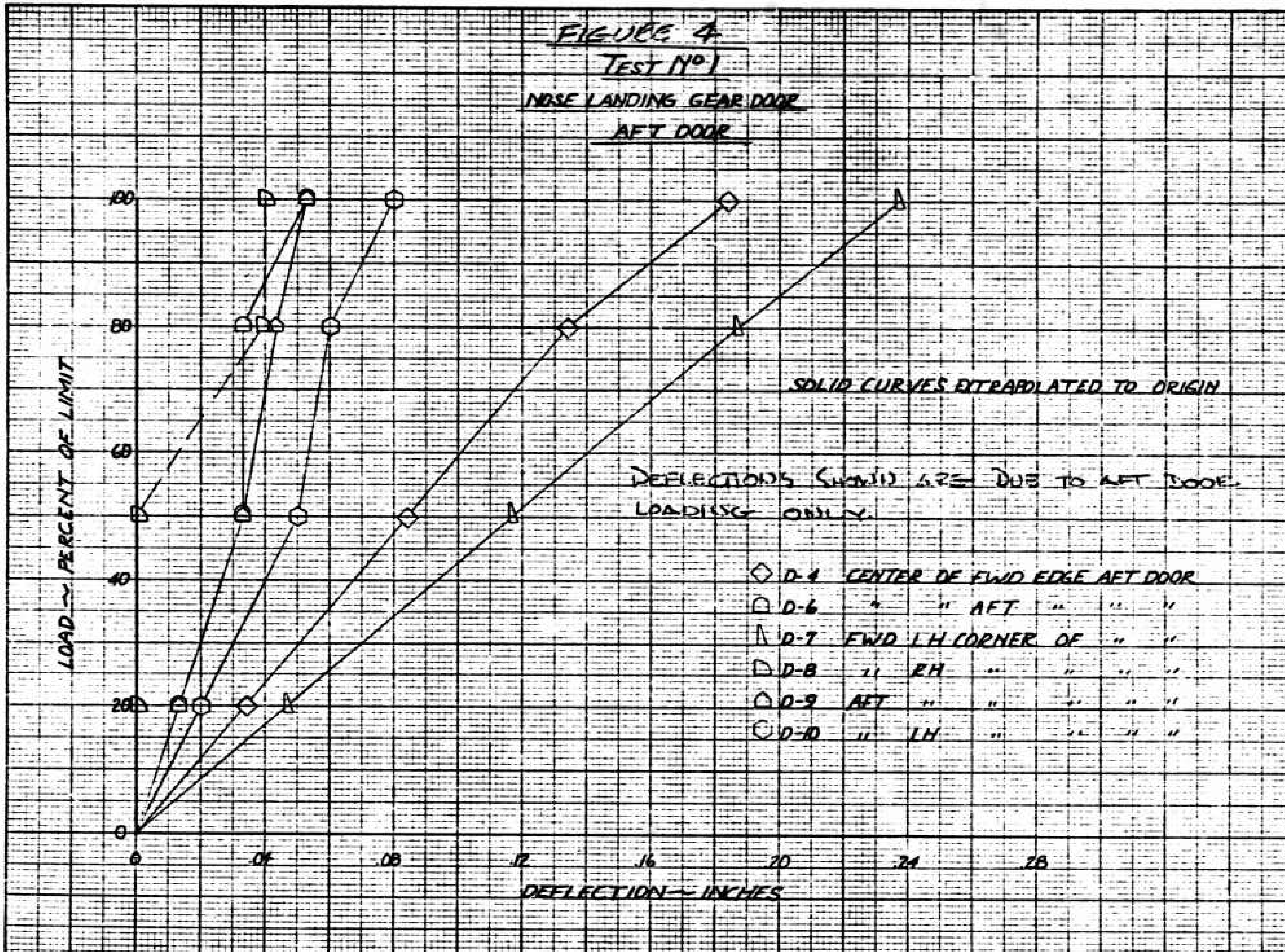


FIGURE 4
TEST No 1
NOSE LANDING GEAR DOOR
AFT DOOR
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
.04
.08
.12
.16
.20
.24
.28
DEFLECTION ~ INCHES
SOLID CURVES EXTRAPOLATED TO ORIGIN
DEFLECTIONS SHOWN ARE DUE TO AFT DOOR LOADING ONLY.
D-4 CENTER OF FWD EDGE AFT DOOR
D-6 " " AFT " " "
D-7 FWD LH CORNER OF " "
D-8 " RH " " " "
D-9 AFT " " " " "
D-10 " LH " " " "

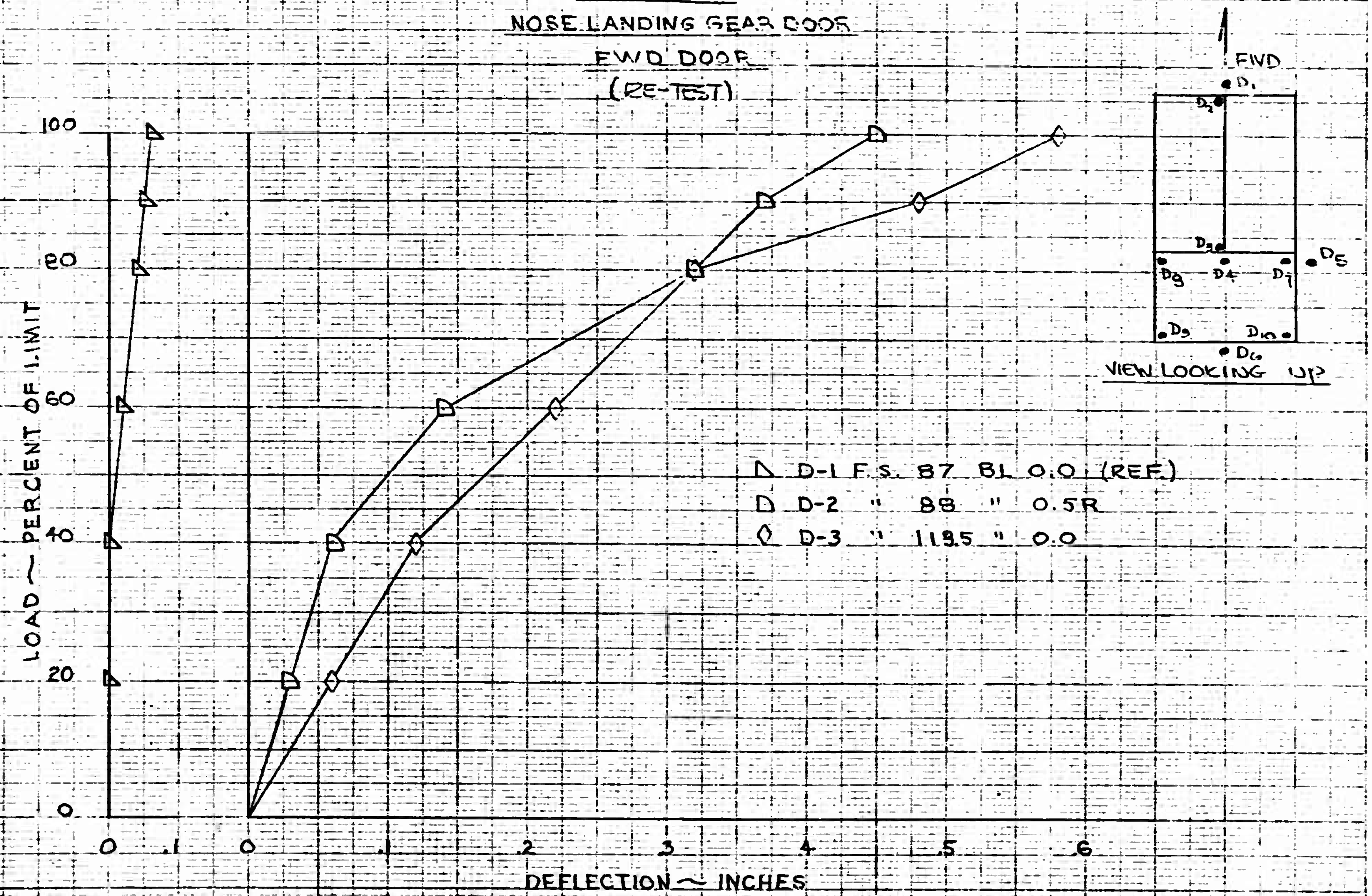
FIGURE 5

TEST N° 1

NOSE LANDING GEAR DOOR

FWD DOOR

(RE-TEST)



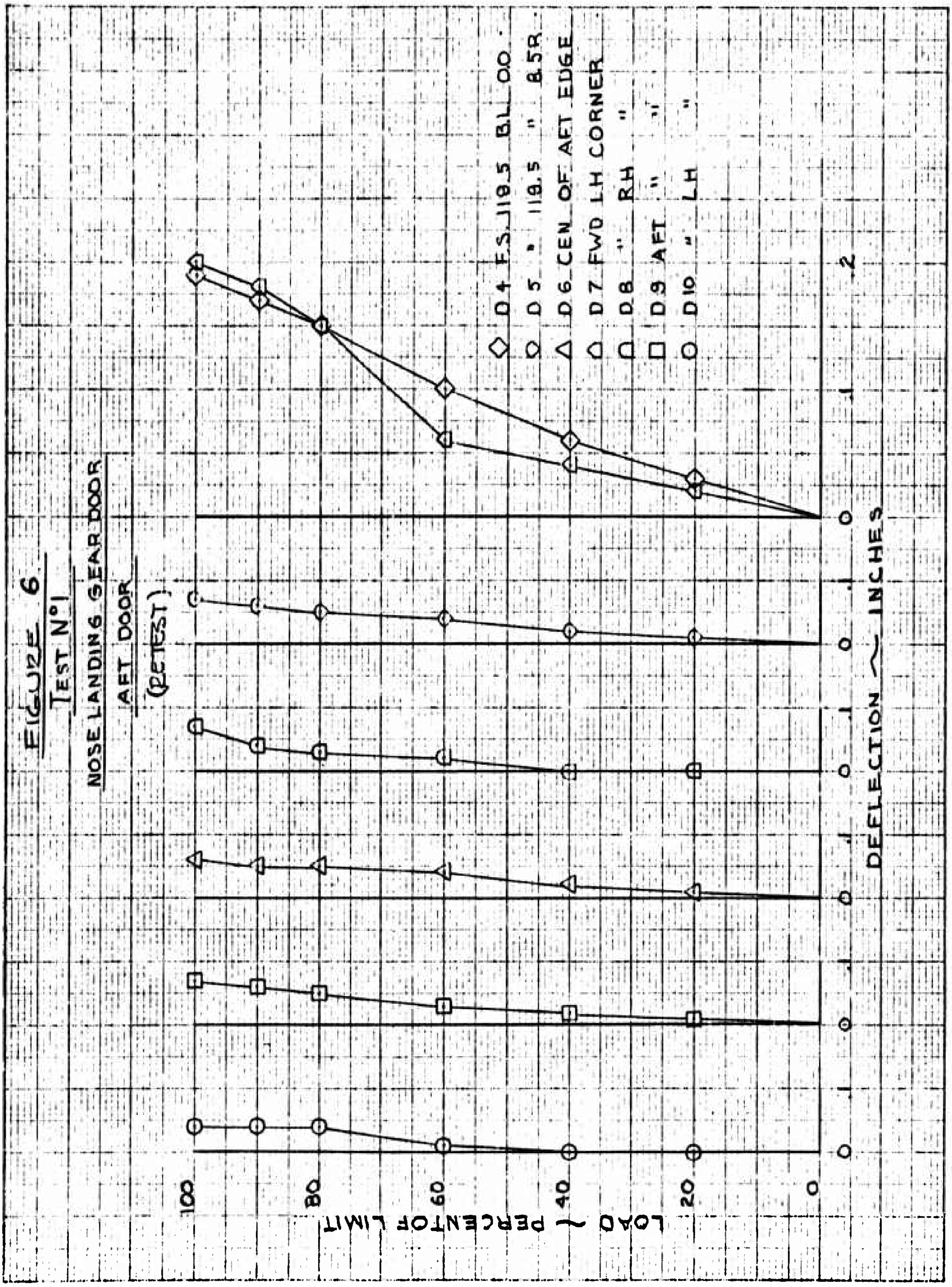


FIGURE 6
TEST N°1
NOSE LANDING GEAR DOOR
AFT DOOR
(RETEST)
D4 F.S. 119.5 B.L. 0.0
D5 " 119.5 " 8.5R
D6 CEN. OF AFT EDGE
D7 FWD LH CORNER
D8 " RH "
D9 AFT " "
D10 " LH "
LOAD ~ PERCENT OF LIMIT
100
80
60
40
20
0
DEFLECTION ~ INCHES
0
.1
1
2

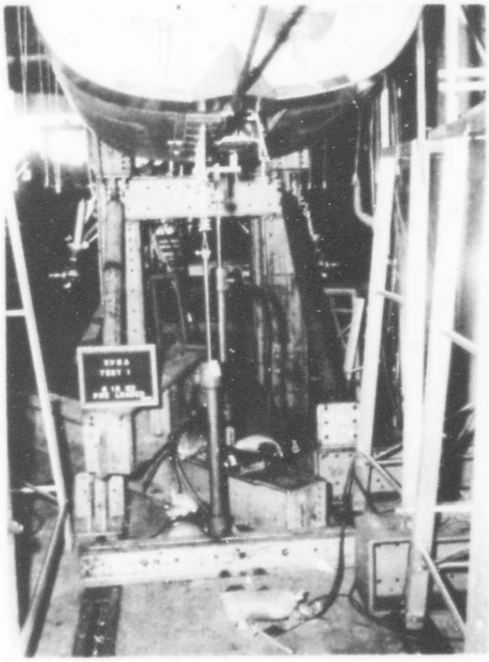


Figure 7
Nose Landing Gear
Door Test

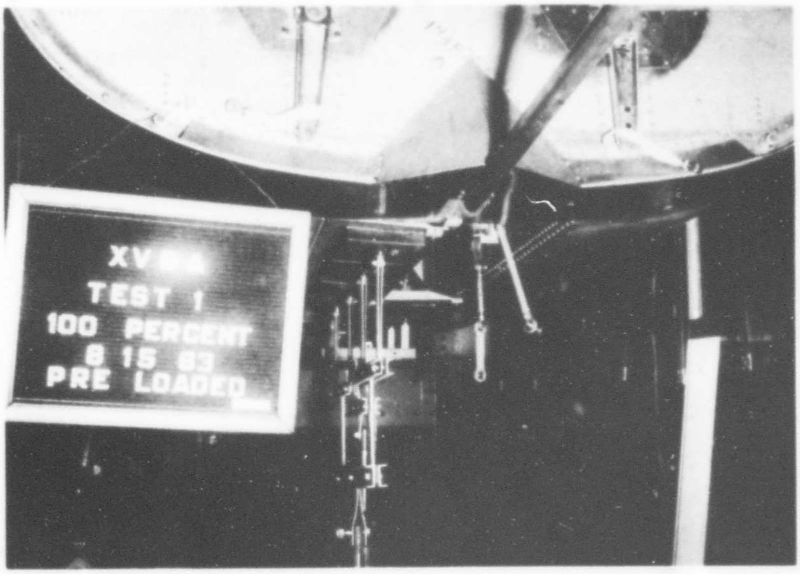


Figure 8 Closeup Showing Whiffle Tree Loading Arrangement on NLG Door

3.2 TEST NO. 2 - ELEVATOR AND CONTROL ATTACHMENTS

3.2.1 Test Condition

Maximum Pilot Effort Hinge Moment

3.2.2 Introduction

The elevator test representing maximum pilot effort hinge moment capability was undertaken according to the test procedures outline. Shot bags were placed over the left elevator and deflections were measured at two span-wise locations (BL 18 and BL 53) and at three points along each span-wise station. These correspond to the R. S. (rear spar of horizontal stabilizer), HL (hinge line of elevator) and TE (trailing edge of the elevator).

3.2.3 Summary

Deflections due to the placement of shot bags were noted and a curve of load expressed as a per cent of limit load versus their deflections was plotted as per Figure 9. Figures 10 and 11 show the loading arrangement. All deflections are with respect to the rear spar of the horizontal stabilizer.

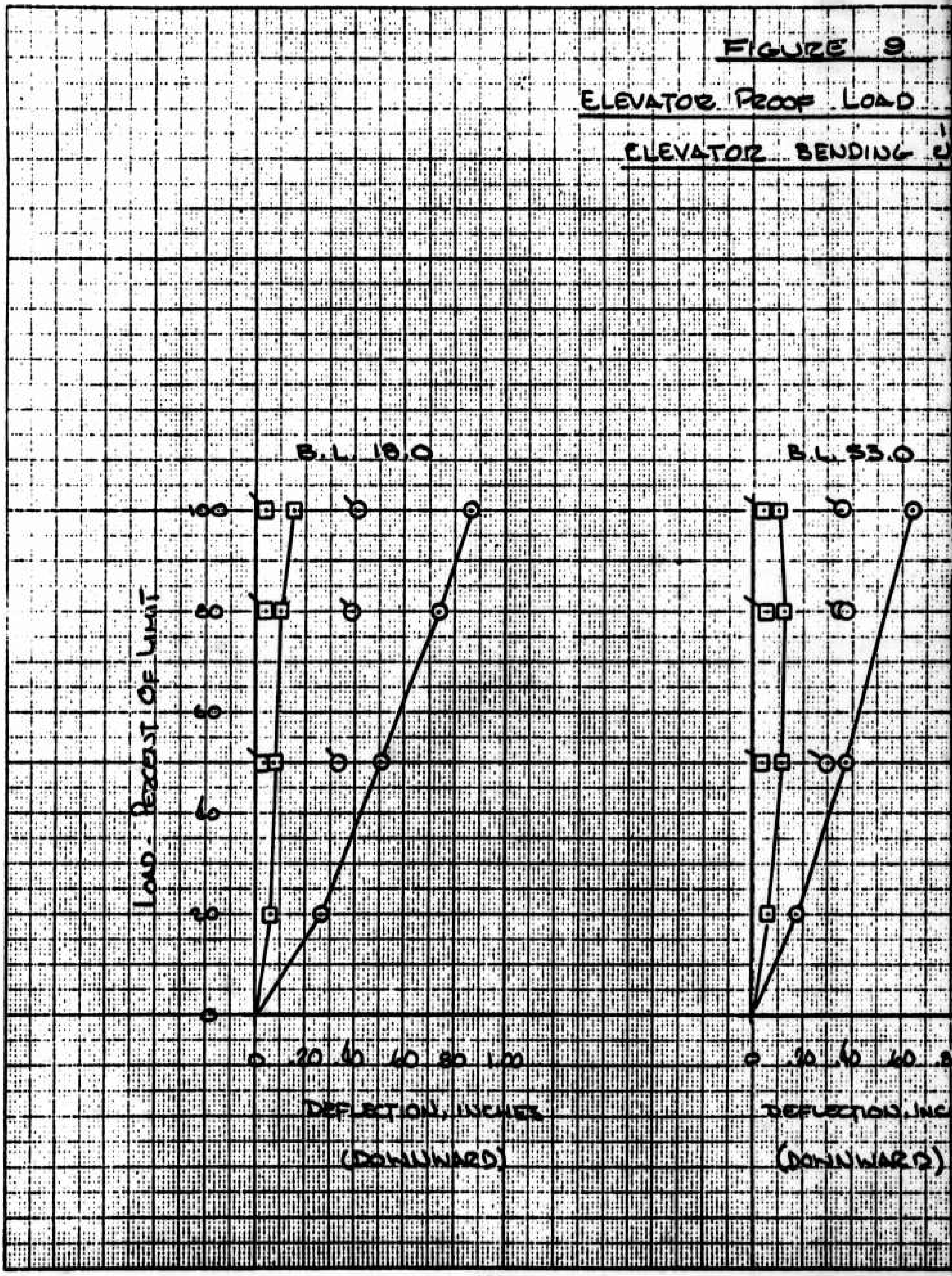
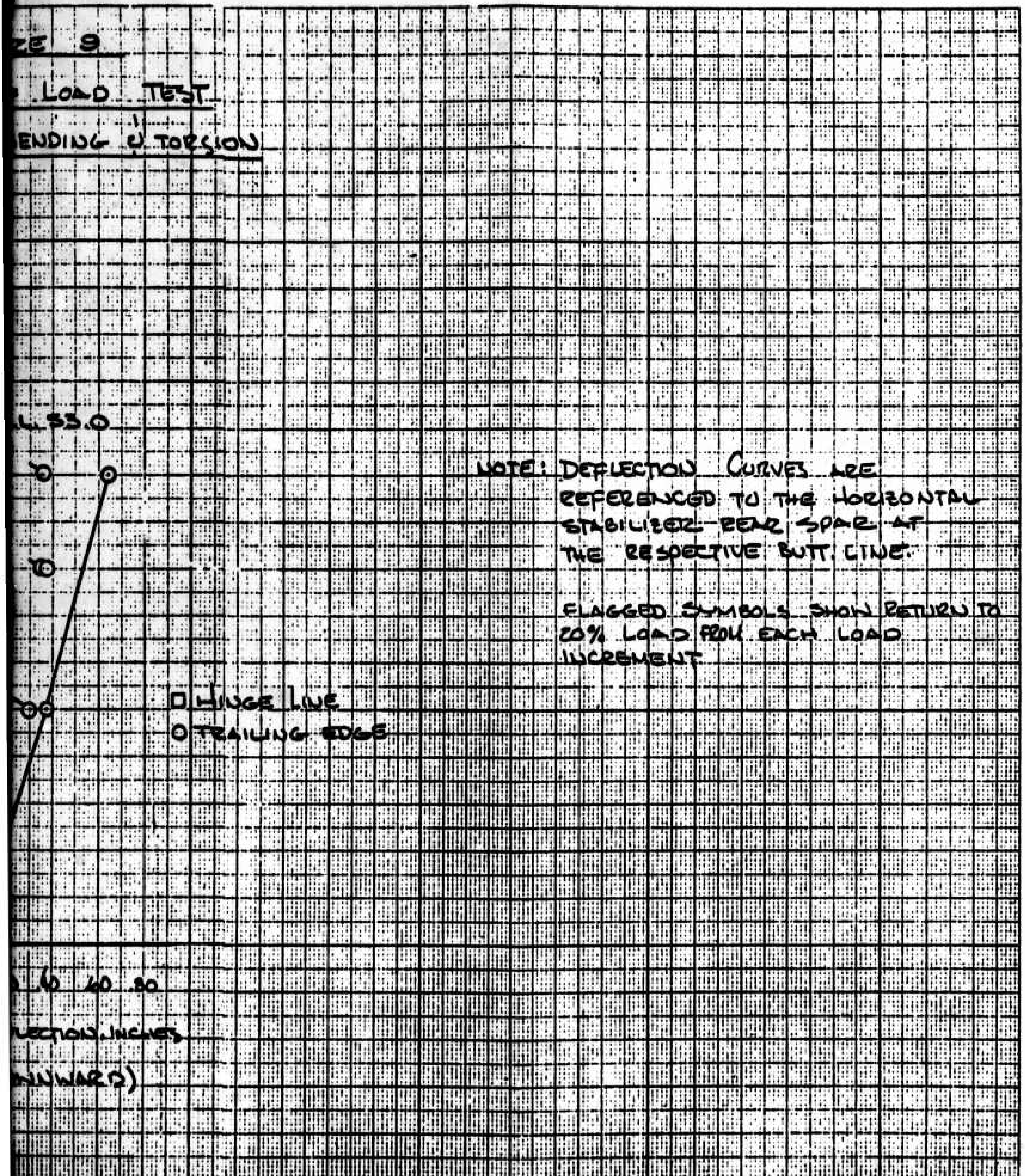


FIGURE 9
ELEVATOR PROOF LOAD
ELEVATOR BENDING
B.L. 18.0
B.L. 33.0
LOAD - PERCENT OF LIMIT
100
80
60
40
20
0
0 .20 .40 .60 .80 1.00
DEFLECTION, INCHES
(DOWNWARD)
DEFLECTION, INC
(DOWNWARD)

A


LOAD TEST
ENDING & TORSION
HINGE LINE
TRAILING EDGE
NOTE: DEFLECTION CURVES ARE REFERENCED TO THE HORIZONTAL STABILIZER REAR SPAR AT THE RESPECTIVE BUTT LINE.
FLAGGED SYMBOLS SHOW RETURN TO 20% LOAD FROM EACH LOAD INCREMENT
(DOWNWARD)

B

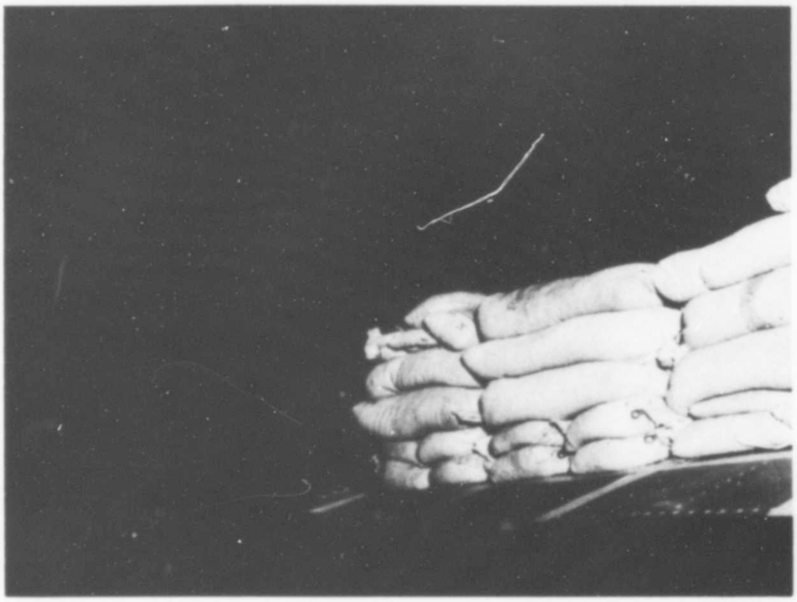


Figure 10 Elevator Test Showing Placement of Shot Bags

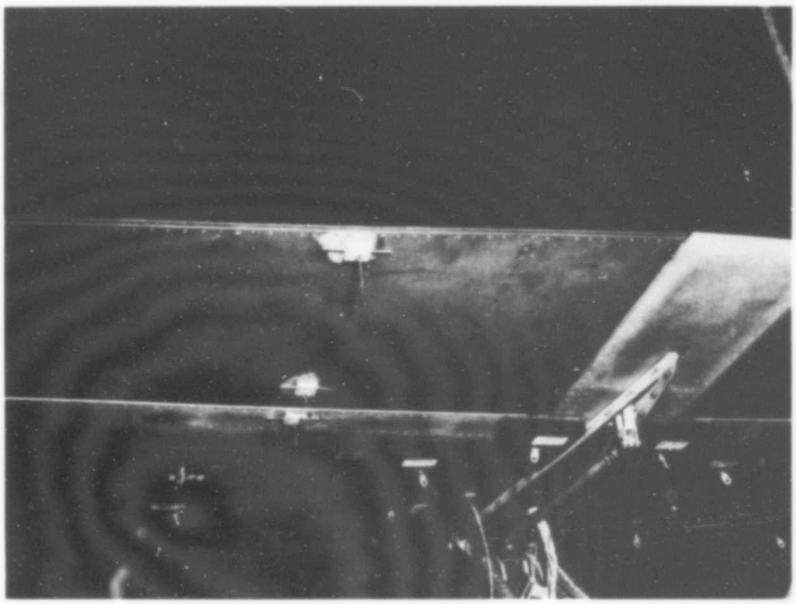


Figure 11 View of Bottom Side of Elevator Showing Deflection Instrumentation Pickup

3.3 **TEST NO. 3 - NOSE LANDING GEAR AND LOCAL FITTINGS**

3.3.1 **Test Condition**

Ground Turning - Main Gear in CTOL Position GW 12, 500# C.G. @ FS 240

3.3.2 **Introduction**

This is a critical condition for the nose landing gear and local support structure. Simulated loads were applied according to the conditions outlined in the test procedures.

3.3.3 **Summary**

During the test, it became evident that large deflections of the gear were produced by the side loads applied. Consequently, it was decided that two additional deflection measurements would provide a better representation of the resultant deflections. These two additional deflections: D-22 and D-23 were taken at the bottom of the Oleo and at the bottom of the cylinder respectively. Figure 12 shows the deflections versus the applied side load expressed as a percentage of limit load.

The deflection data was zeroed at the 20% load point to allow for removal of any nonlinearity due to freeplay friction.

Figures 13 and 14 represent the strain measurements along the forward nose section. Figure 15 shows the loading arrangement. The locations of the strain measurements are indicated on the figures. With the exception of the upper longeron at FS 165 and at FS 214, all strains are caused by tension loads, the former are due to compression loads.

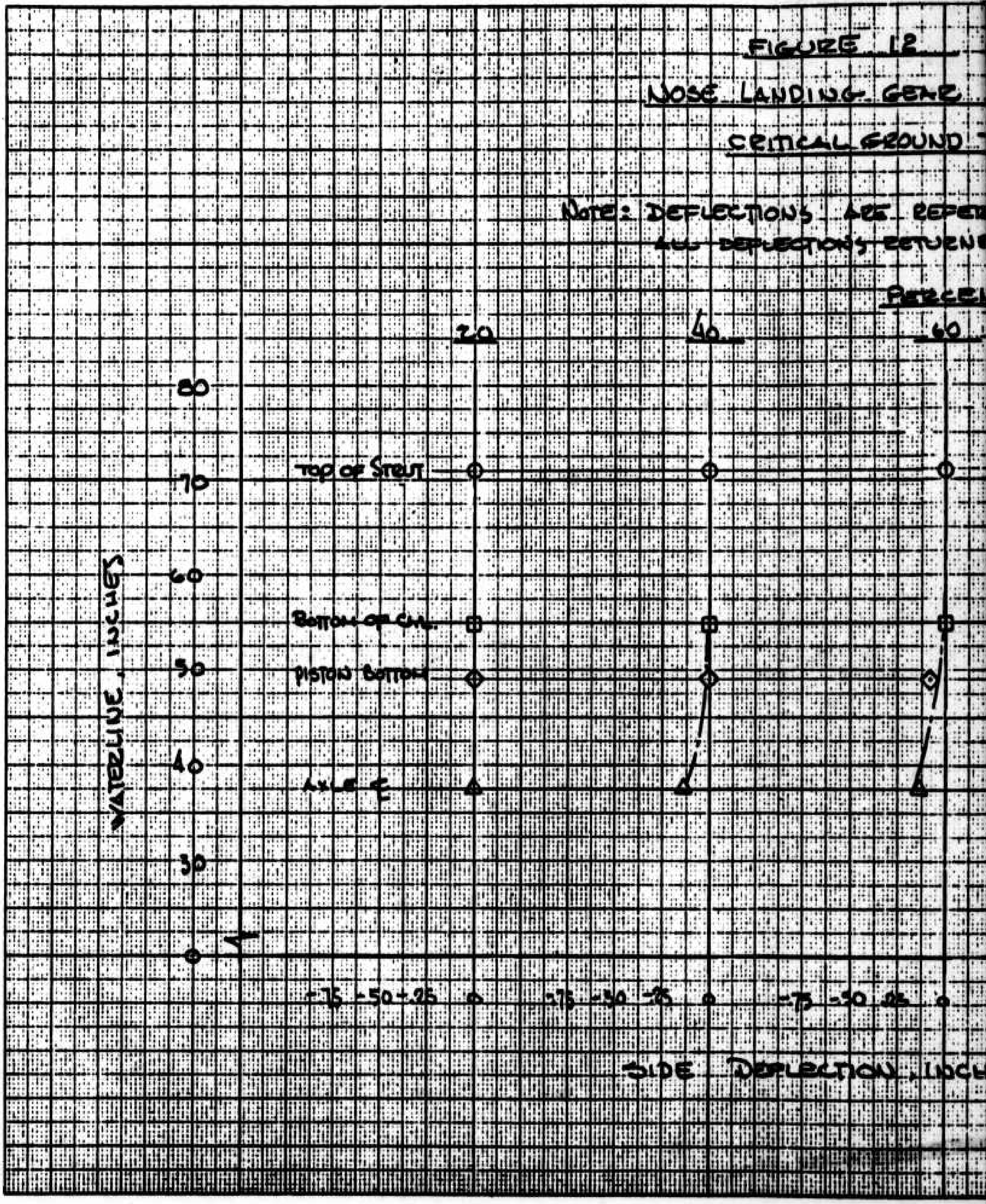
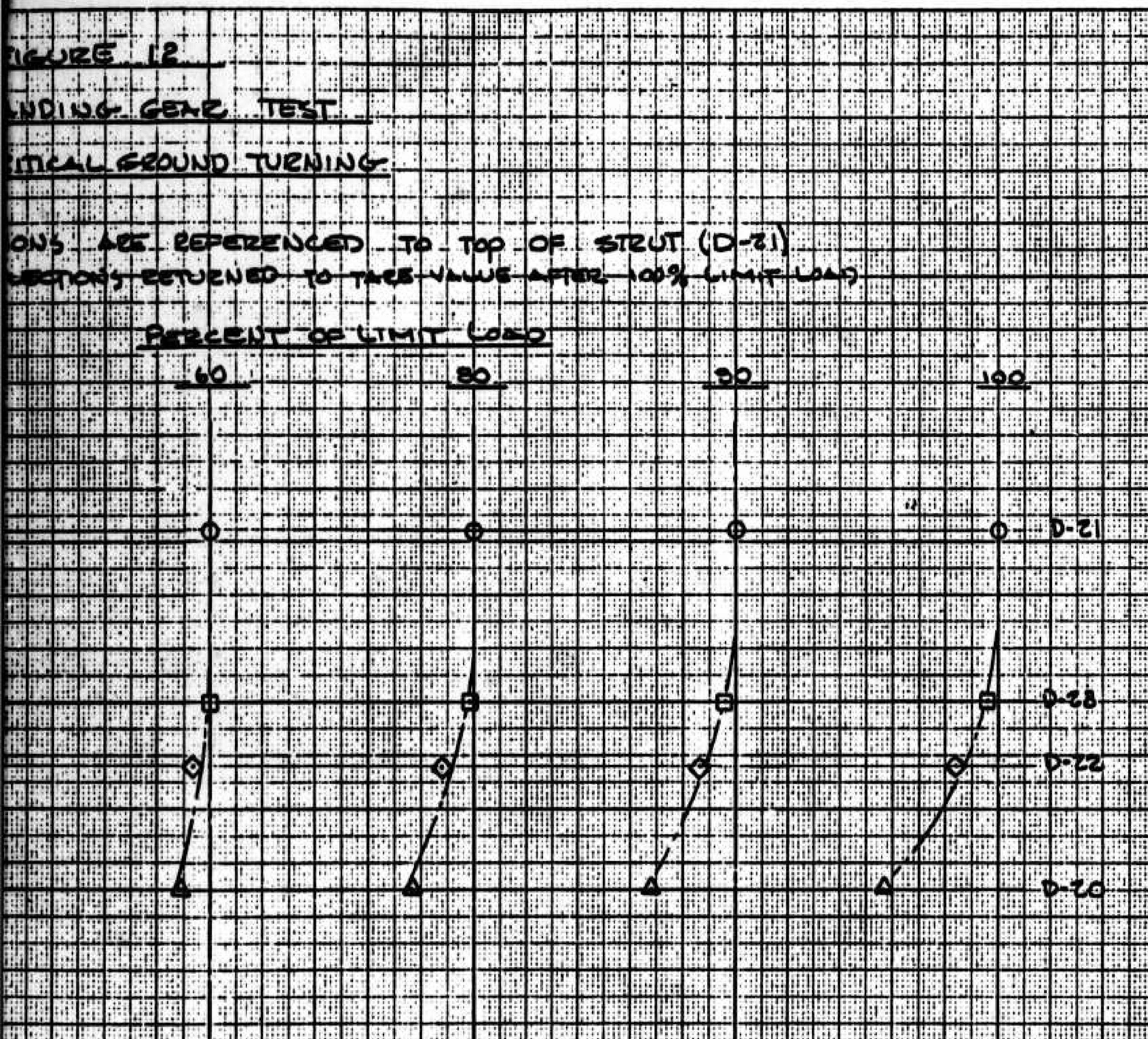


FIGURE 12
NOSE LANDING GEAR
CRITICAL GROUND
NOTE: DEFLECTIONS ARE
20
40
60
80
70
60
50
40
30
TOP OF STRUT
BOTTOM OF CYL.
PISTON BOTTOM
AXLE ℄
WATERLINE, INCHES
-75 -50 -25 0
-75 -50 -25 0
-75 -50 -25 0
SIDE DEFLECTION, INCH

A


IGURE 12
NDING GEAR TEST
ITICAL GROUND TURNING
ONS ARE REFERENCED TO TOP OF STRUT (D-21)
ECTIONS RETURNED TO TARE VALUE AFTER 100% LIMIT LOAD
PERCENT OF LIMIT LOAD
60
80
90
100
D-21
D-28
D-22
D-20
-.75 -.50 -.25 0
-.75 -.50 -.25 0
-.75 -.50 -.25 0
-.75 -.50 -.25 0
FLECTION, INCHES

B

FIGURE 13

TEST No 3

NOSE LANDING GEAR TURN TEST

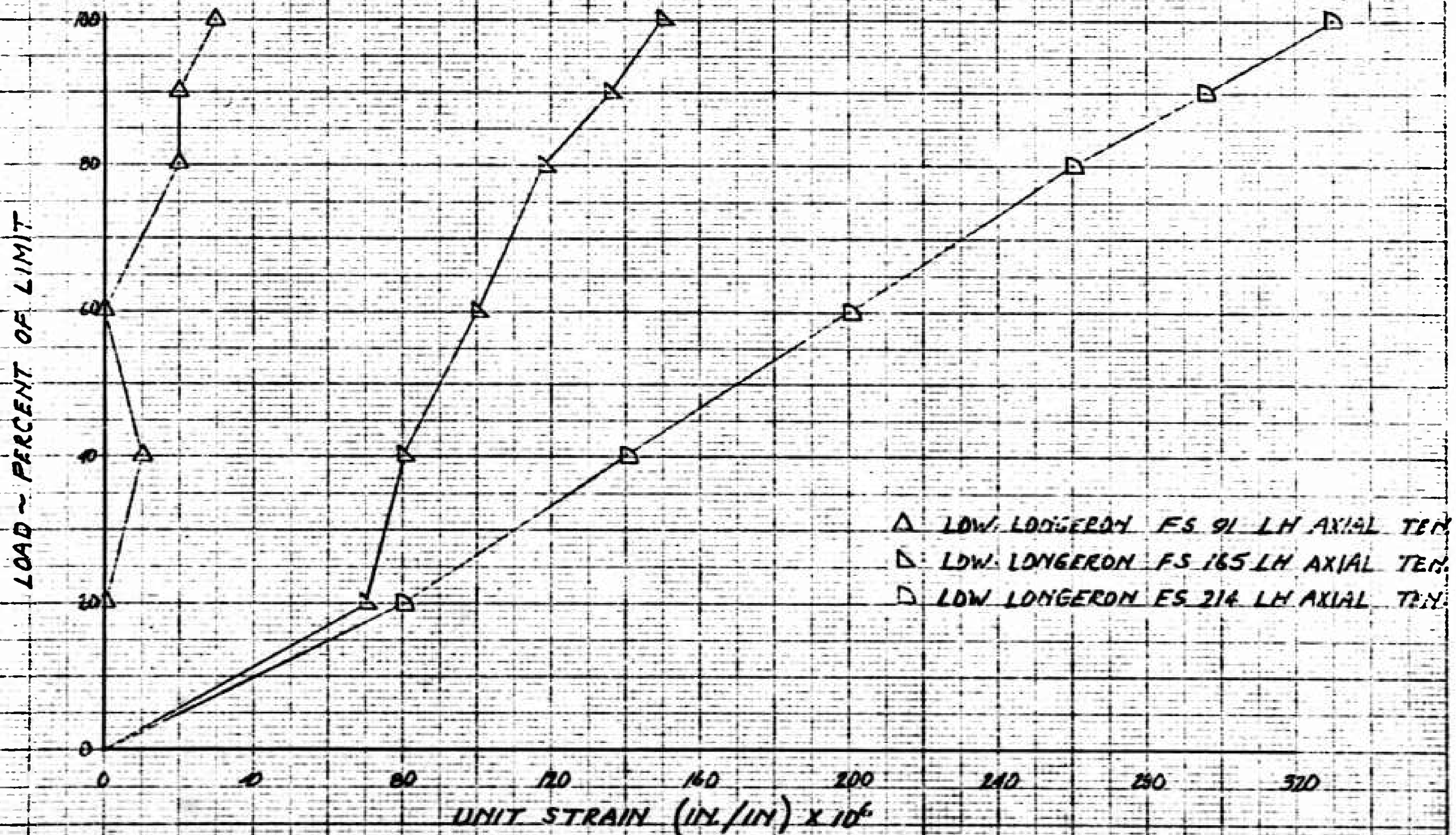
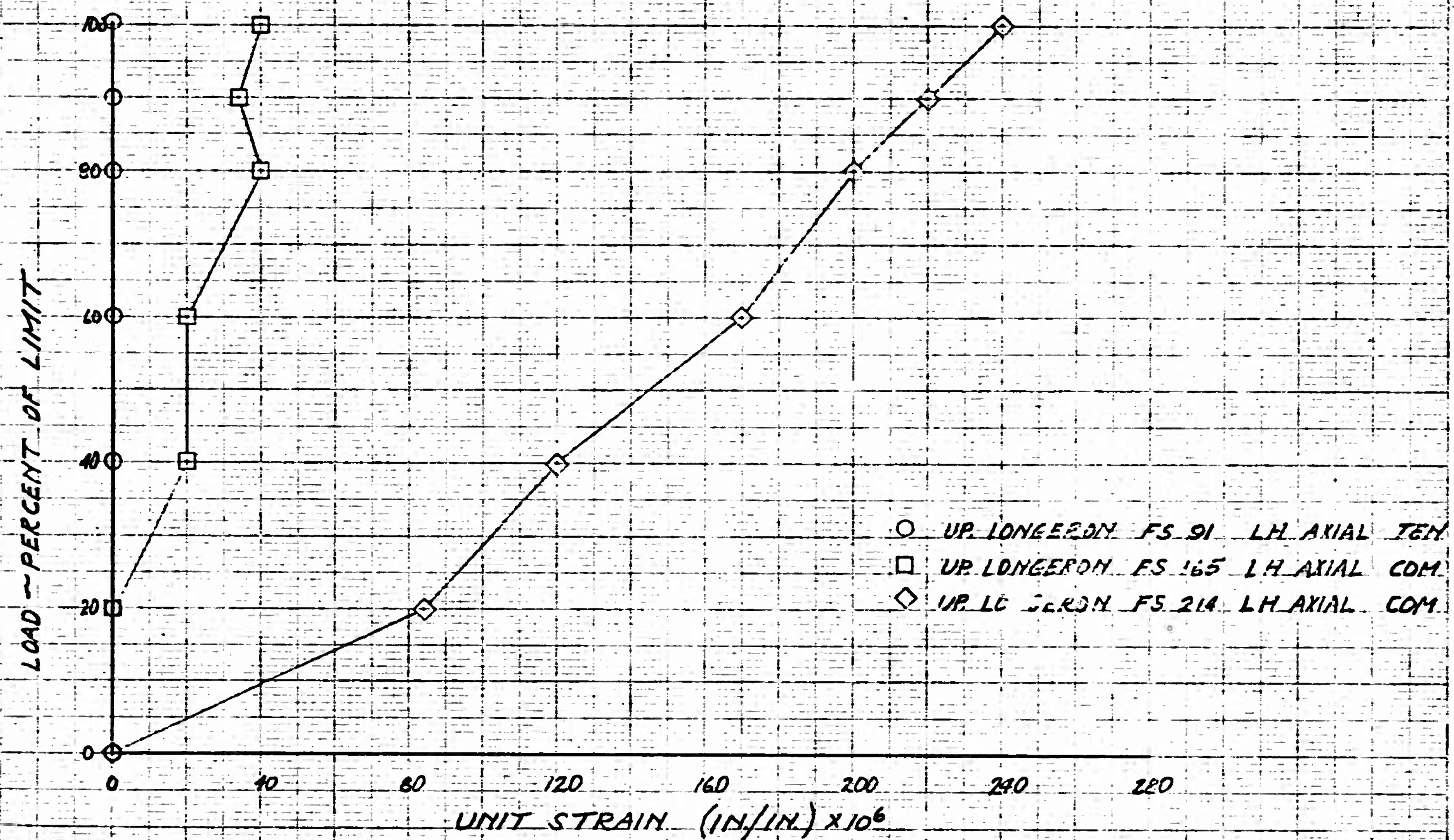


FIGURE 14
TEST No 5
NOSE LANDING GEAR TURN TEST



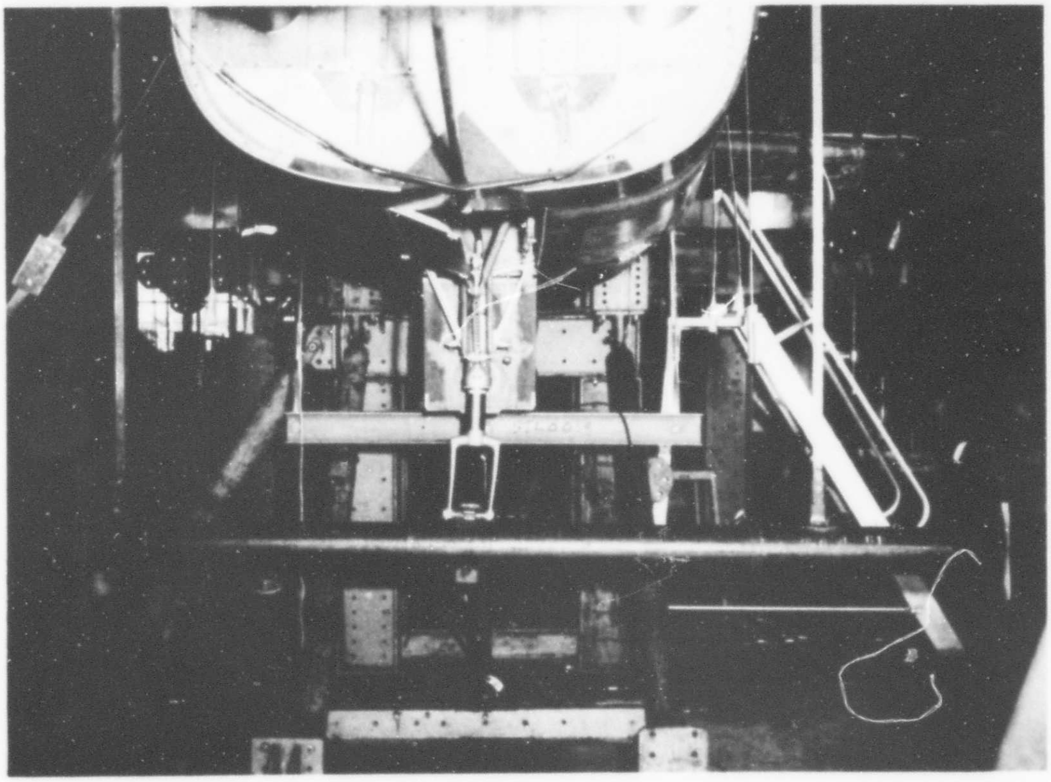


Figure 15 Deflection of Nose Landing Gear Due to Ground Turning

3.4 TEST NO. 4 - NOSE LANDING GEAR AND LOCAL FITTINGS

3.4.1 Test Condition

Three-Point Springback C.G. @ FS 240 Wt. 9200# (Nose Gear)

3.4.2 Introduction

The test was conducted according to the test procedures outline. The nose gear oleo was fixed in the 20% compressed position and vertical and forward loads were applied as called for.

3.4.3 Summary

Initial trials indicated large longitudinal deflections of the axle. It was, therefore, decided to place another deflection measurement (D-33) at the top of the fork to provide additional deflection representation of various gear components. Four deflections; the original three called for, plus the additional one, are plotted versus the applied load (expressed as a per cent of limit) in Figure 16. The deflections are referenced to the top of the cylinder at Trunnion (D-31).

Strain gage readings of the nose section corresponding to net inertial and gear induced reaction were also made. These data were plotted in Figures 17 and 18 and appear as per cent of limit load versus unit strain. Figures 19 and 20 show the loading arrangement.

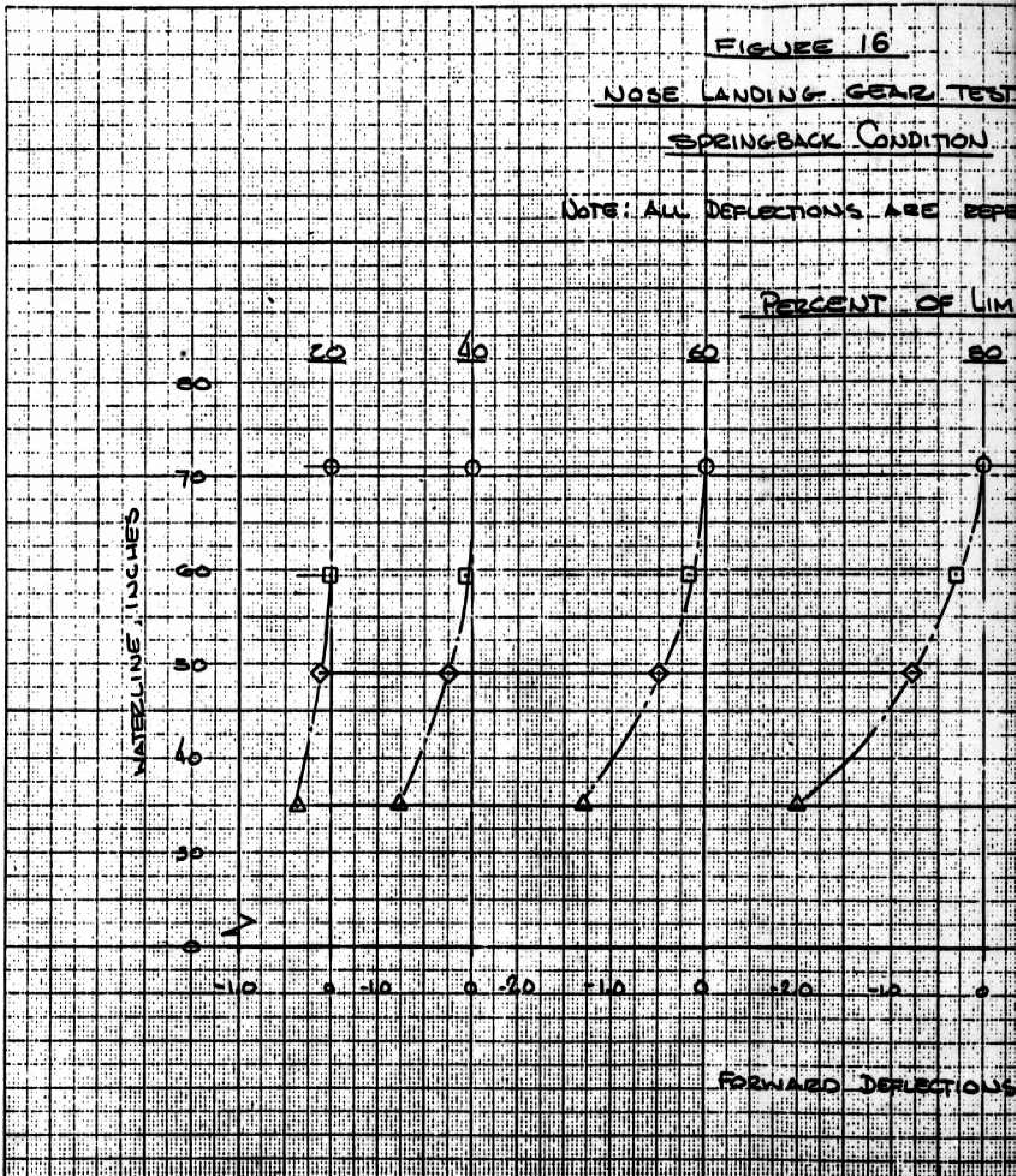
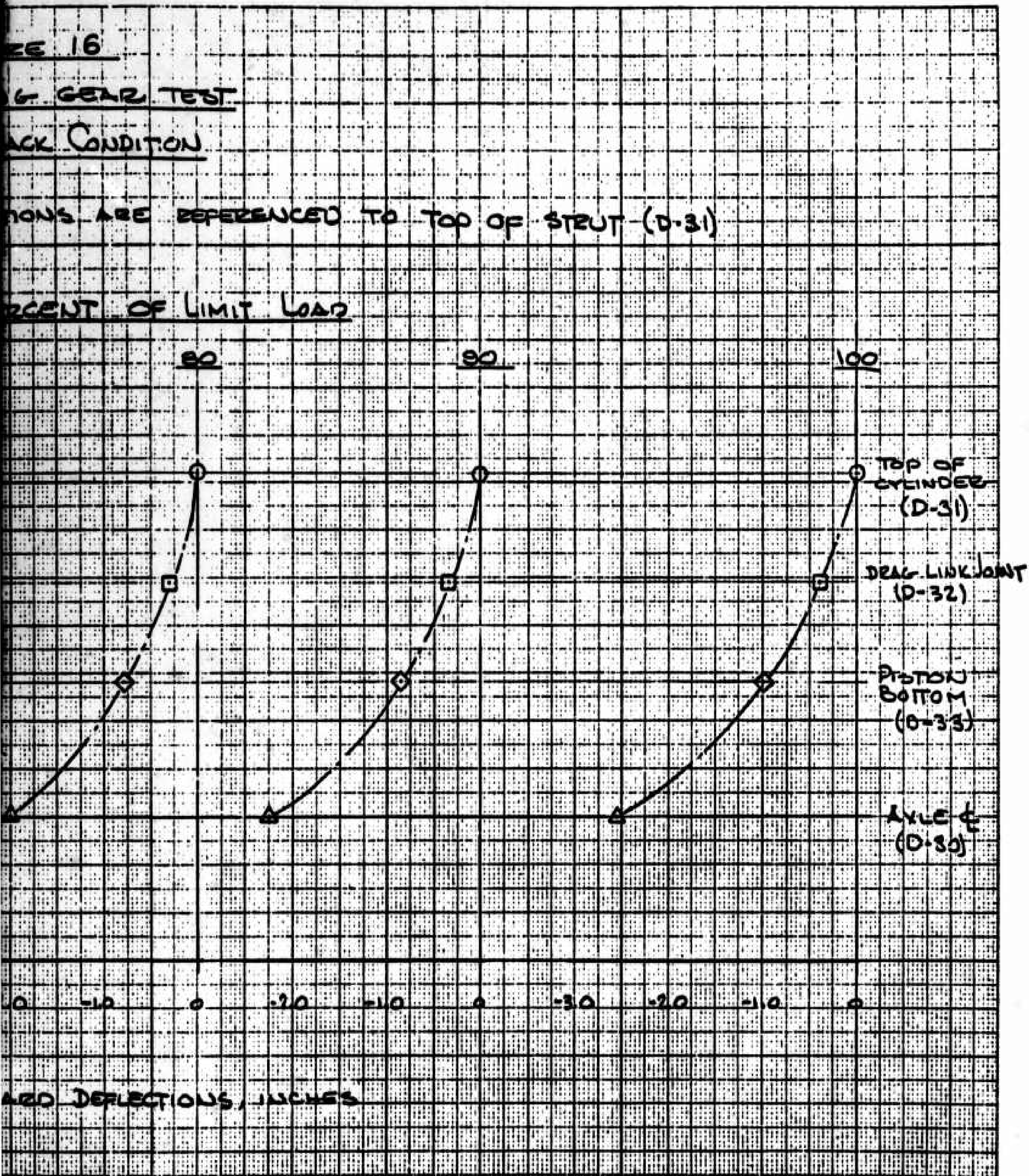


FIGURE 16
NOSE LANDING GEAR TEST
SPRINGBACK CONDITION
NOTE: ALL DEFLECTIONS ARE REFE
PERCENT OF LIMI
20
40
60
80
WATERLINE, INCHES
80
70
60
50
40
30
0
-10
0
-10
0
-20
-10
0
-20
-10
0
FORWARD DEFLECTIONS

A


RE 16
G GEAR TEST
ACK CONDITION
IONS ARE REFERENCED TO TOP OF STRUT (D-31)
RCENT OF LIMIT LOAD
80
90
100
TOP OF CYLINDER (D-31)
DRAG LINK JOINT (D-32)
PISTON BOTTOM (D-33)
AXLE ℄ (D-30)
-1.0
0
-2.0
-1.0
0
-3.0
-2.0
-1.0
0
ARD DEFLECTIONS, INCHES

B

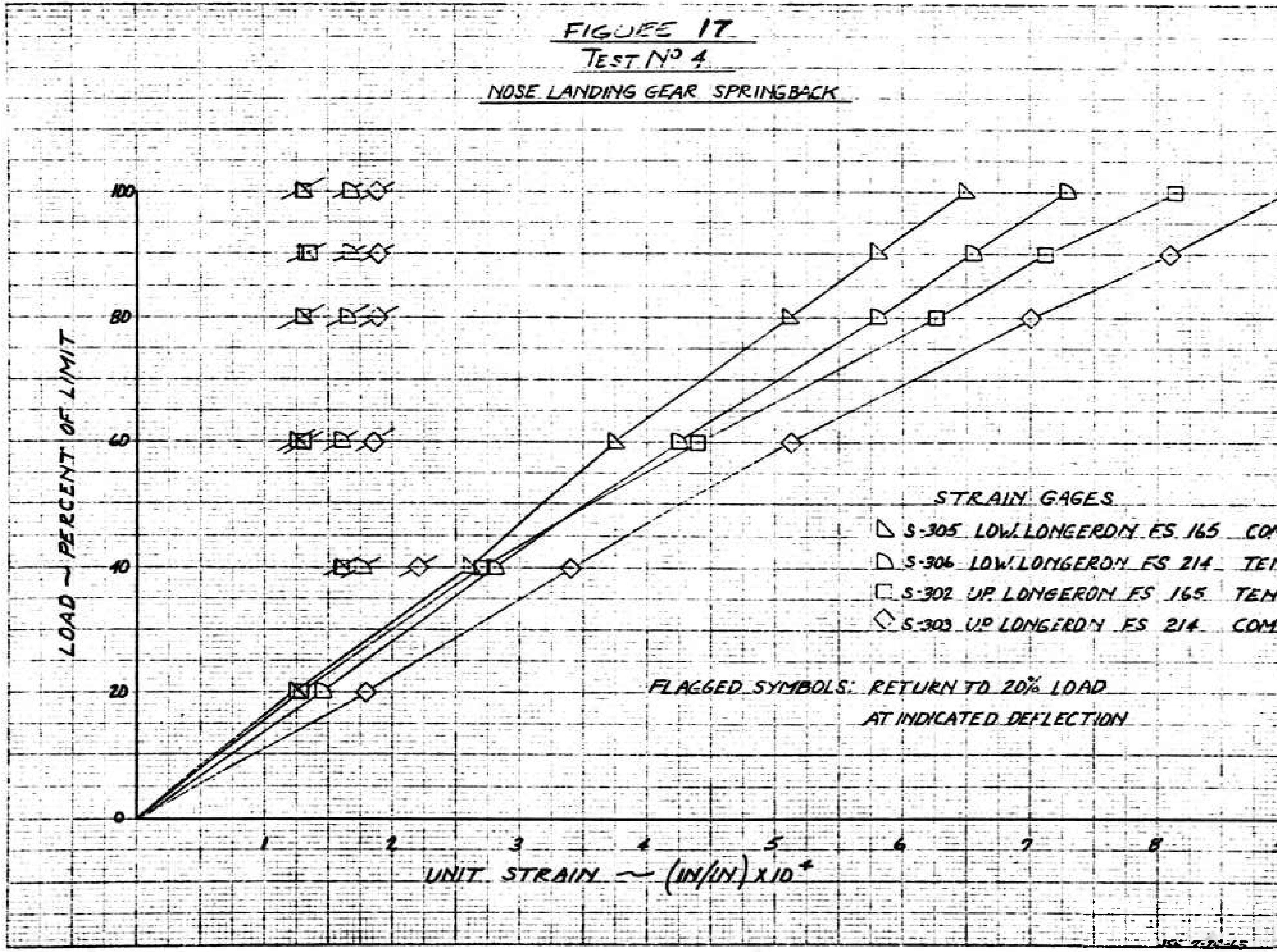


FIGURE 17
TEST No 4
NOSE LANDING GEAR SPRINGBACK
LOAD ~ PERCENT OF LIMIT
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
UNIT STRAIN ~ (IN/IN) X10⁴
STRAIN GAGES
S-305 LOW. LONGERON FS 165 COM
S-306 LOW. LONGERON FS 214 TEN
S-302 UP. LONGERON FS 165 TEN
S-303 UP. LONGERON FS 214 COM
FLAGGED SYMBOLS: RETURN TO 20% LOAD
AT INDICATED DEFLECTION

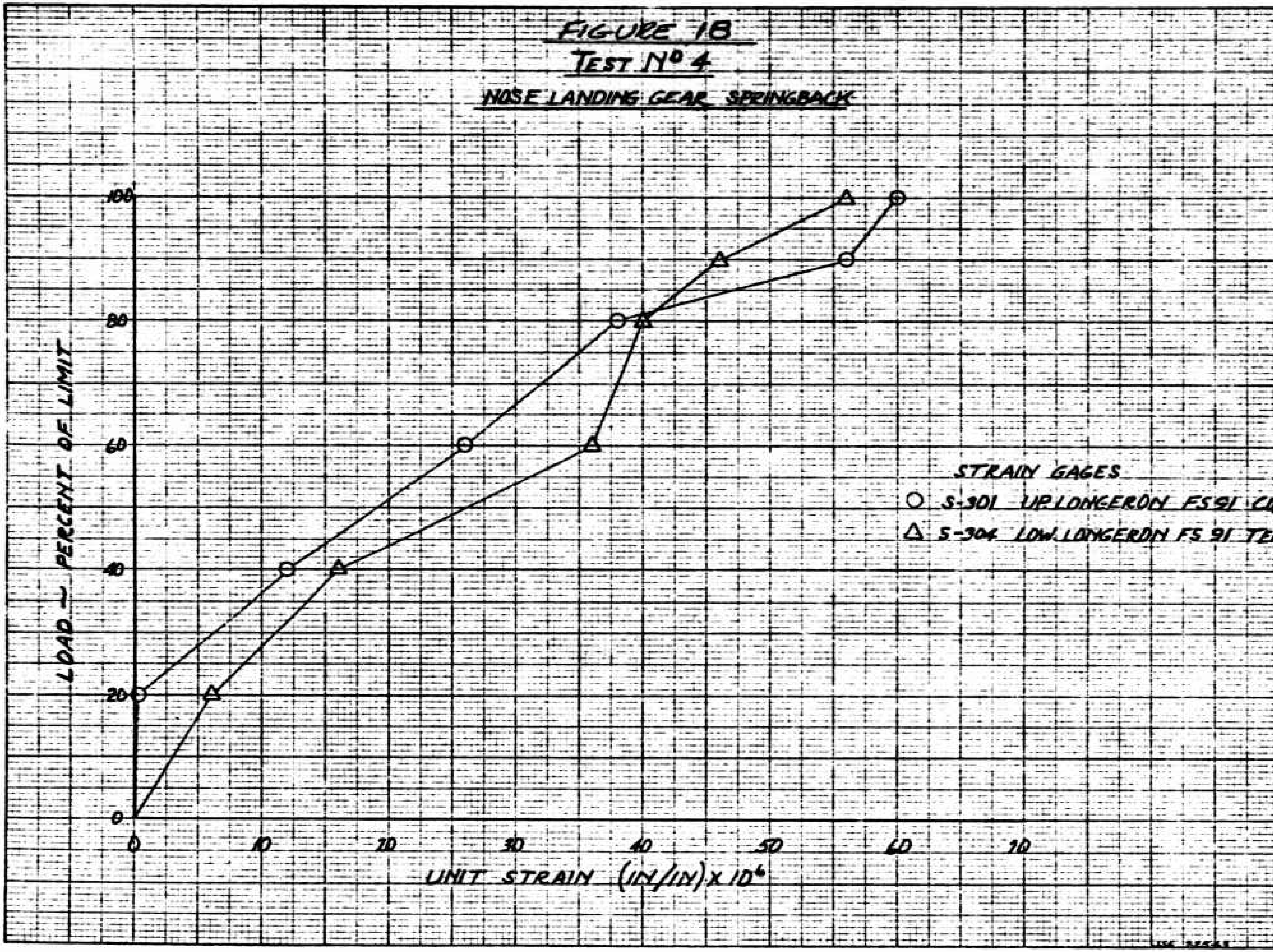


FIGURE 18
TEST Nº 4
NOSE LANDING GEAR SPRINGBACK

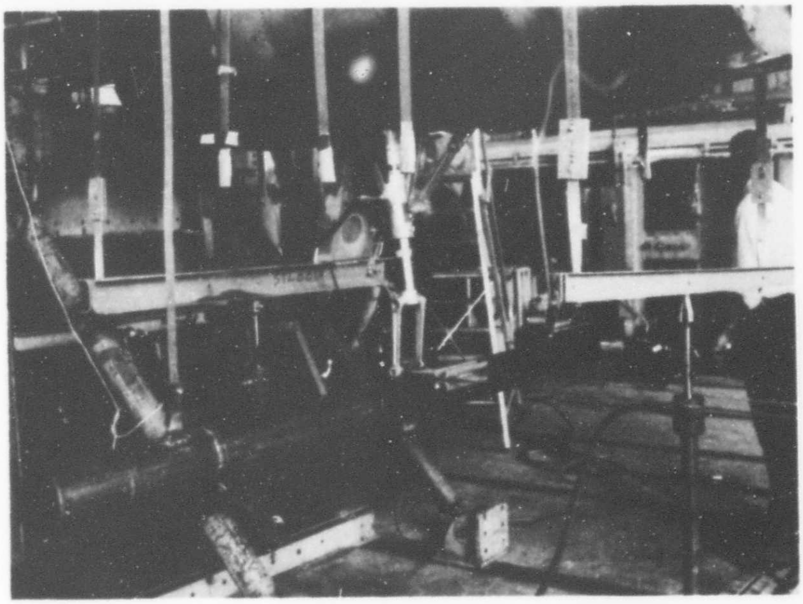


Figure 19 Oblique View Showing Load Application Hardware During NLG Springback Test

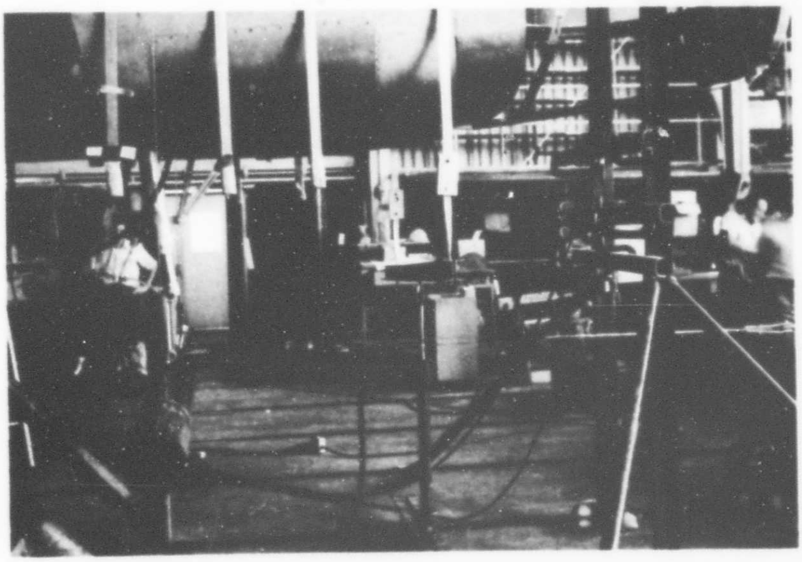


Figure 20 Side View of NLG Under Load During Springback Test

3.5 TEST NO. 5 - FORWARD ENGINE MOUNTS, BULKHEAD 214

3.5.1 Test Condition

Rolling Pull Out

3.5.2 Introduction

The forward engine mount static test was conducted according to the test procedures outline.

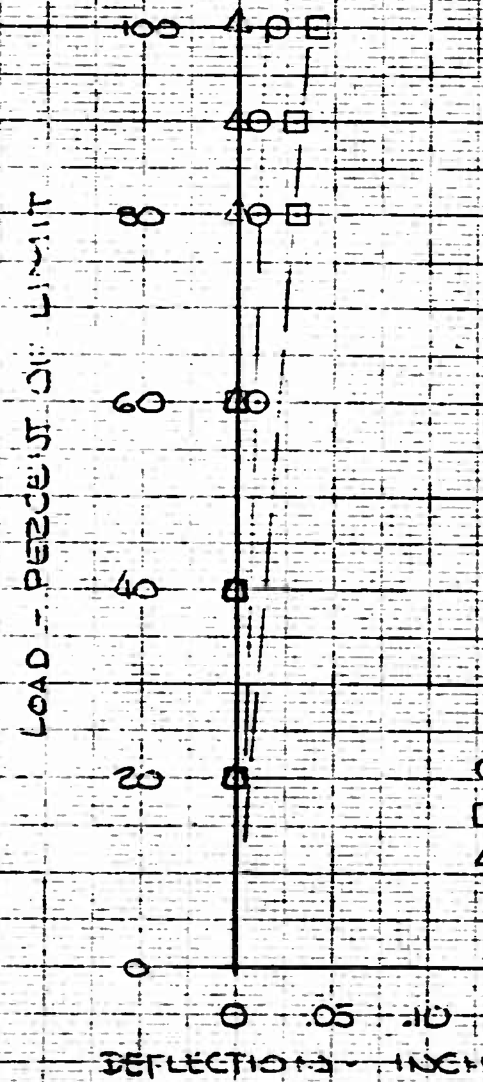
3.5.3 Summary

Loads were applied as called for in the test procedure. Due to lack of any measurable deflections below the 60% load condition, the points were not plotted as a graph in Figure 21. Figure 22 shows the loading arrangement. However, a table of the measured data appears in Figure 21 for the record.

FIGURE 21

TEST No 5

FORWARD ENGINE MOUNTS AT BULKHEAD 214



INSTRUMENTATION ACCURACY: ±.020

DEFLECTION DATA

%	○ D-40	□ D-41	△ D-42
20	.00	.00	.00
40	.00	.00	.00
20	.00	.00	.00
60	.01	.00	.00
80	.00	.00	.00
80	.01	.03	.00
70	.00	.00	.00
90	.01	.05	.00
20	.01	.00	.00
100	.02	.04	.00
20	.02	.00	.00

○ D-40 TOP FUSELAGE FS 214, WL 163, B.L. 11.5 R, VERT.
□ D-41 TOP FUSELAGE FS 214, WL 72, B.L. 0.0, VERT.
△ D-42 LOWER FUSELAGE FS 214, WL 72, B.L. 0.0, VERT.

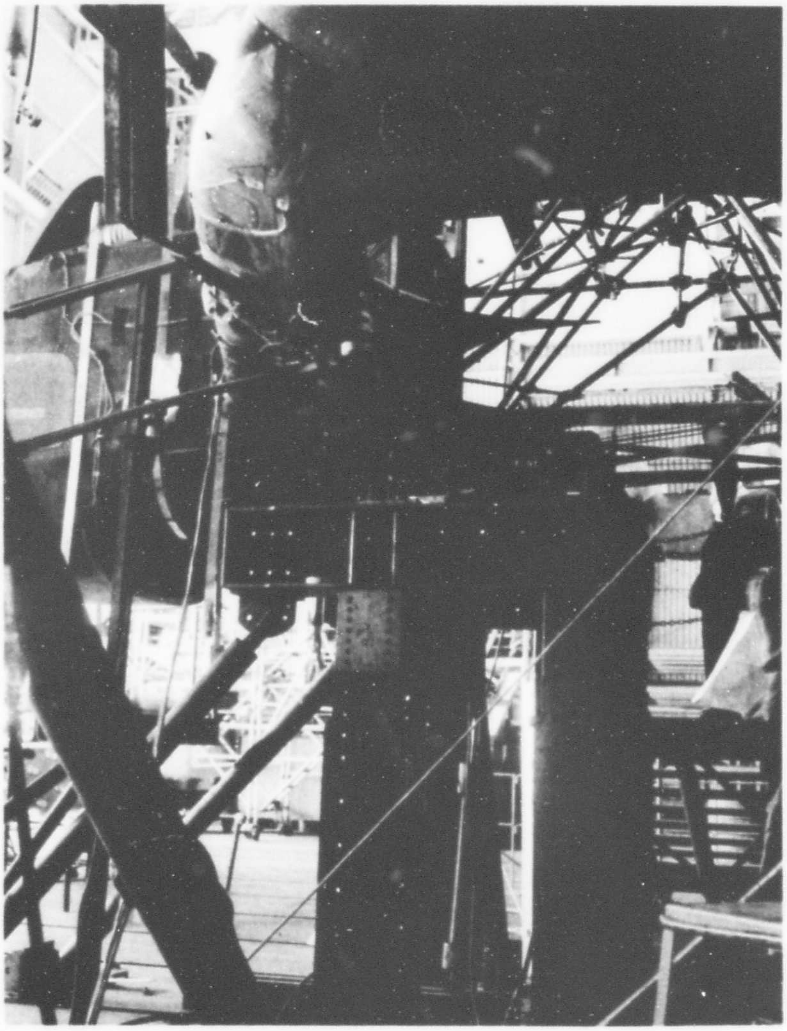


Figure 22 View of Engine Mount With Load Cylinder (Between Upright Beams) During Rolling Pullout Test.

3.6 TEST NO. 6 - WING FAN FORWARD TRUNNION AND FITTING

3.6.1 Test Condition

Transition Flight, Pitching, $\beta_v = 40^\circ$ Vectored Thrust

3.6.2 Introduction

This test represents a critical condition for the wing fan forward fitting, spar attachment and inboard leading edge of wing. The test was undertaken and completed according to the test procedures outline.

3.6.3 Summary

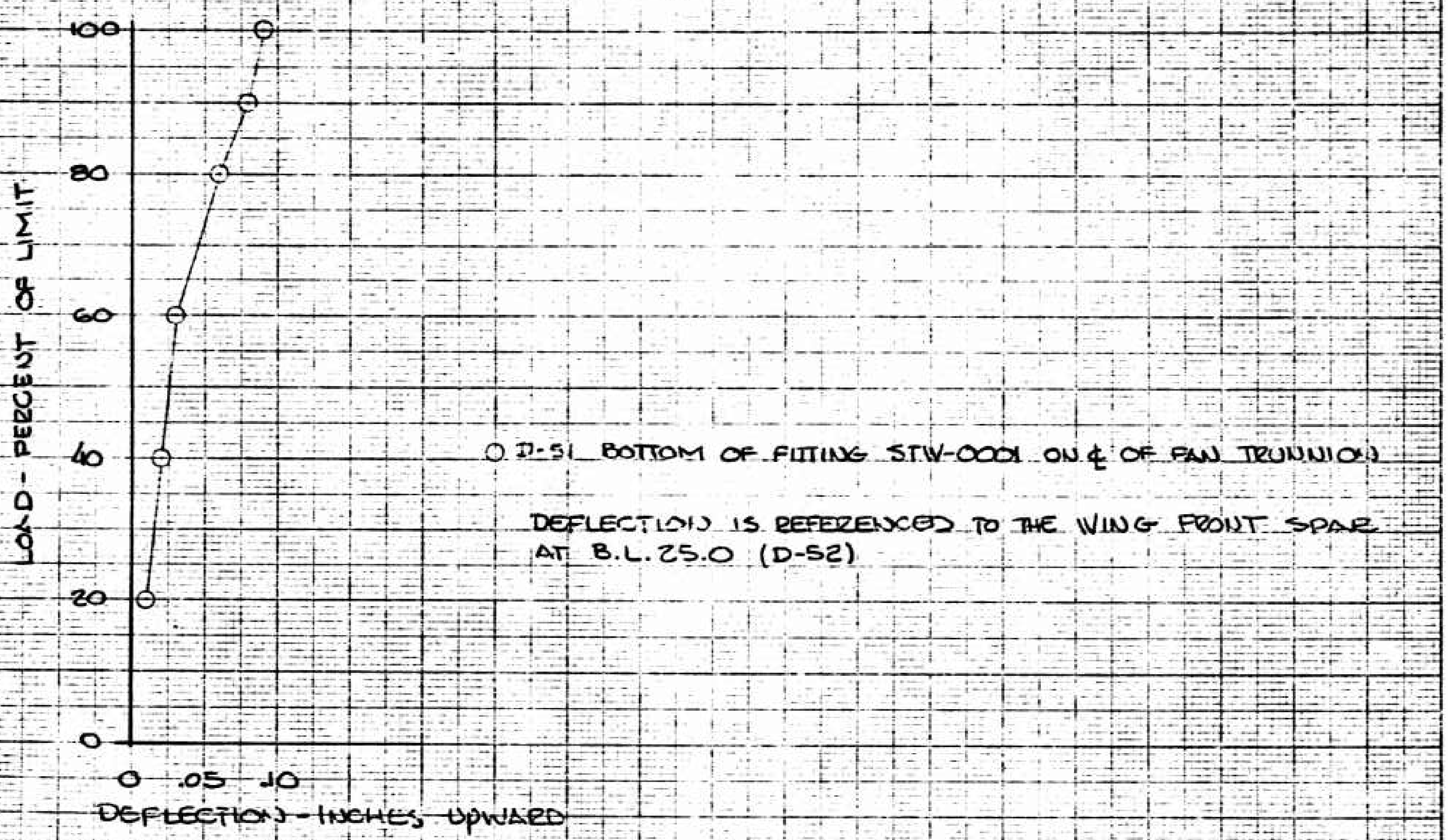
Measured vertical deflection data were plotted in Figure 23. Figure 24 shows the loading arrangement. Longitudinal deflection data proved to be unreliable and, therefore, are not shown.

All strain measurements indicated less than one thousand micro inches (1000μ") and no plotting of strain data was therefore attempted. The maximum strain at 100% load indicated 760μ" on strain gage S-654.

FIGURE 23

TEST NO 6

WING FAN FORWARD TRUNNION



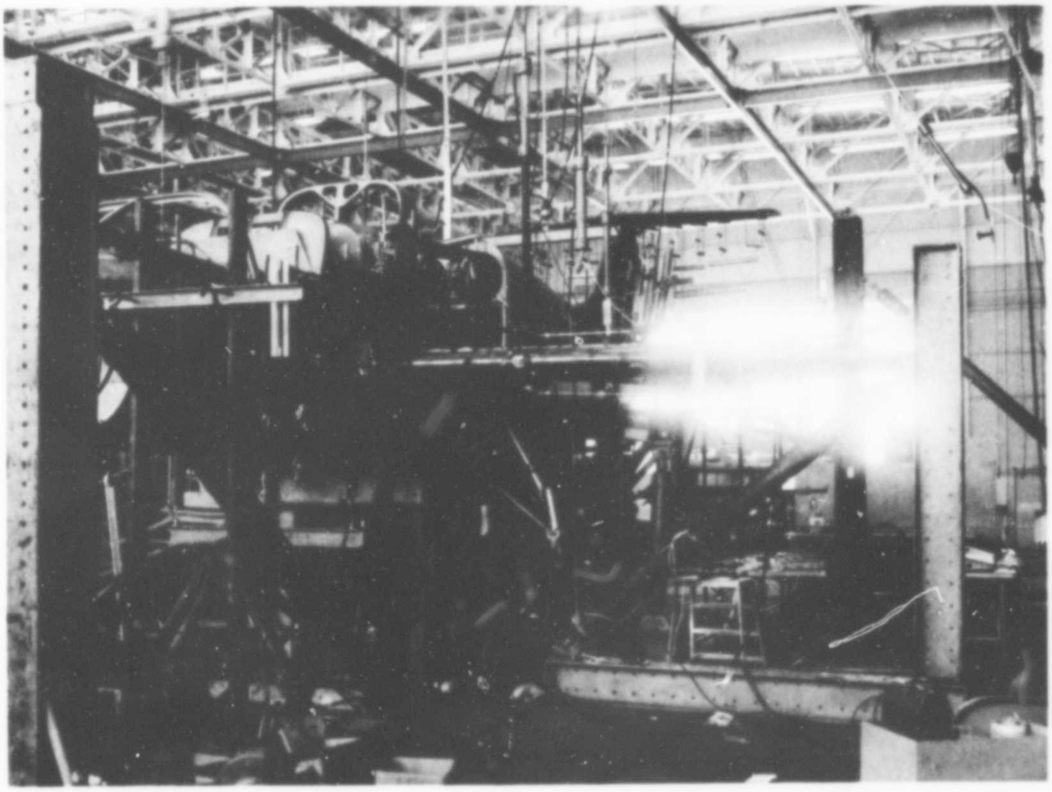


Figure 24 View Showing Wing Fan Forward Trunnion During Test. $\beta_V = 40°$ Vector Thrust

3.7 TEST NO. 7 - WING FAN FORWARD AND AFT TRUNNION FITTINGS

3.7.1 Test Condition

Composite Condition, Hovering Flight with Roll $\beta_v = 0°$

3.7.2 Introduction

This test represented the critical condition for the wing fan forward and aft fittings and their attachment and also the leading edge of the wing. The test was initiated and completed according to the test procedures outline.

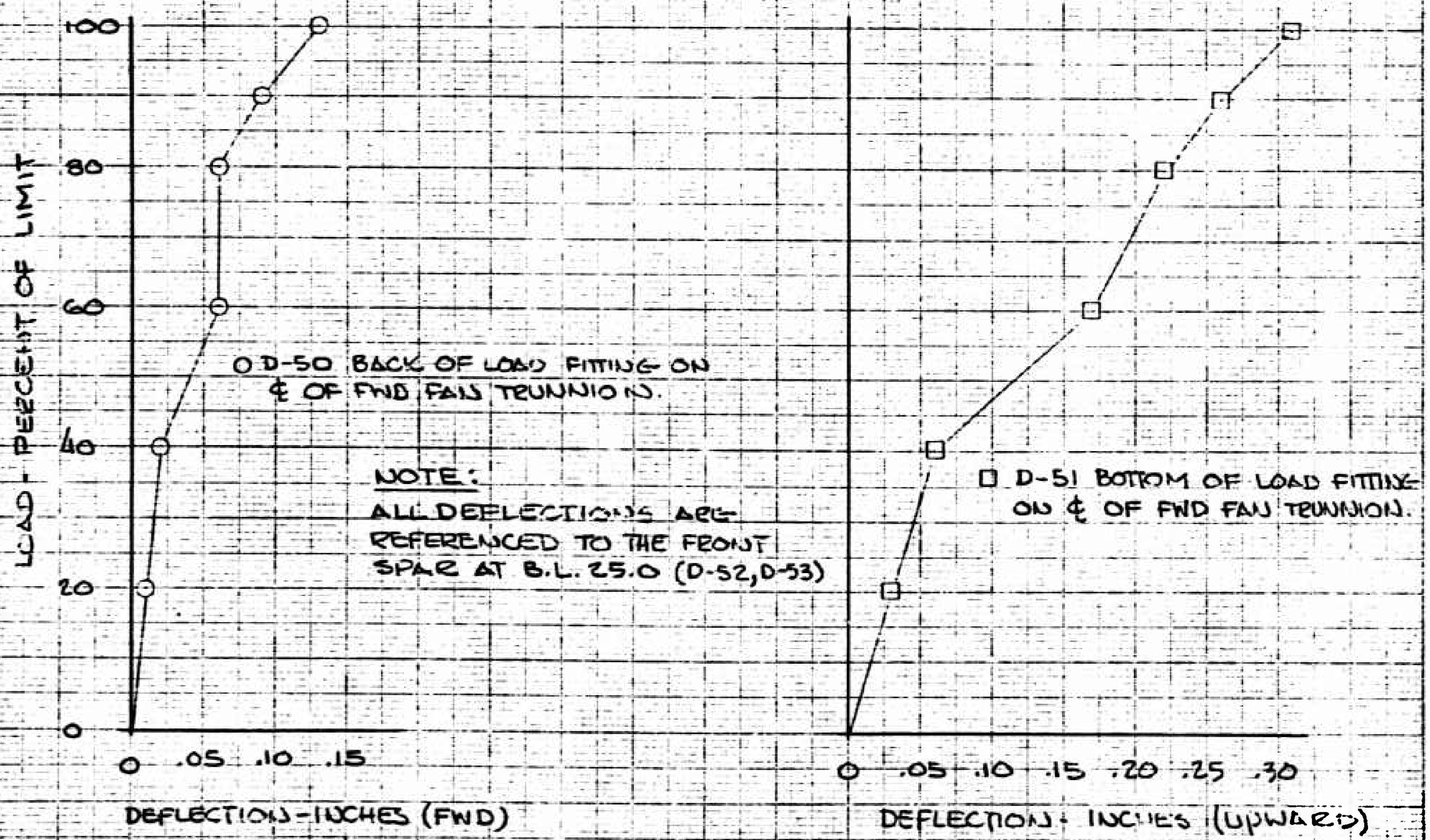
3.7.3 Summary

Deflection measurements were plotted versus applied load expressed as per cent of limit load in Figures 25 and 26. Figures 27 and 28 show the loading arrangement. All deflections were extrapolated to the origin with the zero load abscissa increment added so as to show total deflections.

Strain gage readings were all below 1000 μ ". Gage S-616B read 950 μ " and gage S-645-C read 860 μ " at 100% applied limit load.

FIGURE 25
TEST Nº 7

WING FAN FORWARD TRUNNION



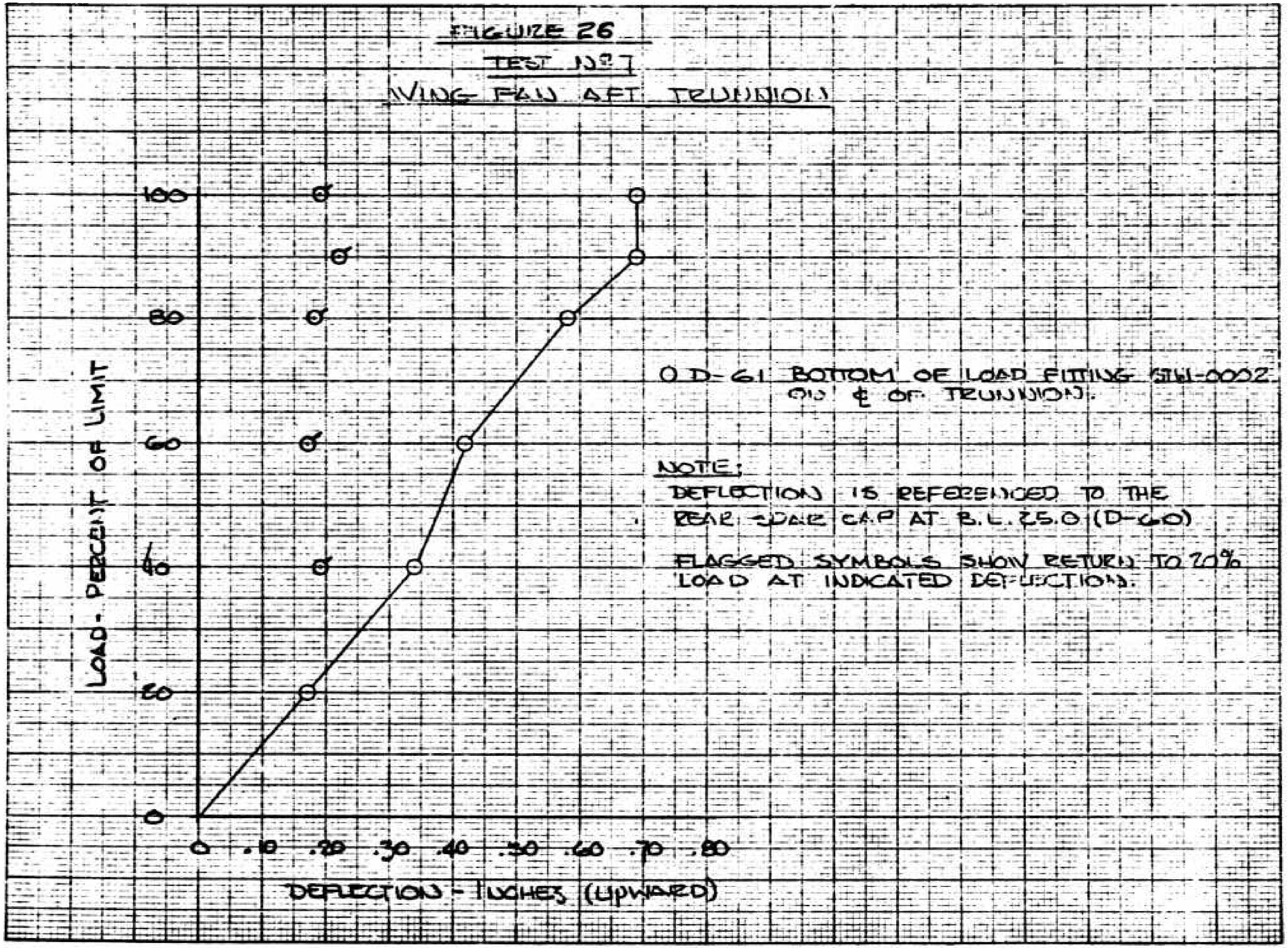


FIGURE 26
TEST NO 7
WING FAN AFT TRUNNION
0 D-61 BOTTOM OF LOAD FITTING 5141-0002
ON ₵ OF TRUNNION.
NOTE:
DEFLECTION IS REFERENCED TO THE
REAR SPAR CAP AT B.L. 25.0 (D-60)
FLAGGED SYMBOLS SHOW RETURN TO 20%
LOAD AT INDICATED DEFLECTION.
LOAD - PERCENT OF LIMIT
100
80
60
40
20
0
0 .10 .20 .30 .40 .50 .60 .70 .80
DEFLECTION - INCHES (UPWARD)

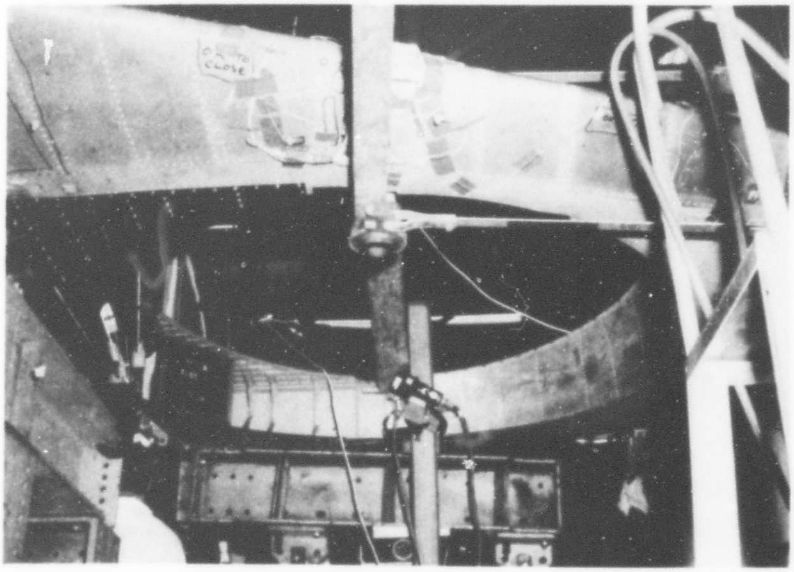


Figure 27 Head-On View Showing Forward and Side Load Applications

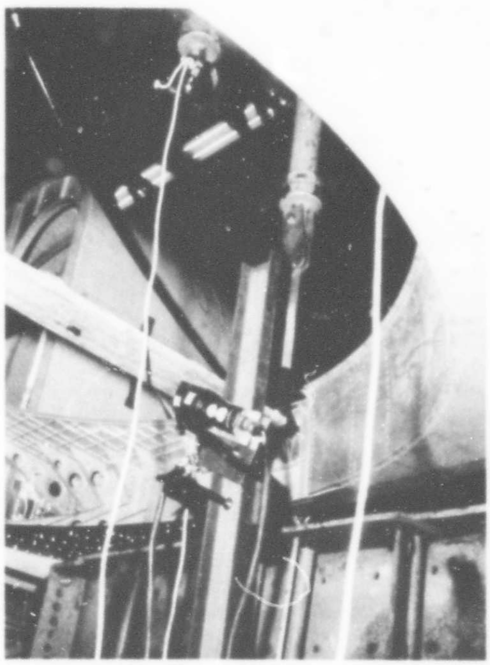


Figure 28
View Showing Rear Trunnion Vertical Load Application

3.8 TEST NO. 8 - AILERON AND ACTUATOR FITTING

3.8.1 Test Condition

High Speed Roll - Maximum Load and Maximum Hinge Moment V = 500 knots @ S. L.

3.8.2 Introduction

A deviation from the original test was made because it was felt that aileron loads alone were approaching wing spar design bending loads. The wing test was to follow the aileron test and wing test instrumentation was not as yet complete. To save the wing for the wing test in the event of any damage, the loads applied to the fixed aileron would check the fittings and provide relative deflections while the induced wing spar bending was alleviated by providing an equal and opposite load over the forward wing section.

3.8.3 Summary

Downward loads were applied to the left aileron which was set with a rigid link at 19° trailing edge up. Up loads were applied to the wing simultaneously to oppose wing spar bending. Deflections relative to the floor were measured as called for in the test procedures.

Figure 29 shows the aileron deflections at the inboard and outboard station plotted versus the applied load expressed as per cent of limit loads. Both curves were extrapolated to zero deflection by straight-lining the 40% and 20% load points back to the origin. Figures 30 and 31 show the loading arrangement. The deflections are referenced to their respective buttock line.

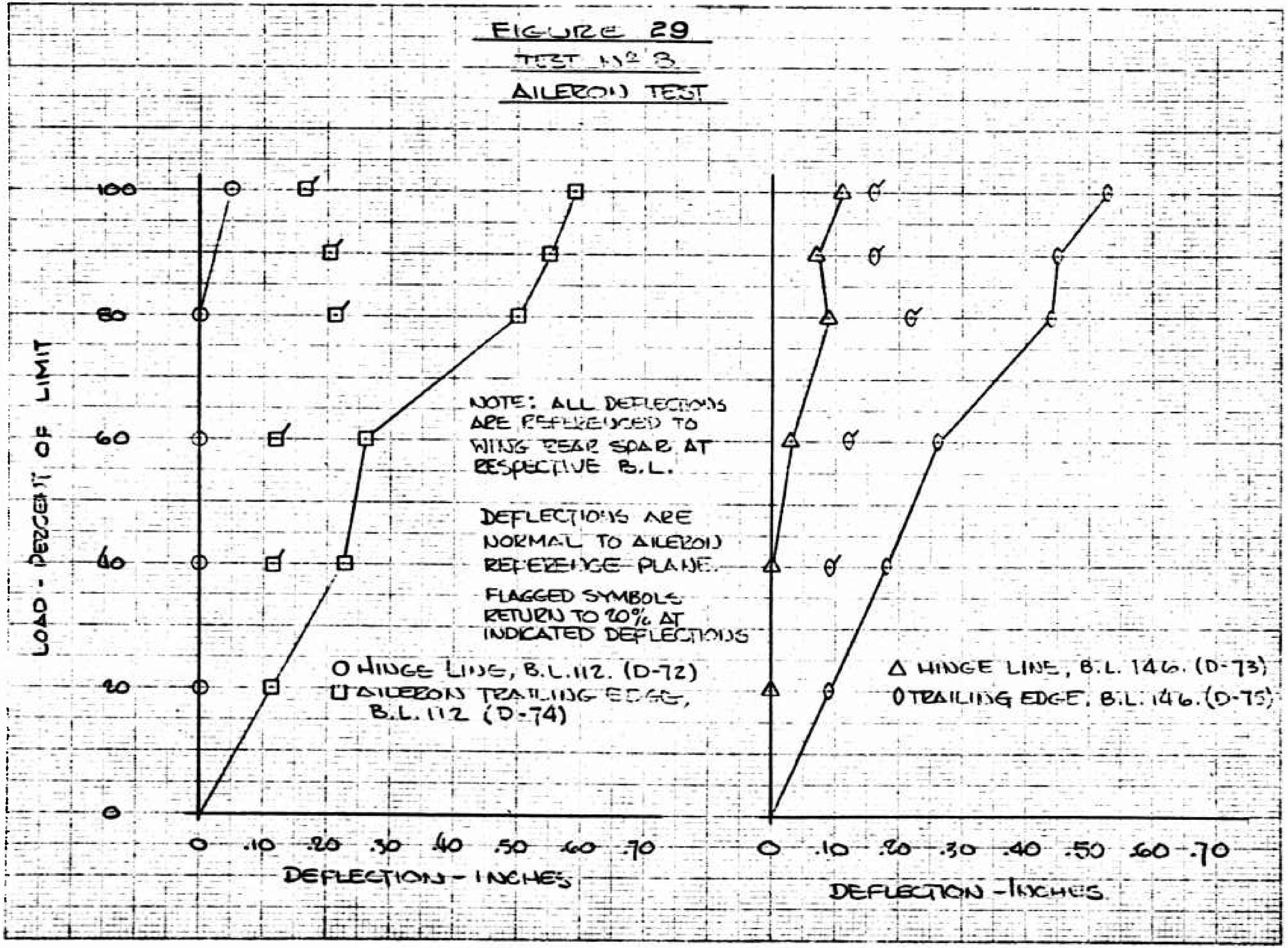


FIGURE 29
TEST No 3
AILERON TEST
LOAD - PERCENT OF LIMIT
100
80
60
40
20
0
0 .10 .20 .30 .40 .50 .60 .70
DEFLECTION - INCHES
0 .10 .20 .30 .40 .50 .60 .70
DEFLECTION - INCHES
NOTE: ALL DEFLECTIONS ARE REFERENCED TO WING REAR SPAR AT RESPECTIVE B.L.
DEFLECTIONS ARE NORMAL TO AILERON REFERENCE PLANE.
FLAGGED SYMBOLS RETURN TO 20% AT INDICATED DEFLECTIONS
O HINGE LINE, B.L.112. (D-72)
□ AILERON TRAILING EDGE, B.L.112 (D-74)
Δ HINGE LINE, B.L. 146. (D-73)
O TRAILING EDGE, B.L. 146. (D-75)

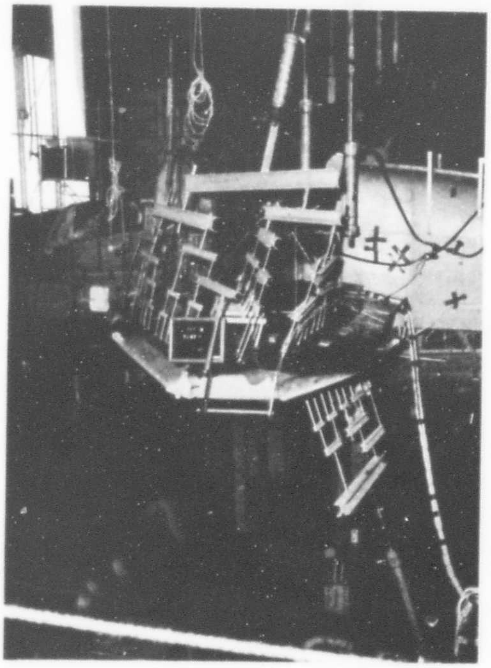


Figure 30
View Showing Wing
Whiffletree Loading
and Aileron Whiffletree

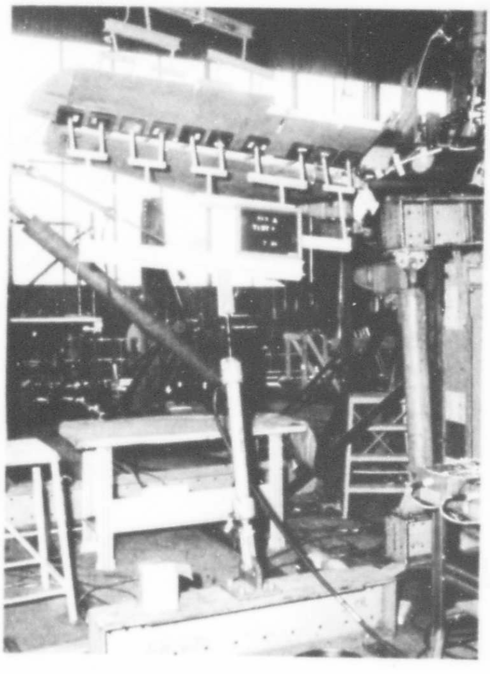


Figure 31
Bottom View of Aileron
Loading Setup

3.9 TEST NO. 9 - BASIC WING

3.9.1 Test Condition

Four "g" Symmetrical Flight Maneuver; Positive Low Angle of Attack
V = 500 knots @ S. L.

3.9.2 Introduction

This test represented a critical condition for the wing structure and its attachment to the fuselage. The test was carried out and completed according to the test procedures outline.

3.9.3 Summary

Deflection measurements of various wing panel points were plotted versus applied load and are shown in Figure 32. The deflections are shown with respect to the wing spar attach points. A digital computer routine was used to convert the measured deflections, which were with respect to the floor, to those presented in Figure 32. The front and rear spar deflection curves are nearly identical and for that reason are not plotted separately.

Aileron control valve motion due to structural deflection of the follow-up tie points is shown in Figure 33. This figure shows valve motion that will induce up aileron of approximately one degree when the wing supports a four "g" load factor.

Strains which indicated greater than 1000μ" at 100% were plotted in Figures 34 through 42 for the various wing points. Figure 43 shows the loading arrangement and Figure 44 shows instrumentation used to measure follow-up motion resulting from structural deflection. Six delta-type strain rosettes were located in the wing leading edge and spar webs to give an indication of shear stresses. The strain readings from these, and the resulting calculations of maximum shear stress are given in Table III. The shear values measured were considerably lower than shear yield allowables of the material.

Leg "C" of S-620 and S-650 were labeled inoperative and, therefore, stresses for these rosettes could not be calculated.

3.9.4 Comparison of Measured Deflections with Predicted:

The wing normal deflections were measured along the front and rear spars at four buttock line locations. As noted, very little twist was evident, which result is in agreement with calculations. The magnitude of the normal deflections are much lower than calculated; about 65% as shown in Table I.

TABLE I

B. L.	CALCULATED DEFLECTION (REF. 3)	DEFLECTION MEASURED (FIG. 9-1)	MEASURED DEFLECTION / CALCULATED DEFLECTION %
42.5	.5	.3	60
61.0	1.2	.8	67
80.7	2.2	1.5	68
100.4	3.5	2.3	66
117.5	4.8	3.1	65
134.7	6.2	4.0	65
151.8	7.6	4.8	63
169.0	9.1	5.8	64

The reasons for these lower measured deflections are as follows:

a. Calculations were based on a 10% reduction in modulus of elasticity to account for a higher temperature (250°F), which was conservatively considered at that time to occur with the flight condition. The test was at room temperature.

b. The effective skin used with rib cap and spar cap flange areas were based on material predicted effective at ultimate load. The test was conducted to limit only, in which case more effective skin was utilized, decreasing actual stress and deformation. This was particularly true in the outer wing, where more skin was effective at the lower stress level.

c. The predicted or calculated weight of the machined spars was 148 lbs., the calculations having been based on drawing dimensions - the same dimensions used for stress analysis. The weight of the spars, as actually machined, totaled 183 lbs., and represents a 24% oversize in cross-sections. This should account for correspondingly low measured deflections as compared to calculated.

3.9.5 Comparison of Measured Strains with Calculated:

Table II is a summary of stresses taken from measured strain gage data. For the sake of comparison, the corresponding values from the stress analysis are shown. In practically all cases the measured values are less than calculated, mainly because of the actual spar overweight condition mentioned above.

TABLE II

Strain Gage No.	Gage Location	Gage Location F. S.	B. L.	W. L.	Measured Stress Figs. 9.3-9.11	Calculated Stress (Ref. 3)
5-601	Fwd Spar, L.H., Upper Cap	214.3	25.50	105.10	-31,000	-28,200
5-602	Fwd Spar, L.H., Upper Cap	215.0	25.50	106.00	-24,200	-28,200
5-604	Fwd Spar, L.H., Lower Cap	215.3	26.175	96.50	15,000	--
*5-605	Fwd Spar, L.H., Upper Cap	214.0	40.0	105.6	-20,900	-27,000
*5-606	Fwd Spar, L.H., Lower Cap	214.0	40.0	96.4	21,300	27,000
5-607	Fwd Spar, L.H., Upper Cap	214.9	61.0	106.0	-15,500	-27,000
5-608	Fwd Spar, L.H., Lower Cap	214.9	61.0	96.0	15,000	27,000
*5-613	Fwd Spar, R.H., Upper Cap	214.0	40.0	105.6	-23,400	-27,000
*5-614	Fwd Spar, R.H., Lower Cap	214.0	40.0	96.4	22,000	27,000
5-628	Rear Spar, L.H., Upper Cap	296.8	25.5	105.0	-22,800	-33,700
5-629	Rear Spar, L.H., Upper Cap	297.5	25.5	105.7	-28,600	-33,700
5-632	Rear Spar, L.H., Upper Cap	297.2	29.0	106.2	-27,400	-33,700
*5-635	Rear Spar, L.H., Upper Cap	297.0	39.6	105.6	-24,000	-27,000
*5-636	Rear Spar, L.H., Lower Cap	297.0	39.6	96.6	22,500	27,000
5-637	Rear Spar, L.H., Upper Cap	296.5	61.0	6.2	-19,200	-27,000
5-638	Rear Spar, L.H., Lower Cap	296.5	61.0	96.0	21,700	27,000
5-642	Rear Spar, L.H., Lower Cap	297.2	112.5	97.7	14,400	15,000
*5-643	Rear Spar, R.H., Upper Cap	296.5	39.6	105.6	-19,100	-27,000
*5-644	Rear Spar, R.H., Lower Cap	296.5	39.6	96.6	21,700	27,000
5-532	Fwd Spar, Upper Cap, Inside Fus	214.0			-20,500	-28,000

*These gages have been installed in the flight test article.

TABLE III.

WING SPAR STRAINS - STRAIN ROSETTE *

ϵ_1	ϵ_2	ϵ_3	σ_{max}	σ_{min}	τ_{max}	Load %
			S-615			
40.0	188.0	-280.0	1877.	-2372.	2124.	20
80.0	576.0	-560.0	5516.	-4602.	5058.	40
96.0	560.0	-870.0	5461.	-7499.	6480.	60
116.0	736.0	-1176.0	7122.	-10207.	8664.	80
122.0	832.0	-1326.0	7998.	-11340.	9170.	90
126.0	922.0	-1490.0	8812.	-13421.	10916.	100
			S-616			
40.0	268.0	-130.0	2621.	-926.	174.	20
80.0	536.0	-260.0	5243.	-1852.	3548.	40
100.0	818.0	-410.0	7899.	-3061.	5480.	60
118.0	1118.0	-554.0	10721.	-4225.	7474.	80
130.0	1288.0	-630.0	12331.	-4827.	8580.	90
140.0	1468.0	-708.0	14028.	-5456.	9742.	100
			S-645			
46.0	134.0	-360.0	1483.	-3198.	2340.	20
92.0	268.0	-720.0	2967.	-6395.	4682.	40
146.0	398.0	-1070.0	4468.	-9477.	6972.	60
186.0	530.0	-1412.0	5890.	-12519.	9204.	80
206.0	598.0	-1580.0	6617.	-14007.	10312.	90
230.0	662.0	-1750.0	7338.	-15510.	11424.	100
			S-647			
10.0	-160.0	280.0	2590.	-1352.	1970.	20
20.0	-320.0	560.0	5180.	-2704.	3942.	40
24.0	-440.0	860.0	7966.	-3737.	5852.	60
24.0	-580.0	1140.0	10548.	-4796.	7672.	80
14.0	-646.0	1276.0	11741.	-5608.	8674.	90
12.0	-714.0	1416.0	13018.	-6218.	9618.	100
			S-648			
-60.0	300.0	-180.0	2505.	-1933.	2218.	20
-120.0	600.0	-360.0	5009.	-3866.	4430.	40
-156.0	912.0	-500.0	7759.	-5321.	6540.	60
-200.0	1210.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A

			S-647			
10.0	-160.0	280.0	2590.	-1352.	1980.	20
20.0	-320.0	560.0	5180.	-2704.	3962.	40
24.0	-440.0	860.0	7966.	-3737.	5852.	60
24.0	-580.0	1140.0	10548.	-4796.	7672.	80
14.0	-646.0	1276.0	11741.	[illegible]	8674.	90
12.0	-714.0	1416.0	13018.	-6018.	9618.	100
			S-648			
-60.0	300.0	-180.0	2505.	-1933.	2218.	20
-120.0	600.0	-360.0	5009.	-3866.	4438.	40
-156.0	912.0	-500.0	7759.	-5321.	6540.	60
-200.0	1210.0	-640.0	10346.	-6822.	8584.	80
-230.0	1344.0	-712.0	11465.	-7636.	9530.	90
-248.0	1496.0	-784.0	12799.	-8379.	10588.	100
			S-660			
-20.0	114.0	230.0	2654.	432.	1112.	20
-40.0	228.0	460.0	5308.	863.	2222.	40
-60.0	334.0	730.0	8289.	1272.	3508.	60
-60.0	444.0	990.0	11207.	1878.	4664.	80
-66.0	498.0	1130.0	12753.	2124.	5314.	90
-74.0	554.0	1264.0	14251.	2359.	5946.	100

* See Text of Test Summary, Page

ϵ_1 ϵ_2, ϵ_3 Measured strains in each leg of Δ Rosette, (μ%)

σ_{max} Maximum tension stress, psi

σ_{min} Maximum compressive stress, psi

τ_{max} Maximum shear stress, psi

B

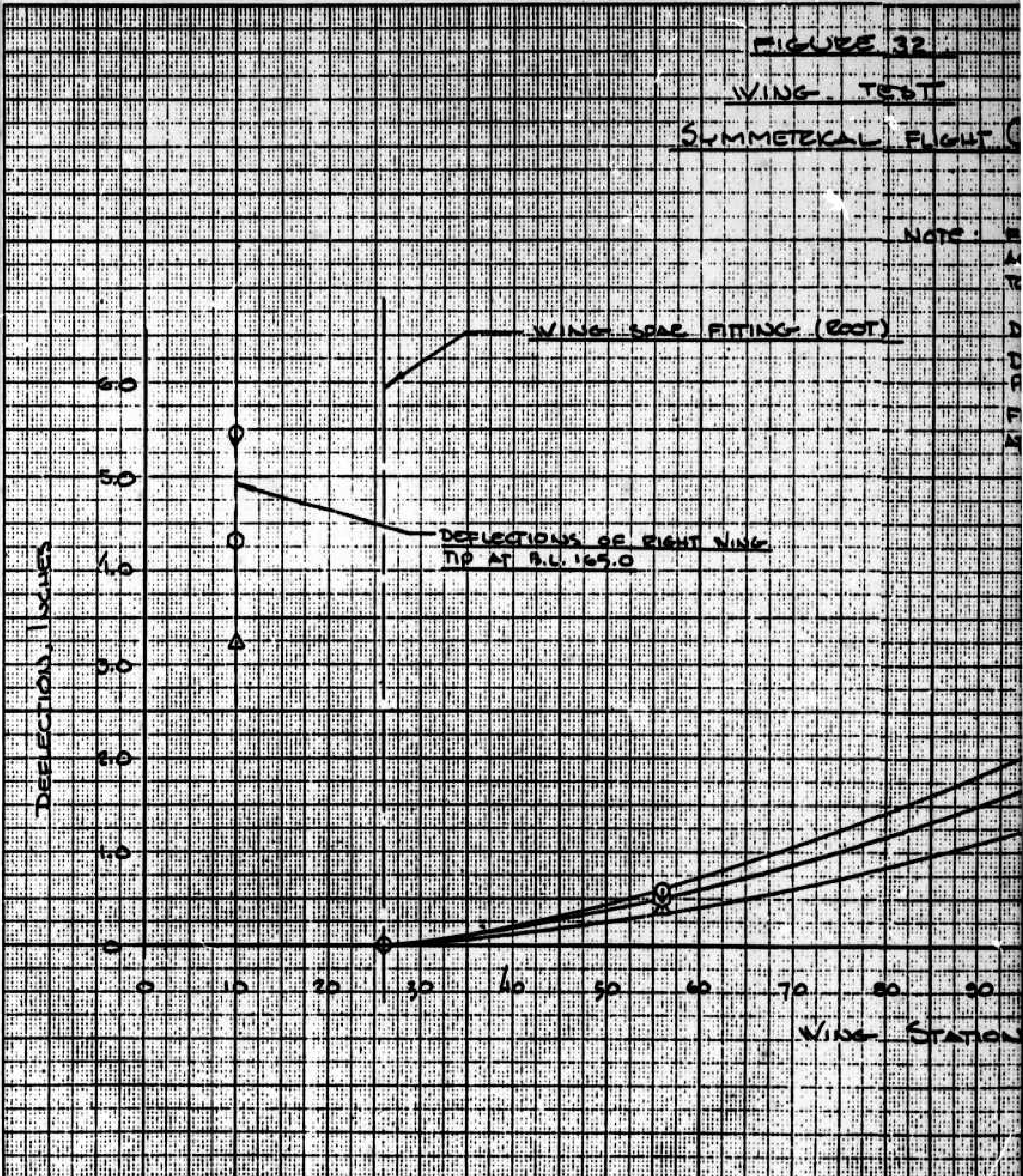
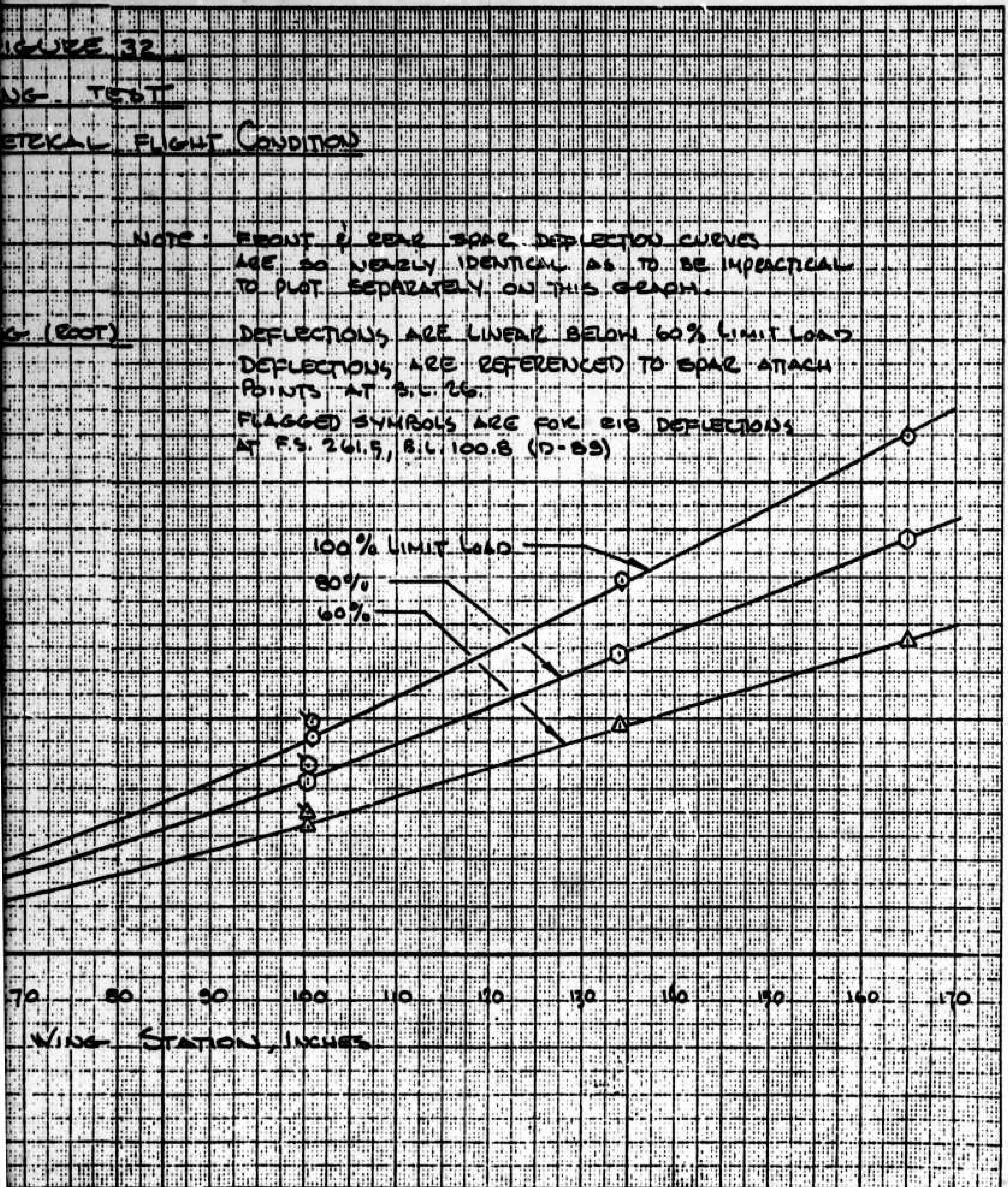


FIGURE 32
WING TEST
SYMMETRICAL FLIGHT
NOTE:
WING SPAR FITTING (ROOT)
DEFLECTIONS OF RIGHT WING TIP AT B.L. 165.0
DEFLECTION, INCHES
6.0
5.0
4.0
3.0
2.0
1.0
0
0
10
20
30
40
50
60
70
80
90
WING STATION

A


IGURE 32
NG TEST
ERTICAL FLIGHT CONDITION
G (ROOT)
NOTE: FRONT & REAR SPAR DEFLECTION CURVES ARE SO NEARLY IDENTICAL AS TO BE IMPRACTICAL TO PLOT SEPARATELY ON THIS GRAPH.
DEFLECTIONS ARE LINEAR BELOW 60% LIMIT LOAD
DEFLECTIONS ARE REFERENCED TO SPAR ATTACH POINTS AT B.L. 26.
FLAGGED SYMBOLS ARE FOR RIB DEFLECTIONS AT F.S. 261.5, B.L. 100.8 (D-B9)
100% LIMIT LOAD
80%
60%
70
80
90
100
110
120
130
140
150
160
170
WING STATION, INCHES

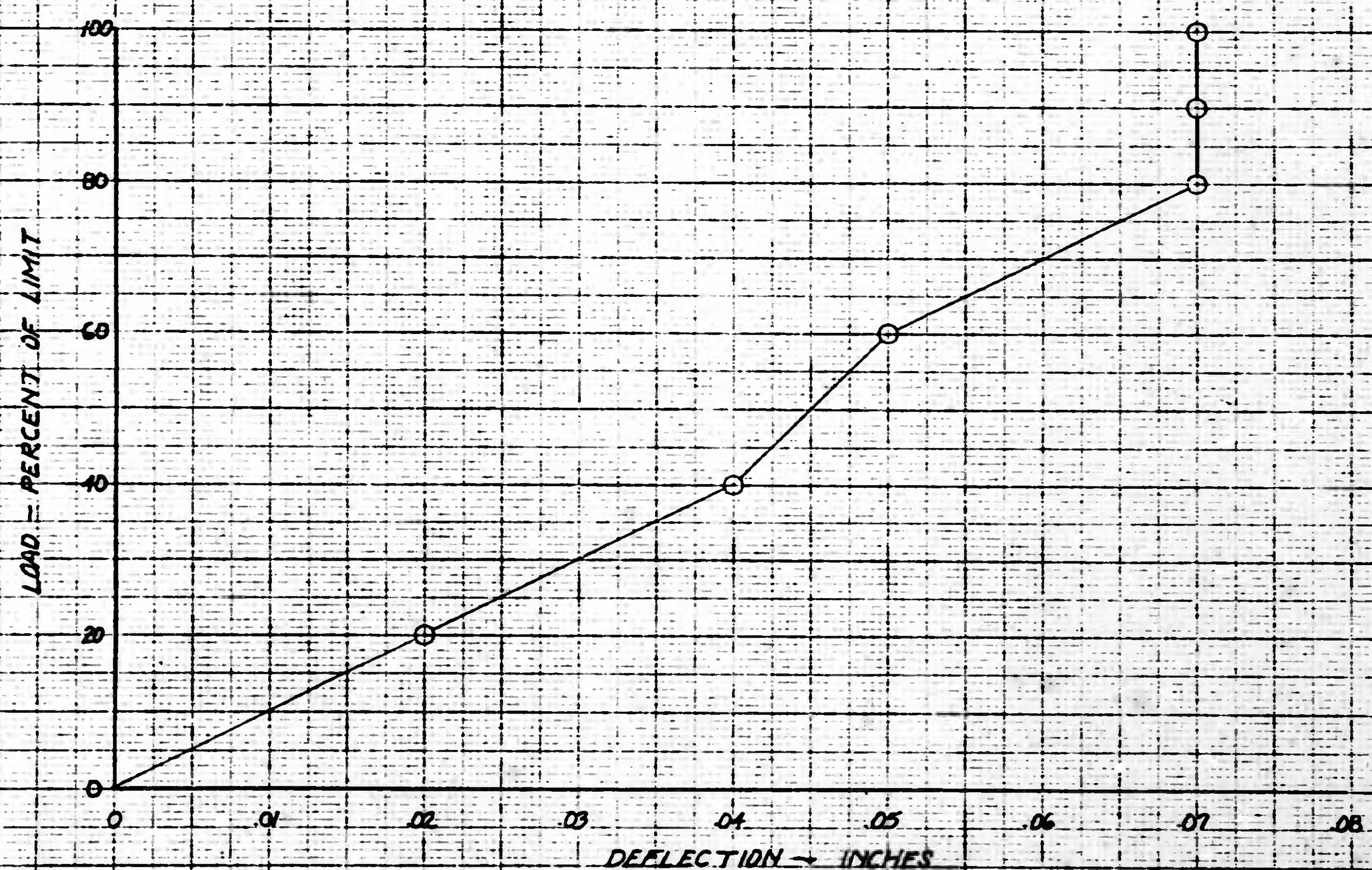
B

FIGURE 33

TEST Nº 9

WING TEST

AILERON CONTROL VALVE MOTION



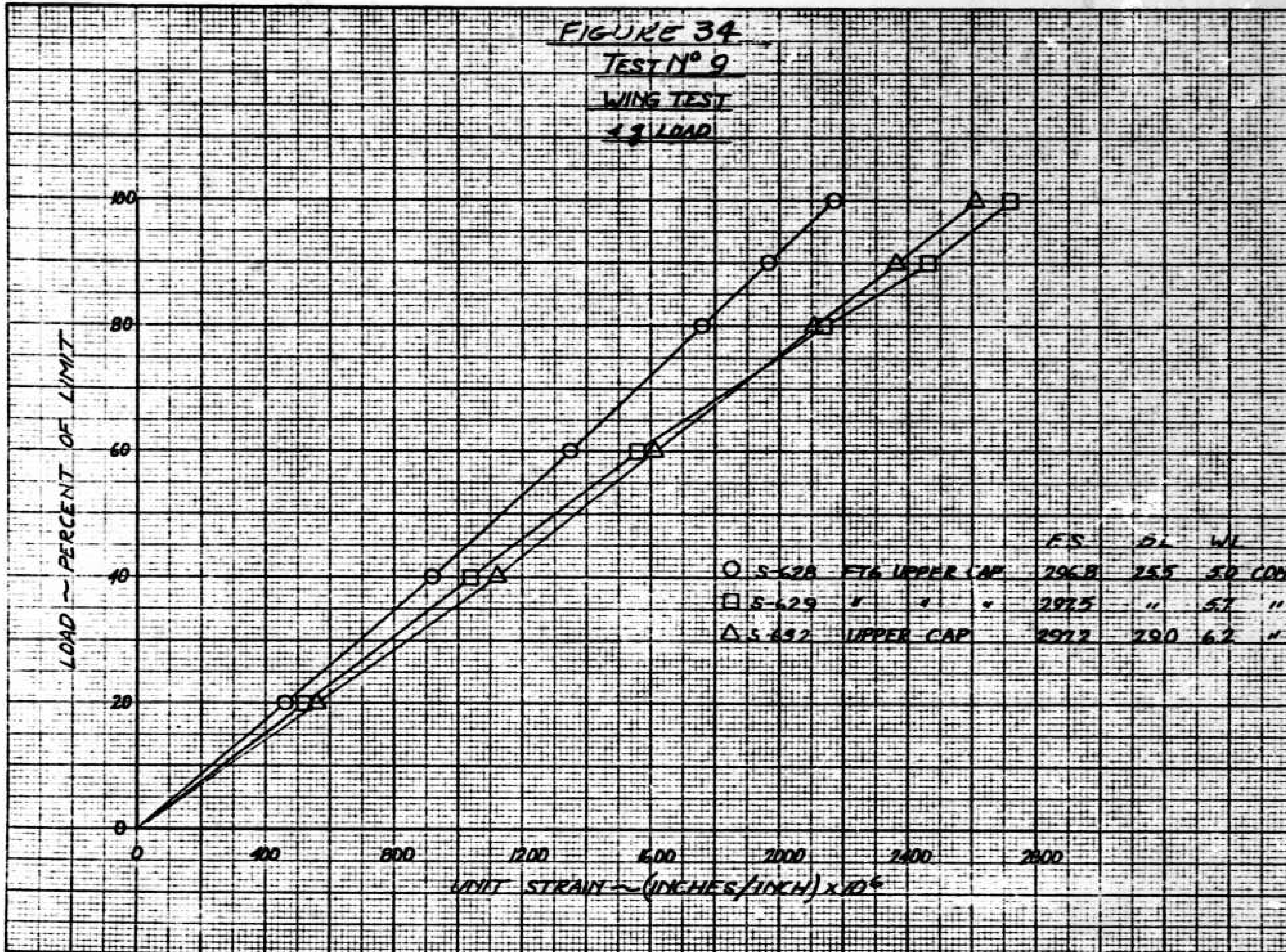


FIGURE 34
TEST No 9
WING TEST
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
2800
UNIT STRAIN ~ (INCHES/INCH) x 10^-6
F.S. B.L. W.L.
○ S-628 FT.6 UPPER CAP 296.8 25.5 5.0 COMP
□ S-629 " " " 297.5 " 5.7 "
△ S-632 UPPER CAP 297.2 29.0 6.2 "

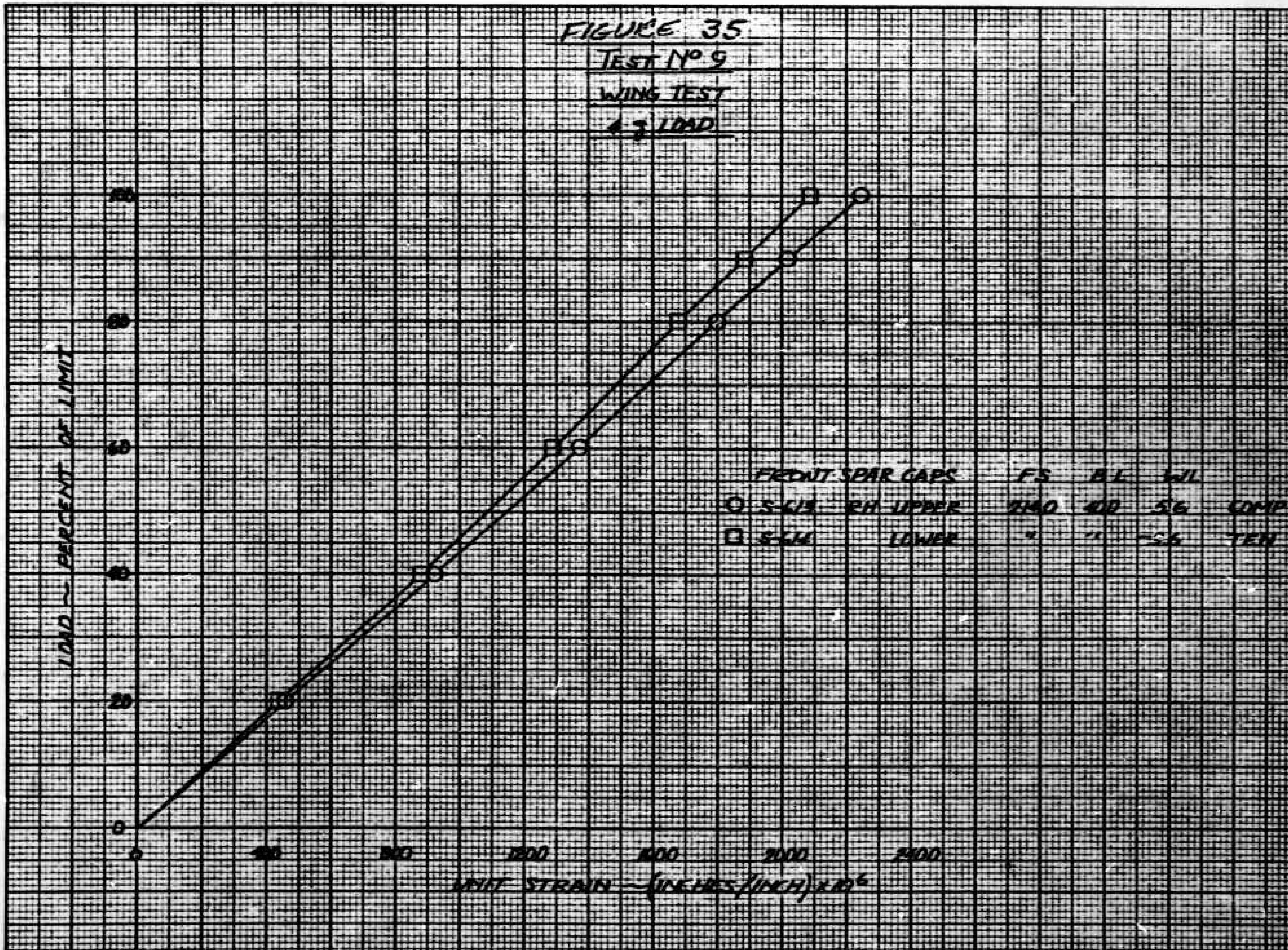


FIGURE 35
TEST No 9
WING TEST
LOAD
FRONT SPAR CAPS F.S. B.L. W.L.
S-613 RH UPPER 2140 100 5.6 COMP
S-614 LOWER " " -5.6 TEN
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) x 10^6

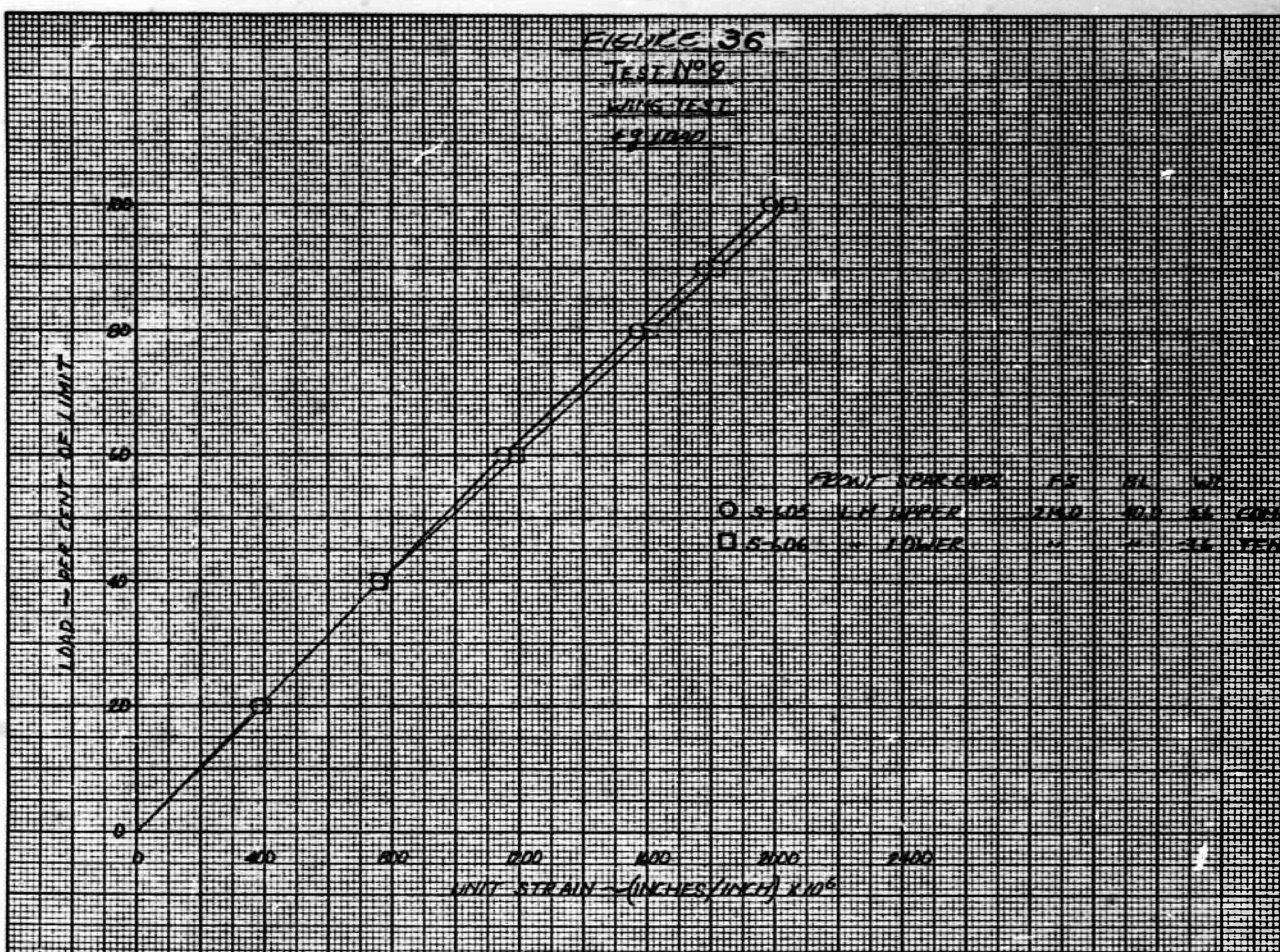


FIGURE 36
TEST No 9
WING TEST
+g LOAD
LOAD — PER CENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN — (INCHES/INCH) X10⁶
FRONT SPAR CAPS F.S. B.L. W.L.
S-105 L.H. UPPER
S-106 LOWER

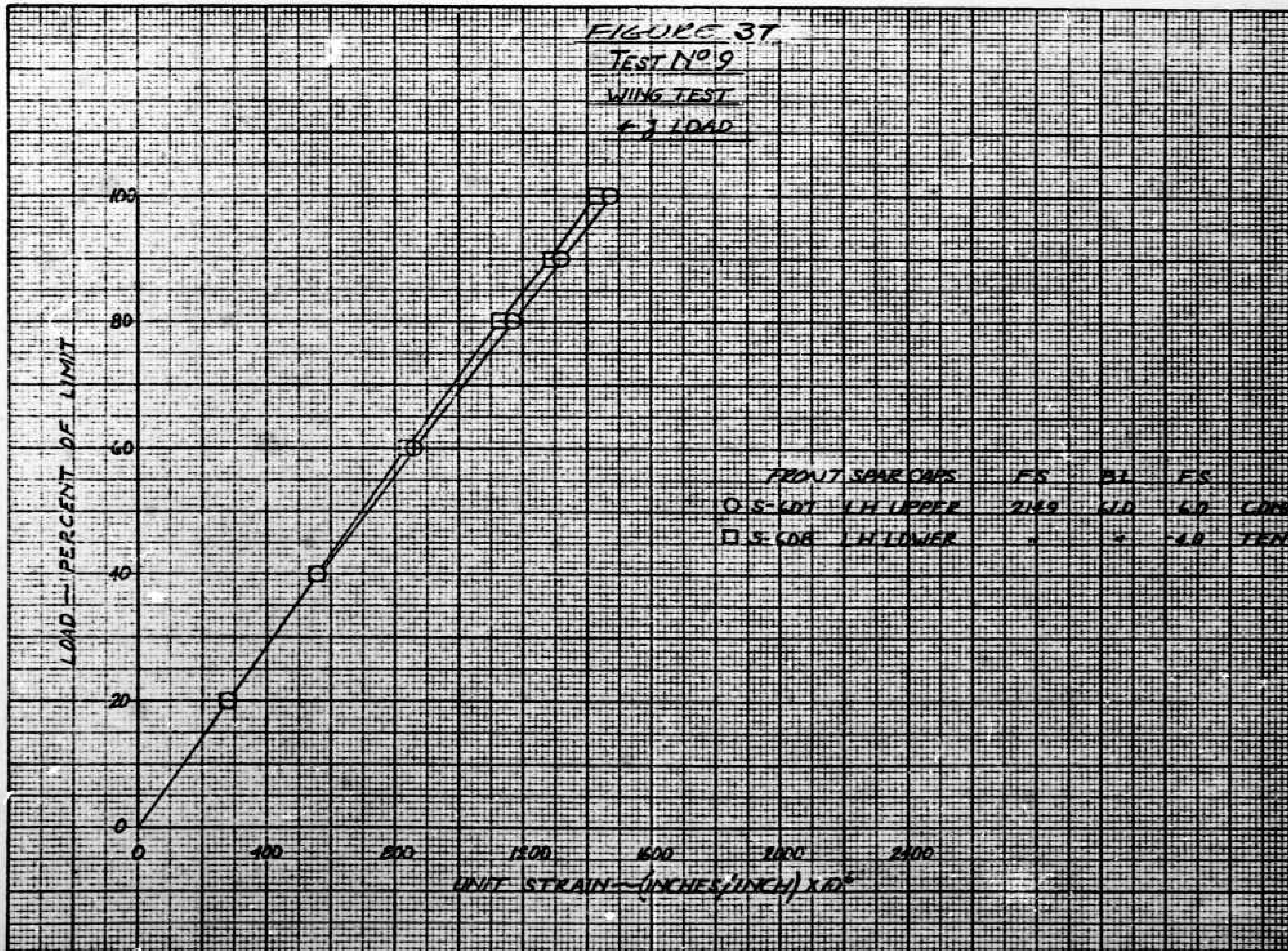


FIGURE 37
TEST No 9
WING TEST
+3 LOAD
LOAD — PERCENT OF LIMIT
0
20
40
60
80
100
0
400
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) X10⁻⁶
FRONT SPAR CAPS F.S. B.L. F.S.
○ S-607 L.H. UPPER 214.9 61.0 6.0 COMP
□ S-608 L.H. LOWER " " -4.8 TEN

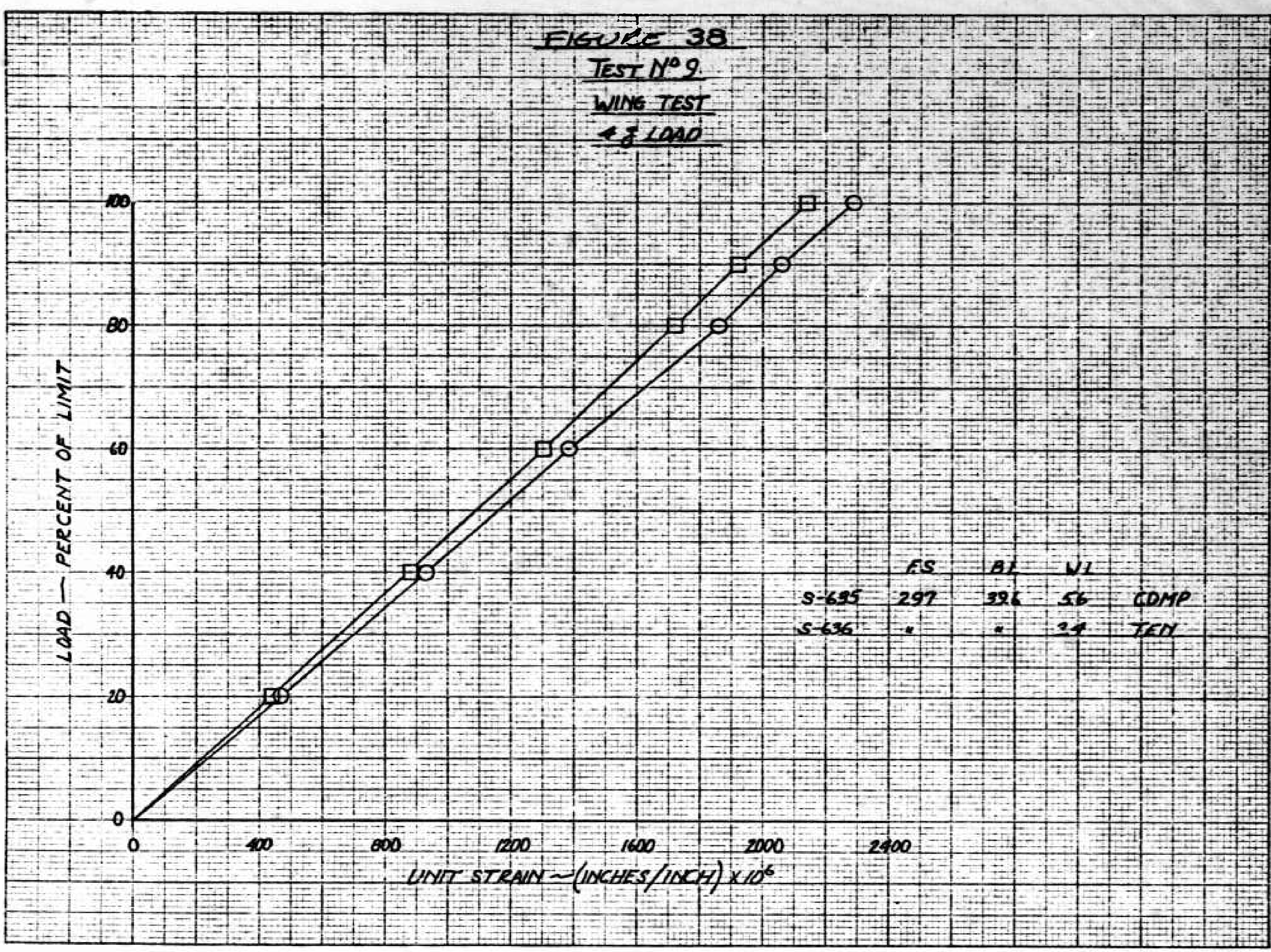
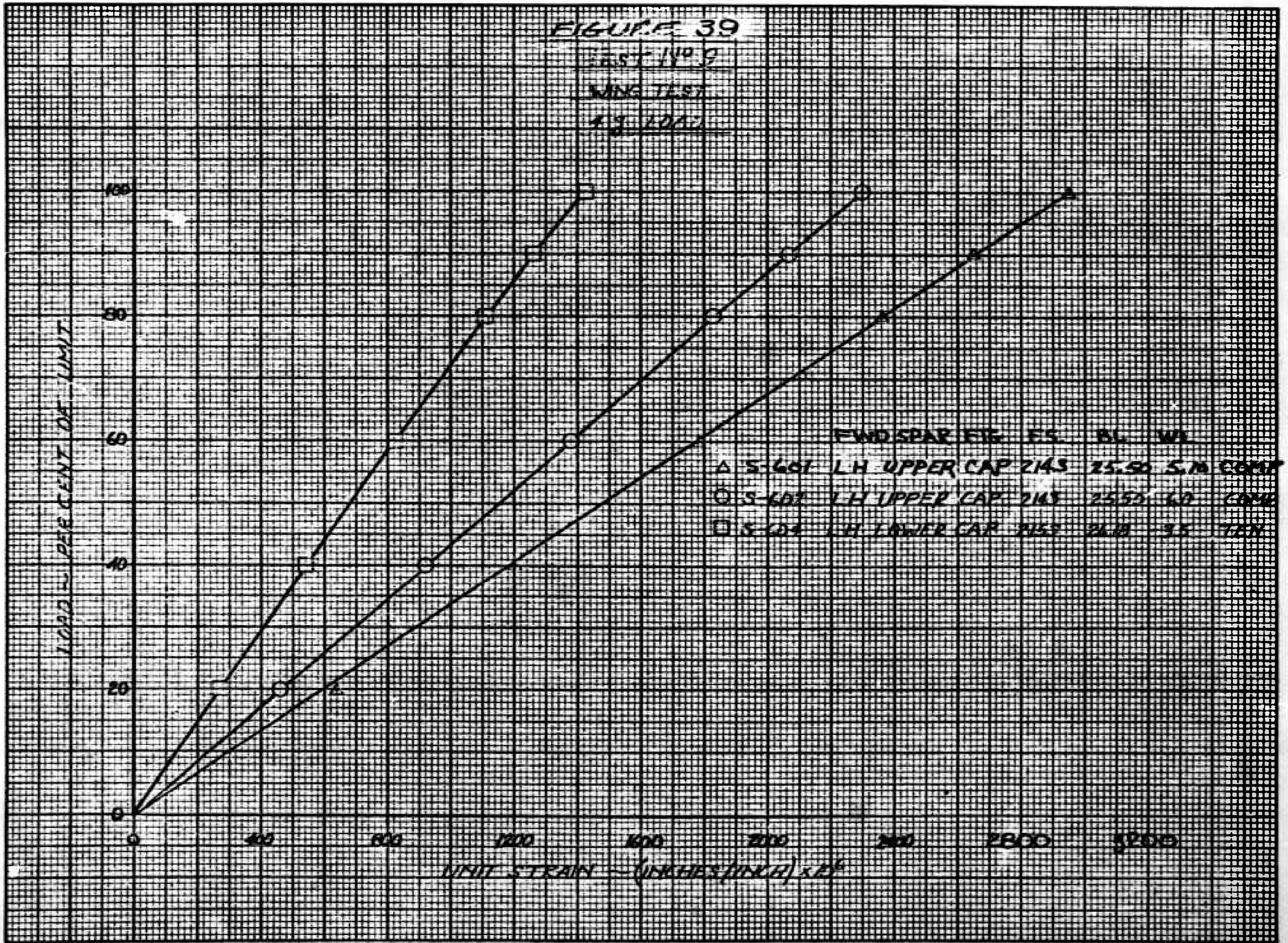


FIGURE 38
TEST Nº 9.
WING TEST
4g LOAD
LOAD — PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) X10⁶
FS BL WL
S-635 297 396 56 COMP
S-636 " " 24 TEN



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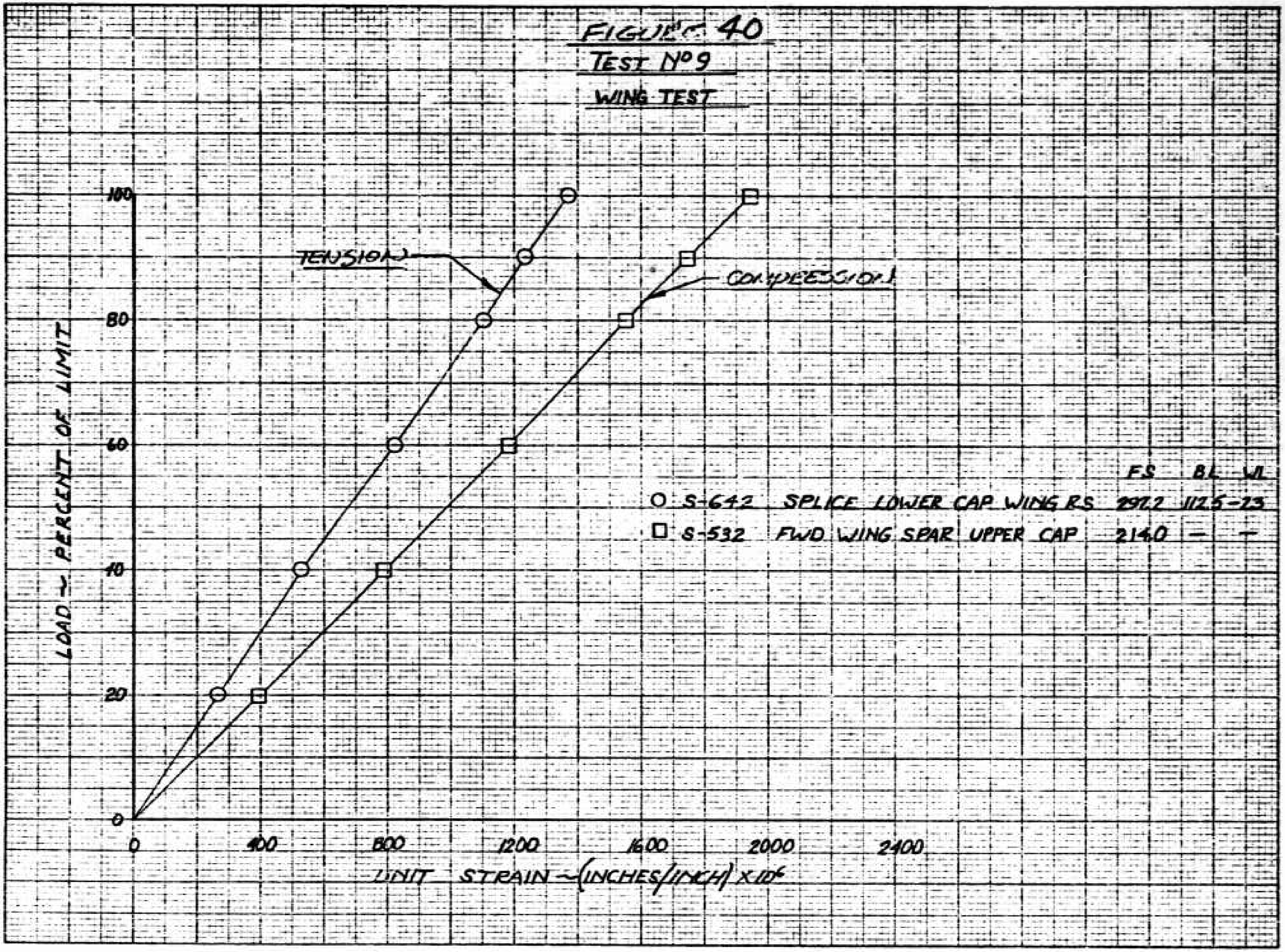


FIGURE 40
TEST Nº 9
WING TEST
TENSION
COMPRESSION
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) X10⁶
FS BL WL
○ S-642 SPLICE LOWER CAP WING RS 297.2 112.5 -23
□ S-532 FWD WING SPAR UPPER CAP 214.0 — —

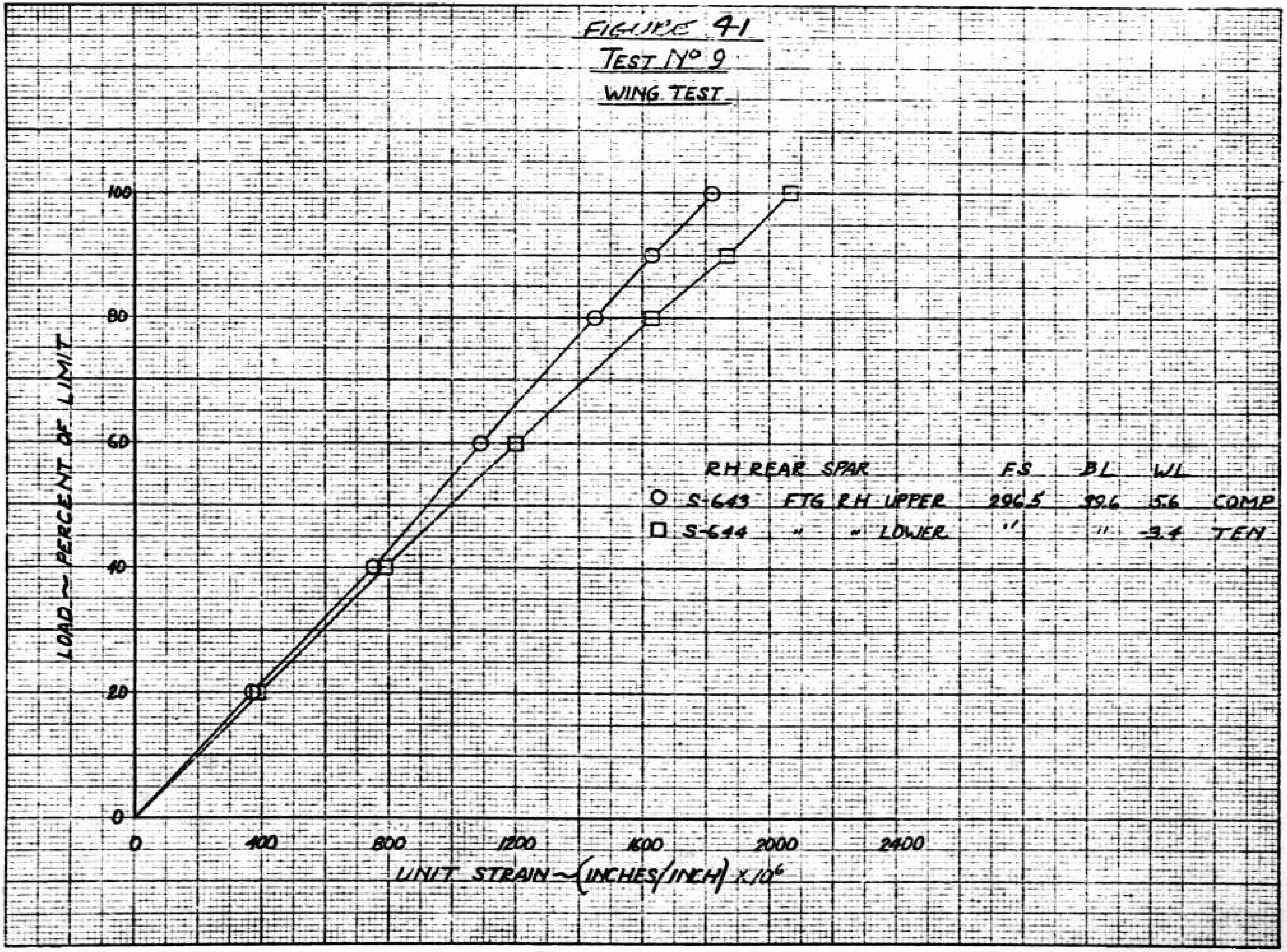
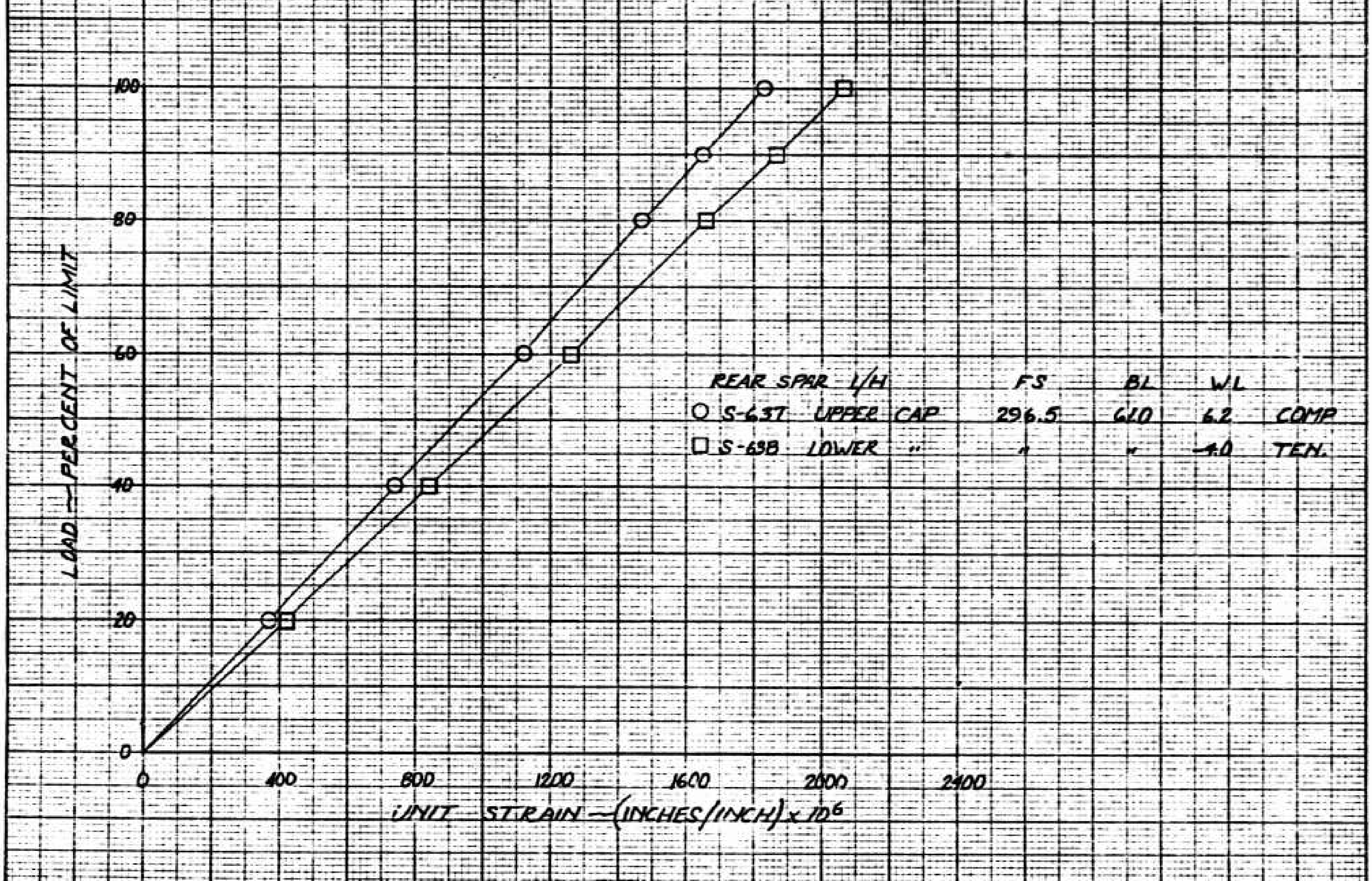


FIGURE 41
TEST Nº 9
WING TEST
RH REAR SPAR FS BL WL
○ S-643 FTG RH UPPER 296.5 39.6 5.6 COMP
□ S-644 " " LOWER " " -3.4 TEN
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) X 10^6

FIGURE 42
TEST No 9
WING TEST



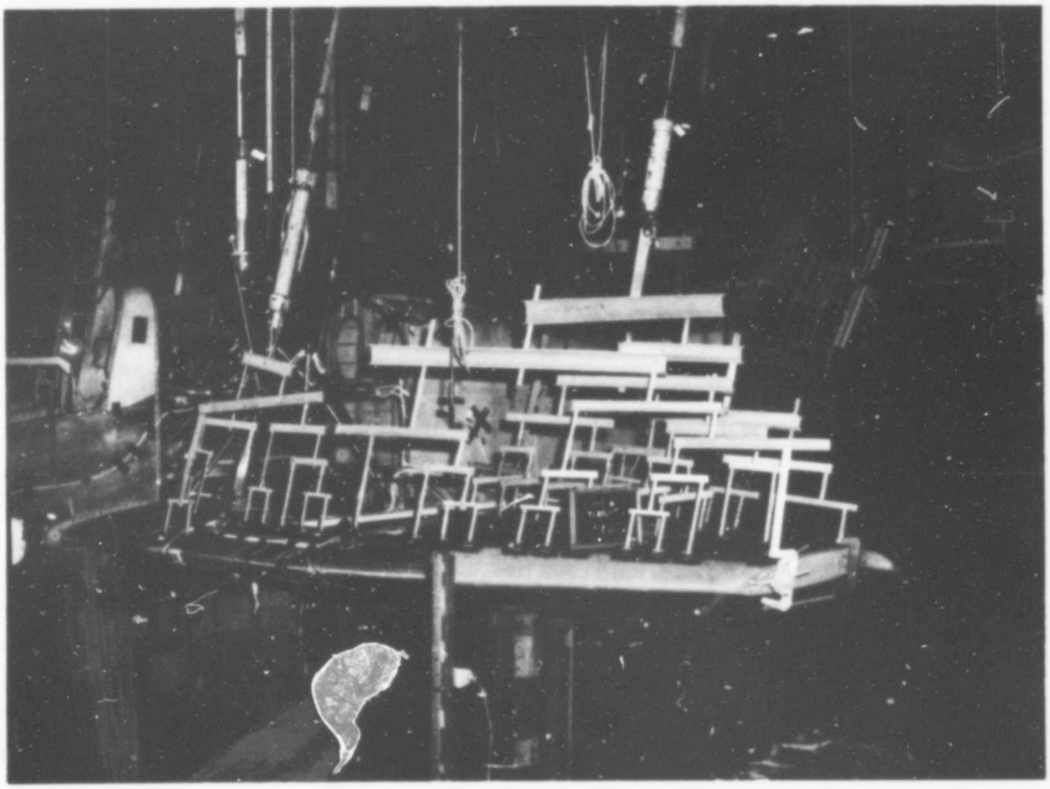


Figure 43 View Showing Whiffletree Loading on Left Wing - Right Wing Similarly Loaded; 4 g Load Being Applied to Wing.

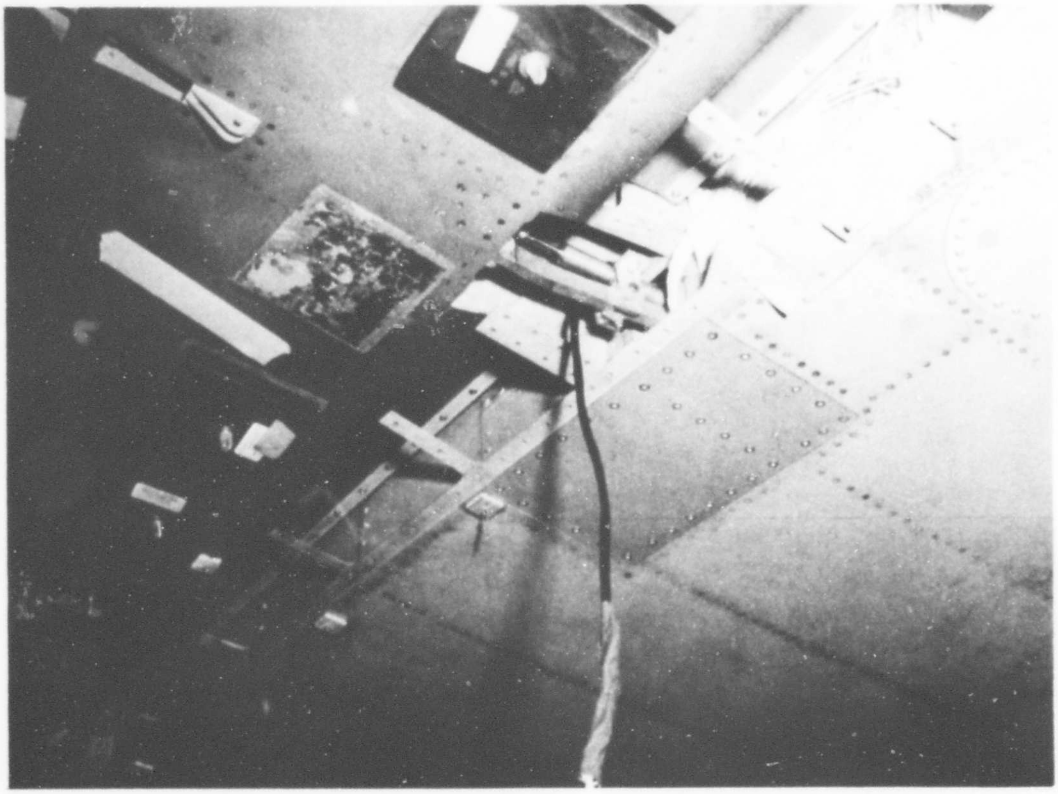


Figure 44 View of Potentiometer Used to Measure Motion of Follow-up Tie Points During Test No. 9

3.10 TEST NO. 10 - FUSELAGE AND HORIZONTAL STABILIZER

3.10.1 Test Condition

Composite condition to provide maximum design loads on both fuselage and horizontal stabilizer which are developed during symmetrical flight.

3.10.2 Introduction

The applied loads for this test were indicative of the maximum envelope of the loads attributed to critical symmetrical flight conditions.

3.10.3 Summary

The test was completed according to the test procedures outline except that deflection gages were relocated as follows:

D-112	FS 87.25 instead of 91.0. Not practical.
D-115	FS 296 and inboard corner of LH jig fitting (rotating fitting) instead of FS 296 BL 0.0. Not practical.
D-119	FS 483 instead of 500; no tail cone.
D-120	BL 3.0 left instead of 0.0. Not practical.
D-122	BL 73 left instead of 70; ten. pad in way.
D-123	BL 73 right instead of 70; ten. pad in way.
D-124	BL 10.0 left instead of 0.0. Not practical.
D-127	BL 0.0 center of space frame horizontal "X" section.

Deflection data were plotted versus the 100% applied limit load and appears in Figure 45. It was found that the deflections varied linearly with the applied load and as such it may be ratioed directly for any other load condition. The data are corrected for jig movement and is plotted with respect to the jig mount points at fuselage stations 214 and 294.

The horizontal stabilizer center spar deflection with respect to the stabilizer pivot point is shown in Figure 46. The rear spar deflections are referenced to the center spar and are shown in Figure 47. Figures

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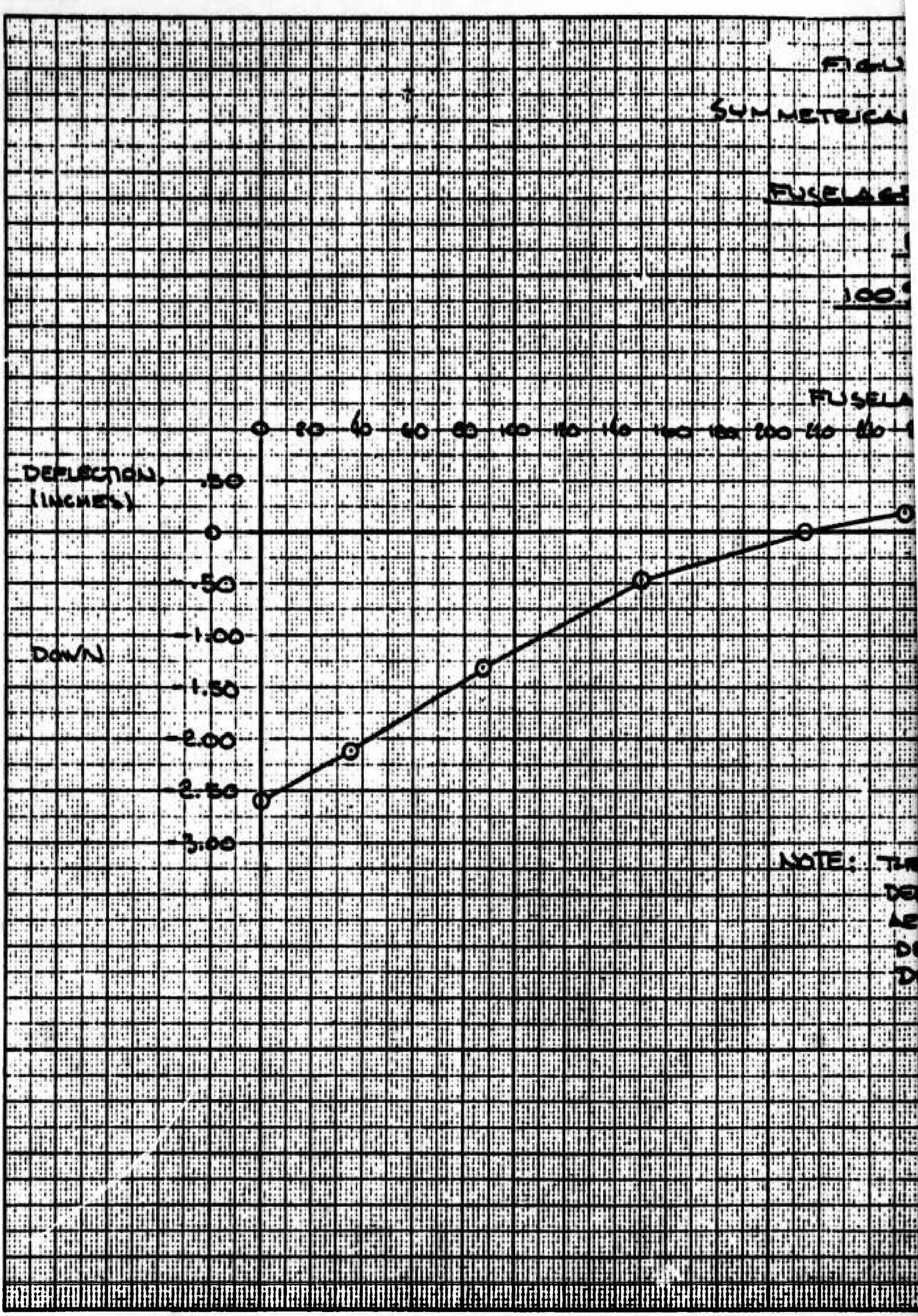
48 through 51 show measured strain versus load, and Figures 52 and 53 show the loading arrangement.

The horizontal stabilizer deflection data taken during Test No. 10 shows that the rear spar deflects approximately 0.6 inches more than the center spar at 100% limit load. An analysis was performed to determine the reason for the relative deflection between spars. It was determined that the following items contribute to the unequal spar deflections:

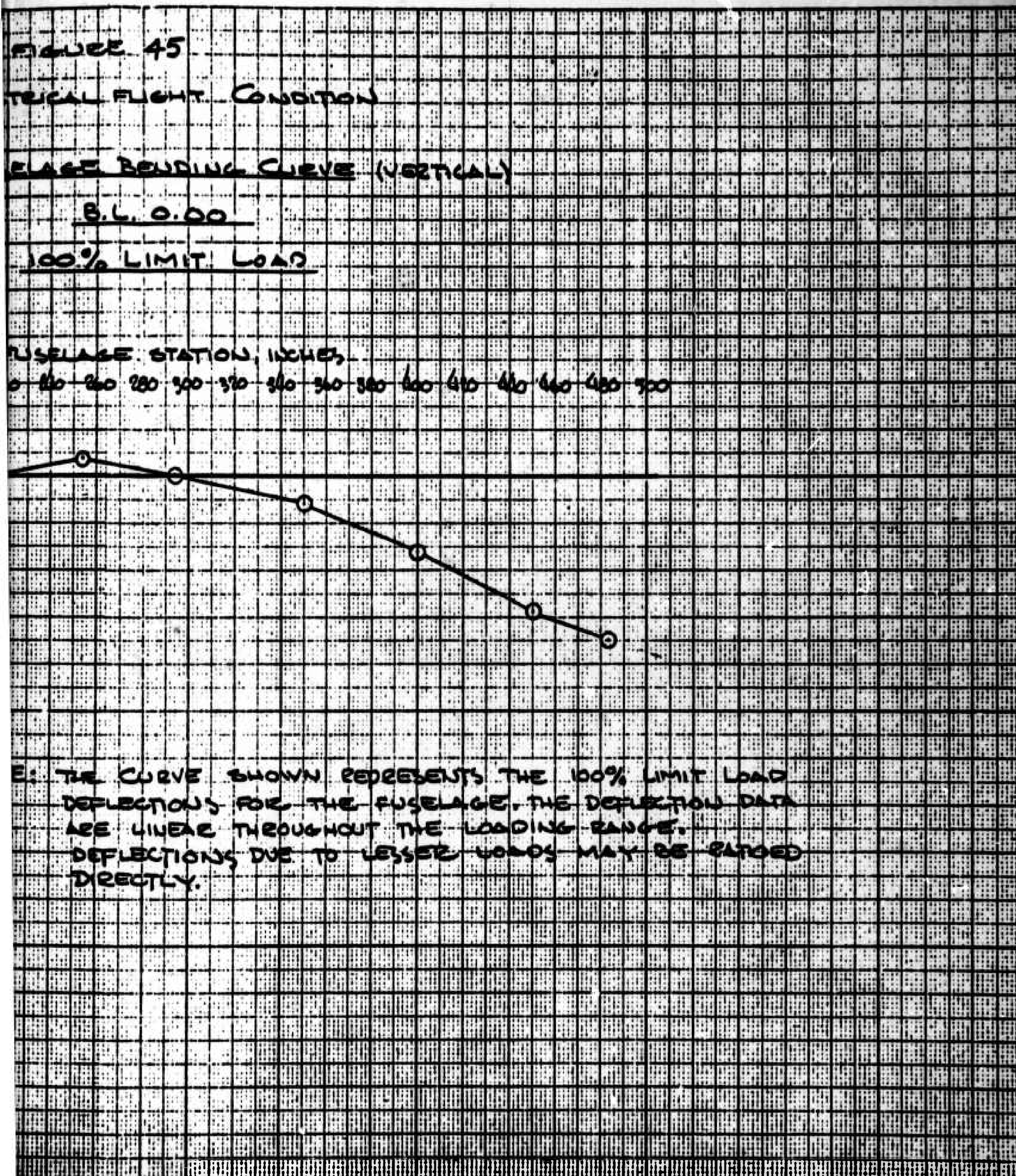
a.	Deflection of root rib (point at rear spar relative to center spar)	.16 in.
b.	Axial deflection of vertical stabilizer front spar (tensile load) and center spar (compressive load) causing horizontal stabilizer to pitch	.18 in.
c.	Pitching of horizontal stabilizer resulting from slope change of fuselage aft end due to fuselage bending	.20 in.
	TOTAL	.54 in.

All of the measured stress values are well below the allowable stresses, and in most cases are less than calculated values. It is believed that the calculated stresses are higher because secondary structure was neglected and more skin is effective at limit load than that calculated for ultimate stress levels.

Space frame strain gages S-509, S-510, S-522 and S-523 show higher than predicted stress levels in the members to which they were applied. The higher readings are believed to be due to induced bending in these members in addition to axial loads. Measured stress levels for this condition are still below critical values, however, and the effect of induced bending on these members is further discussed in the summary of Test No. 15 which produced more critical measured stresses.


FIGU
SYMMETRICAL
FUSELAGE
100
FUSELA
0
20
40
60
80
100
120
140
160
180
200
220
240
DEFLECTION,
(INCHES)
.50
0
-.50
-1.00
DOWN
-1.50
-2.00
-2.50
-3.00
NOTE: TH
DE
AE
DE
D

A


IGURE 45
TICAL FLIGHT CONDITION
ELAGE BENDING CURVE (VERTICAL)
B.L. 0.00
100% LIMIT LOAD
USELAGE STATION, INCHES
0 240 260 280 300 320 340 360 380 400 420 440 460 480 500
E: THE CURVE SHOWN REPRESENTS THE 100% LIMIT LOAD DEFLECTIONS FOR THE FUSELAGE. THE DEFLECTION DATA ARE LINEAR THROUGHOUT THE LOADING RANGE. DEFLECTIONS DUE TO LESSER LOADS MAY BE RATIOED DIRECTLY.

B

FIGURE 46
SYMMETRICAL FLIGHT CONDITION
DOWN BENDING OF CENTER SPAR (F.S. 496)
HORIZONTAL STABILIZER

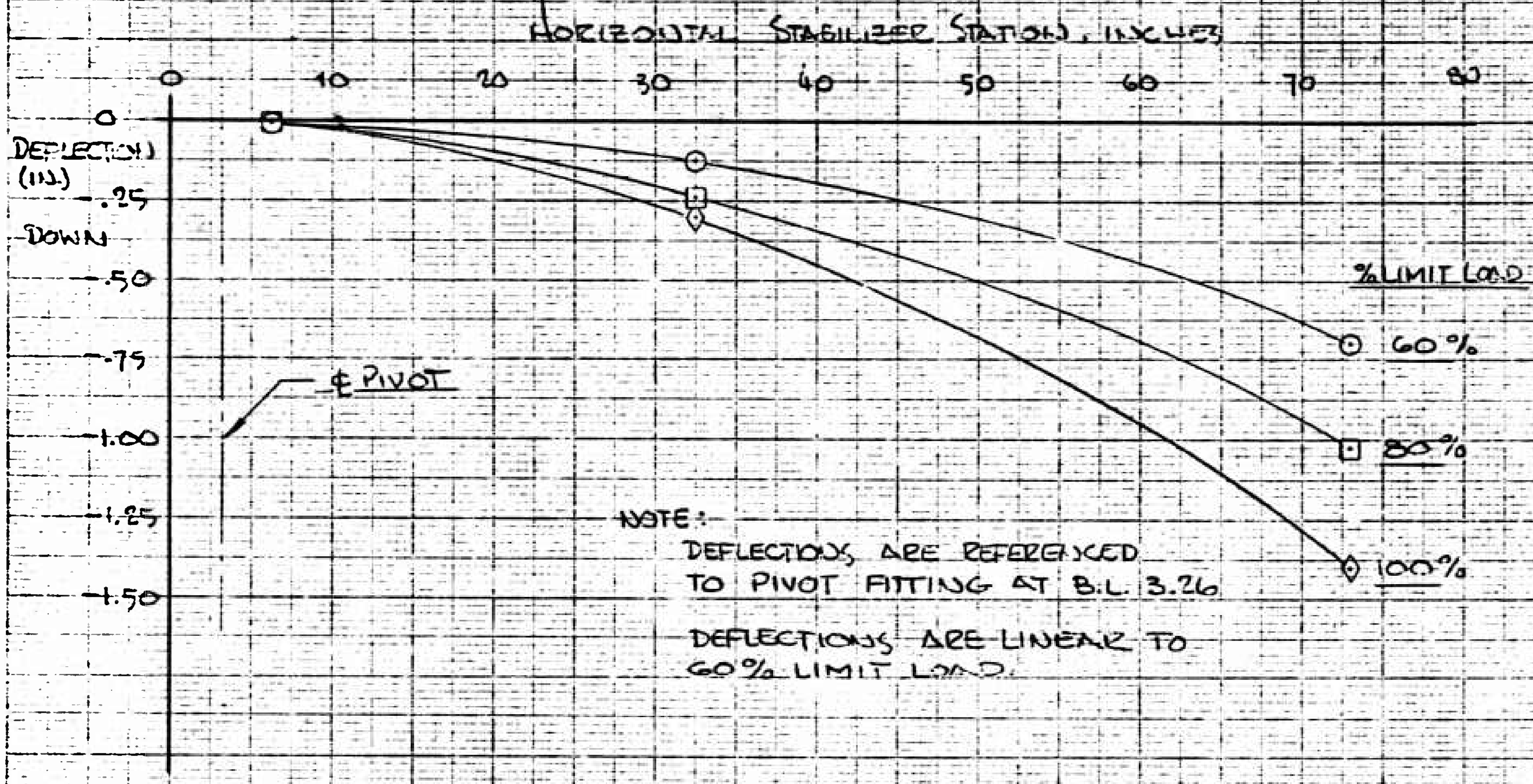
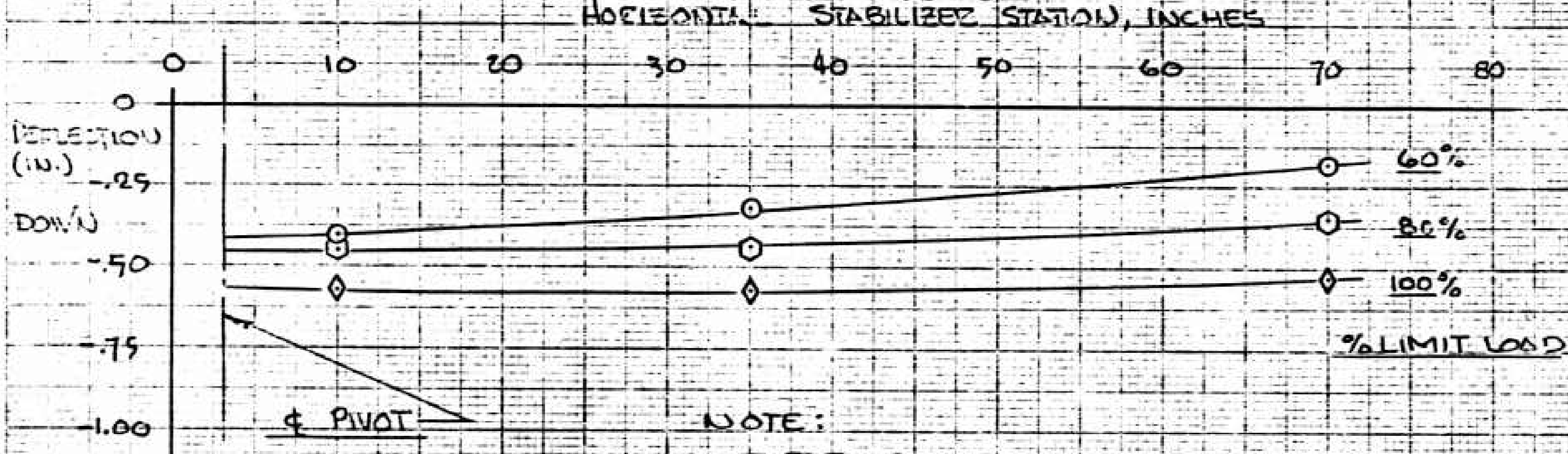


FIGURE 47
SYMMETRICAL FLIGHT CONDITION
DOWN BENDING OF REAR SPAR (F.S. 515)
HORIZONTAL STABILIZER



NOTE:

THESE CURVES ARE REFERENCED TO THE CENTER SPAR AND ARE LINEAR UP TO 60% LIMIT LOAD.

TO FIND DEFLECTION OF REAR SPAR AT STATION 'Y', THE INCREMENT SHOWN IN FIGURE 10-2 AT THE SAME STATION WOULD BE ADDED TO THE DEFLECTION SHOWN ON THIS CURVE.

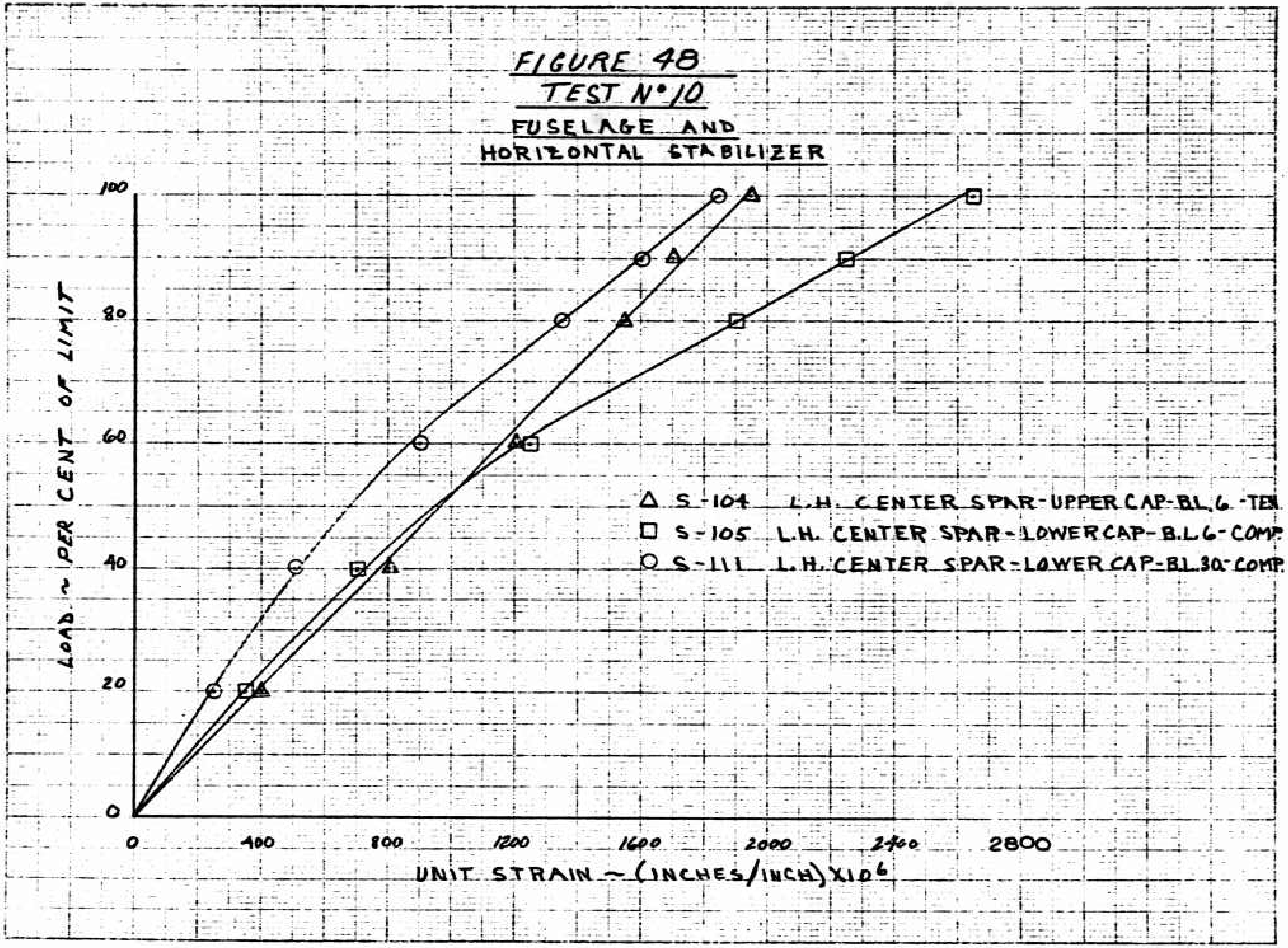


FIGURE 48
TEST N° 10
FUSELAGE AND
HORIZONTAL STABILIZER
△ S-104 L.H. CENTER SPAR-UPPER CAP-BL.6.-TEN.
□ S-105 L.H. CENTER SPAR-LOWER CAP-B.L.6-COMP.
○ S-111 L.H. CENTER SPAR-LOWER CAP-BL.30-COMP.
LOAD ~ PER CENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
2800
UNIT STRAIN ~ (INCHES/INCH) X10⁶

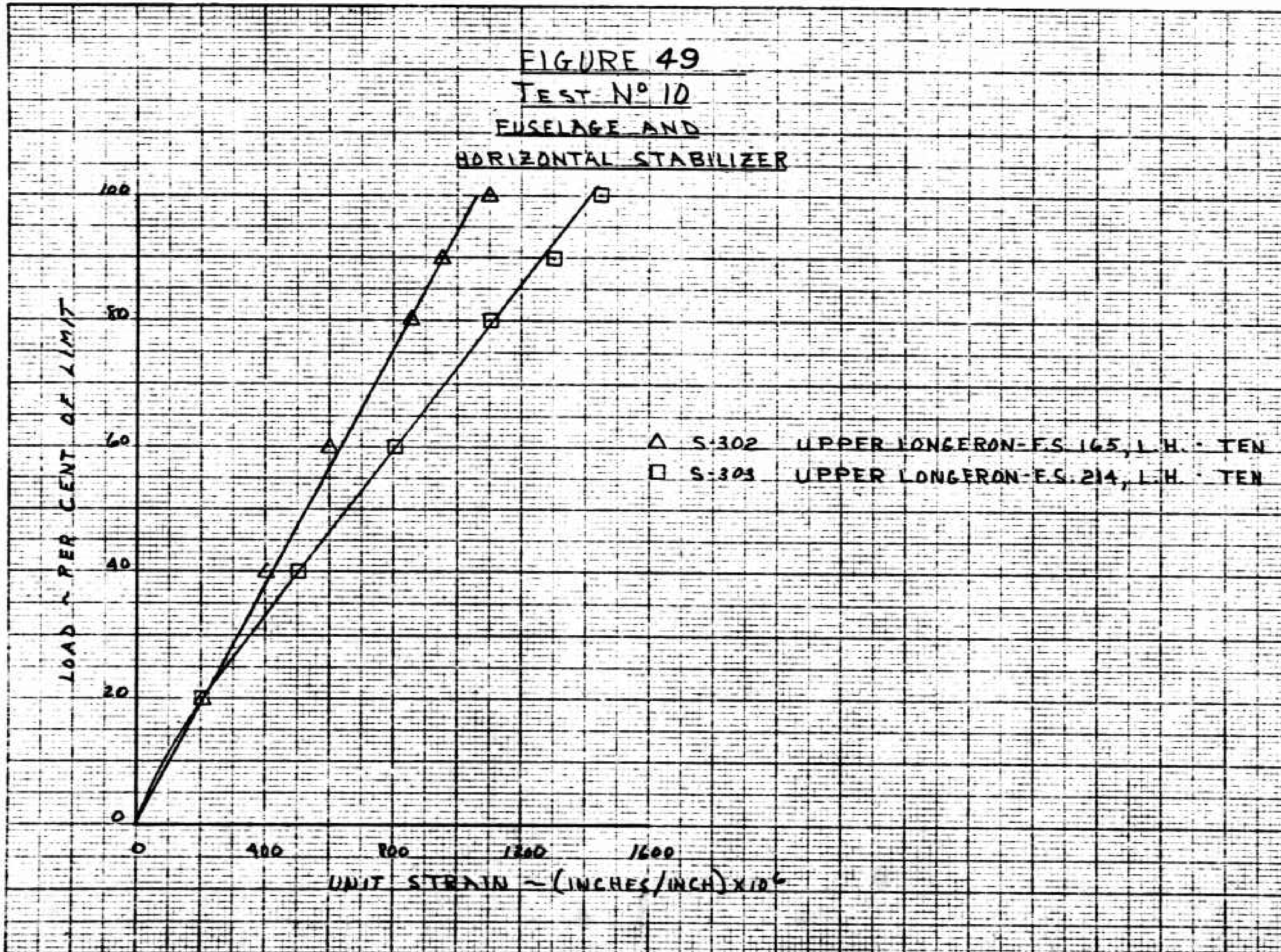


FIGURE 49
TEST N° 10
FUSELAGE AND
HORIZONTAL STABILIZER
100
80
60
40
20
0
0
400
800
1200
1600
LOAD ~ PER CENT OF LIMIT
UNIT STRAIN ~ (INCHES/INCH) x10^6
△ S-302 UPPER LONGERON-F.S. 165, L.H. - TEN
□ S-303 UPPER LONGERON-F.S. 214, L.H. - TEN

FIGURE 50

SYMMETRICAL FLIGHT CONDITION

FUSELAGE STRAIN CURVES

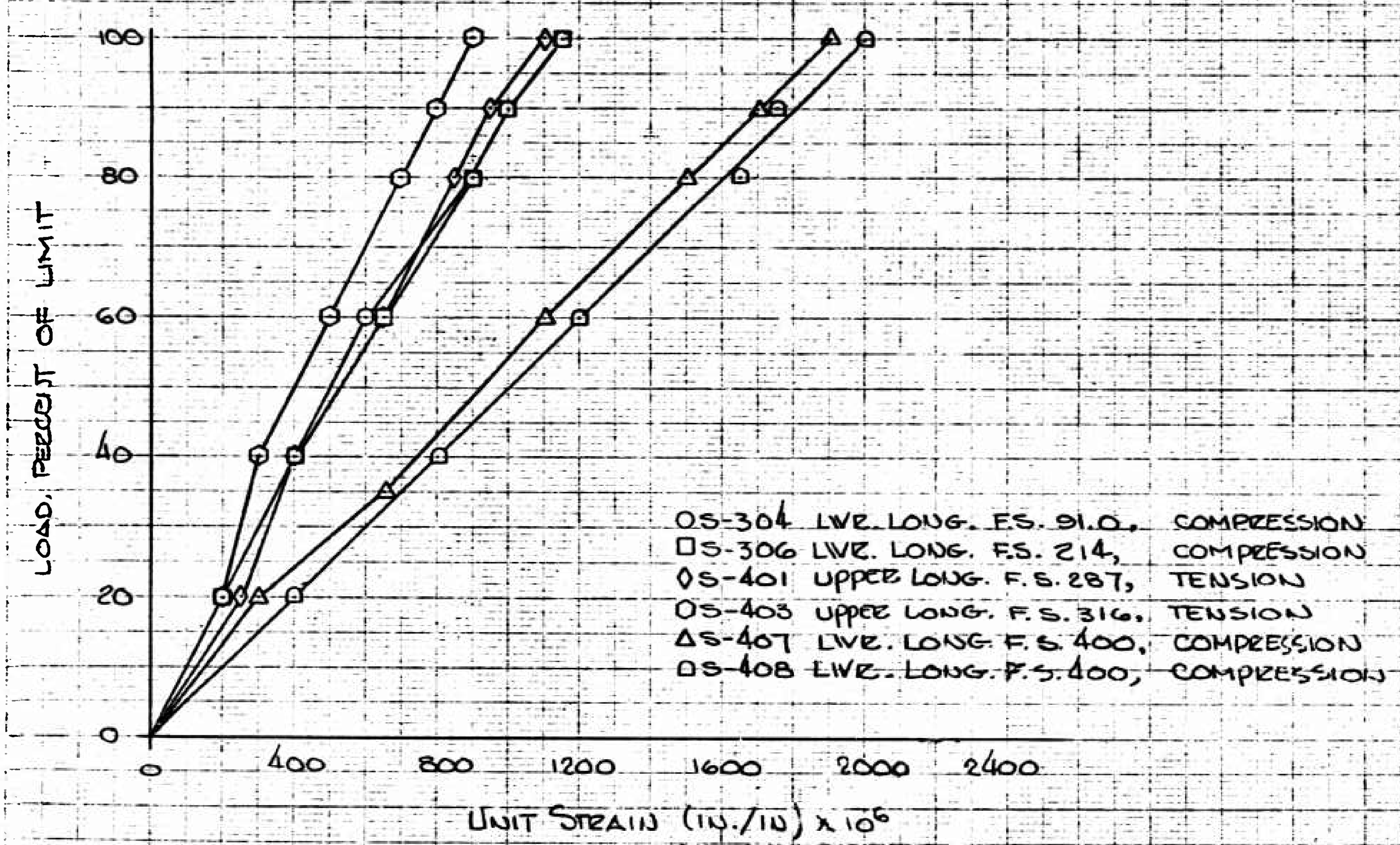
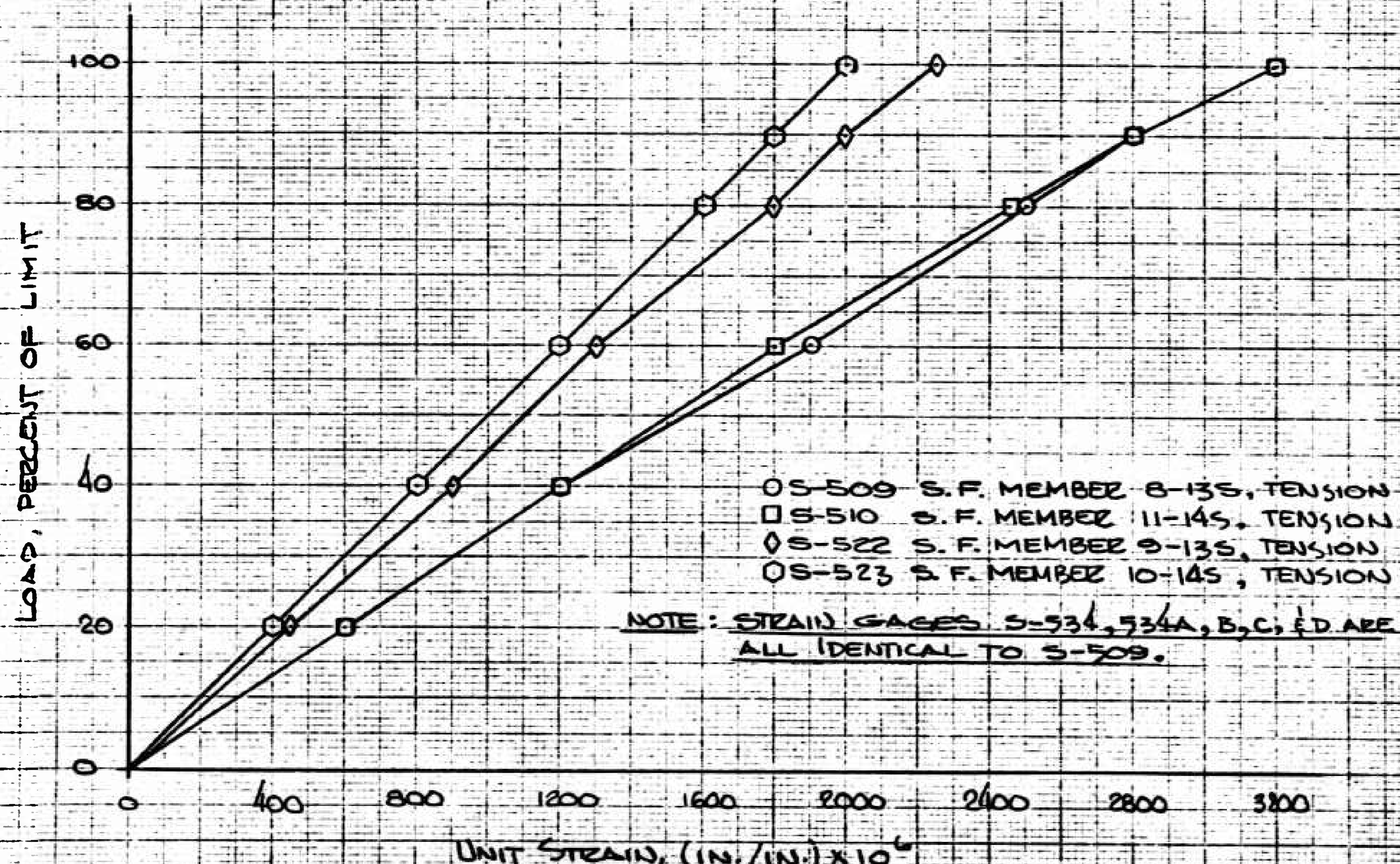


FIGURE 51

SYMMETRICAL FLIGHT CONDITION

SPACE FRAME STRAIN CURVES



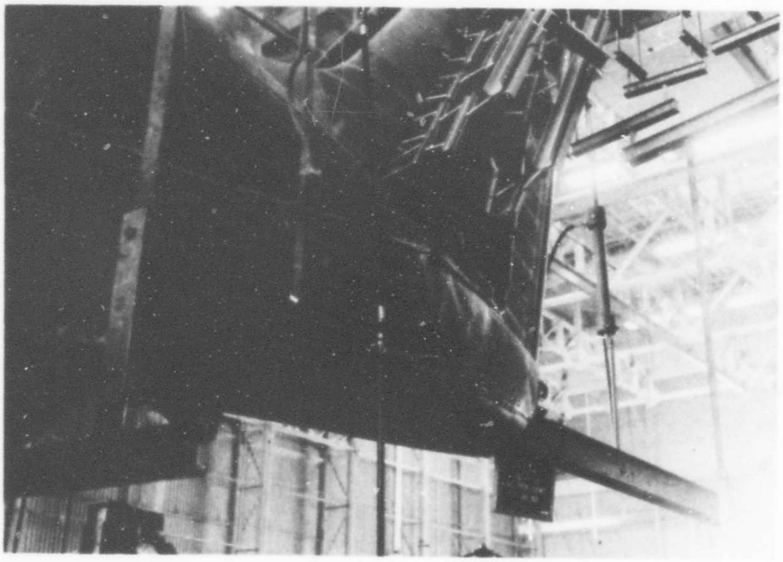


Figure 52 View Showing Aft Fuselage Under 40% Limit Load During Symmetrical Flight Maneuver

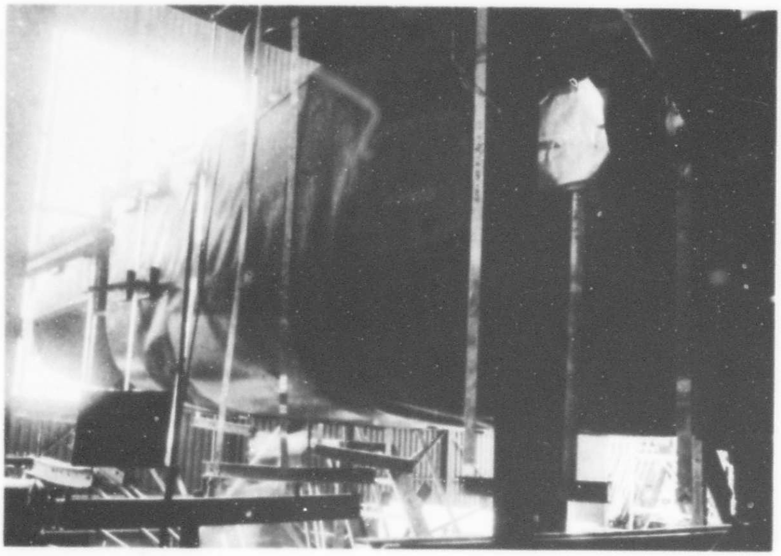


Figure 53 View Looking Toward Left Forward Nose Section Withstanding 100% Limit Load for Symmetrical 4g Maneuver.

3.11 TEST NO. 11 - FUSELAGE, VERTICAL AND HORIZONTAL TAIL - UNSYMMETRICAL FLIGHT

3.11.1 Test Condition

This test simulates the structural loading resulting from the design dynamic overshoot sideslip condition which subjects the structure to both vertical and lateral aerodynamic and inertia loads.

3.11.2 Introduction

The test was conducted and completed according to the procedures outline with the following exceptions:

> Deflection points D-139 and D-141 were moved inboard six inches from original location due to interference with test support bracing.
>
> Deflection point D-144 was moved to the L.H. Horizontal Tail Tip instead of FS 300 W.L. 100 skin.

Additional deflections made:

> D-151 FS 497 W.L. 100 R.S. skin-lateral
>
> D-152 FS 497 W.L. 201 R.S. vertical tail-vertical
>
> D-153 R/H horizontal tail tip-vertical

3.11.3 Summary

Measured downward bending deflection data is plotted in Figure 54 for the 60 and 100% limit load values. The 80 and 100% forward fuselage bending curves are nearly identical, therefore, only the 100% curve is plotted. Side bending curves are shown in Figure 55. In both cases, the bending curves were linear below the 60% load level and are not shown. Deflections are referenced to the jig mount points and are corrected for jig movement under load. Strain measurements that exceeded 1000μ'' are shown in Figures 56 through 59; the strain readings not shown were below 1000μ''. Figures 60 through 63 show the loading arrangement.

All of the measured stress values are well below the allowable stresses, and in most cases are less than calculated values. It is believed that the calculated stresses are higher because secondary structure was neglected and more skin is effective at limit load than that calculated for ultimate stress levels.

The strains in space frame members 8-13, 9-13, 10-14 and 11-14 as measured by gages S-509, S-522, S-523 and S-510 are higher than calculated values. This is caused by induced bending in these members and is explained more fully in the summary of Test No. 15 which produced more critical stress levels in the same members.

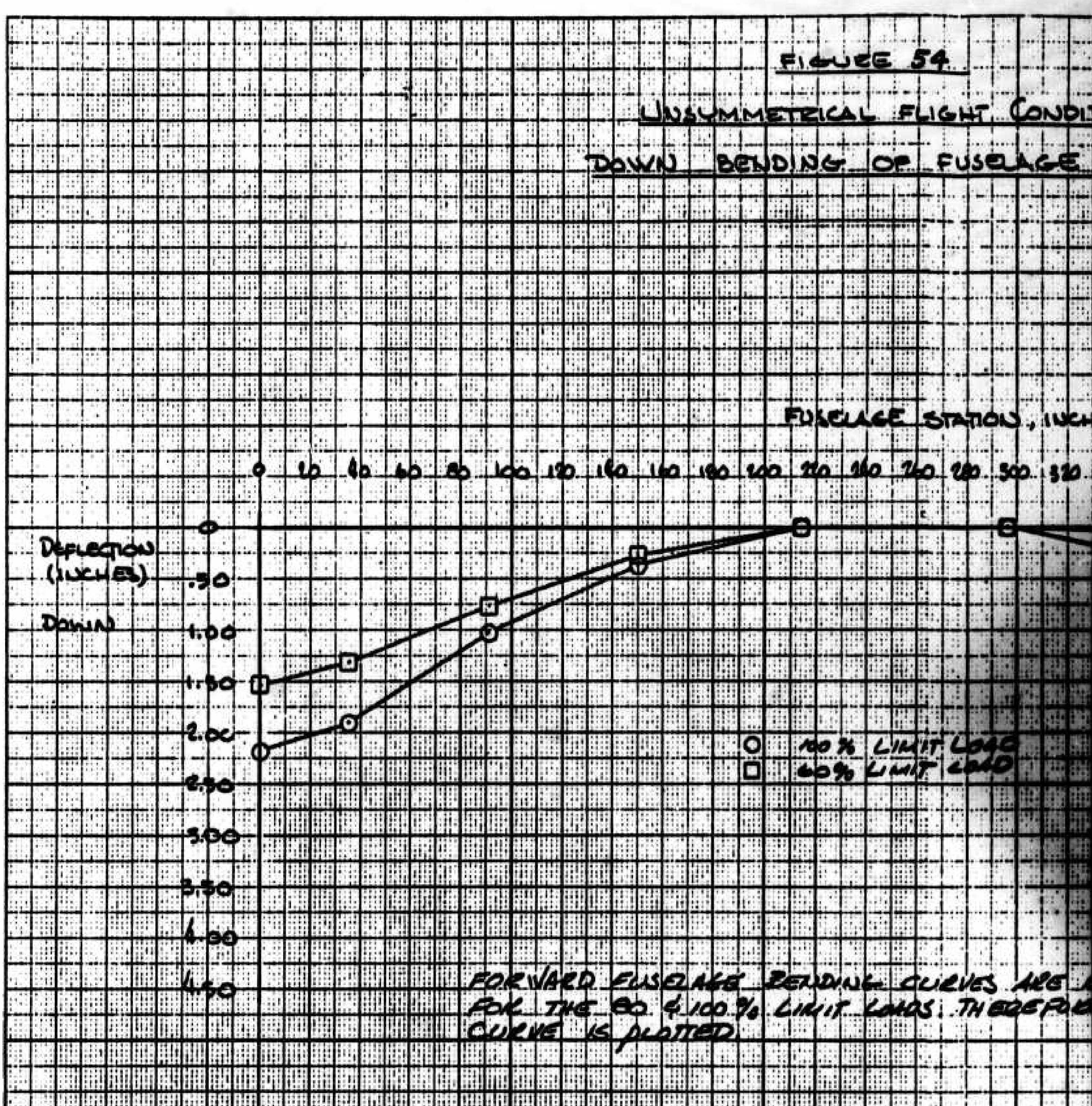
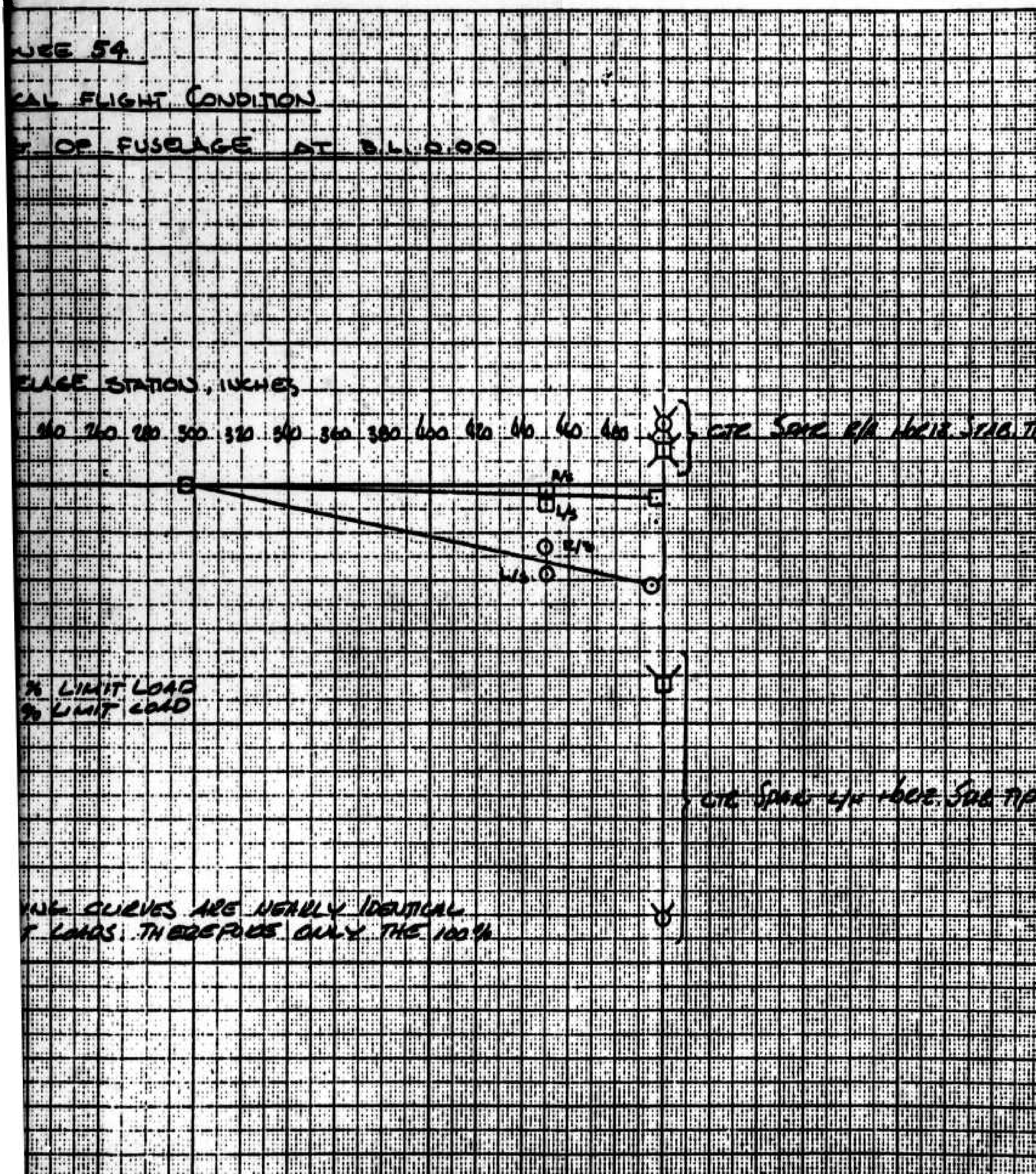


FIGURE 54
UNSYMMETRICAL FLIGHT CONDI
DOWN BENDING OF FUSELAGE
FUSELAGE STATION, INCH
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
DEFLECTION (INCHES) DOWN
0
.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
100% LIMIT LOAD
60% LIMIT LOAD
FORWARD FUSELAGE BENDING CURVES ARE
FOR THE 80 & 100% LIMIT LOADS. THEREFO
CURVE IS PLOTTED.

A


NCE 54
CAL FLIGHT CONDITION
T OF FUSELAGE AT B.L. 0.00
ELAGE STATION, INCHES
240 260 280 300 320 340 360 380 400 420 440 460 480
CTR SPAR R/H HORIZ STAB TIP
R/S
L/S
R/S
L/S
% LIMIT LOAD
% LIMIT LOAD
CTR SPAR L/H HORIZ STAB TIP
ING CURVES ARE NEARLY IDENTICAL
T LOADS. THEREFORE ONLY THE 100%

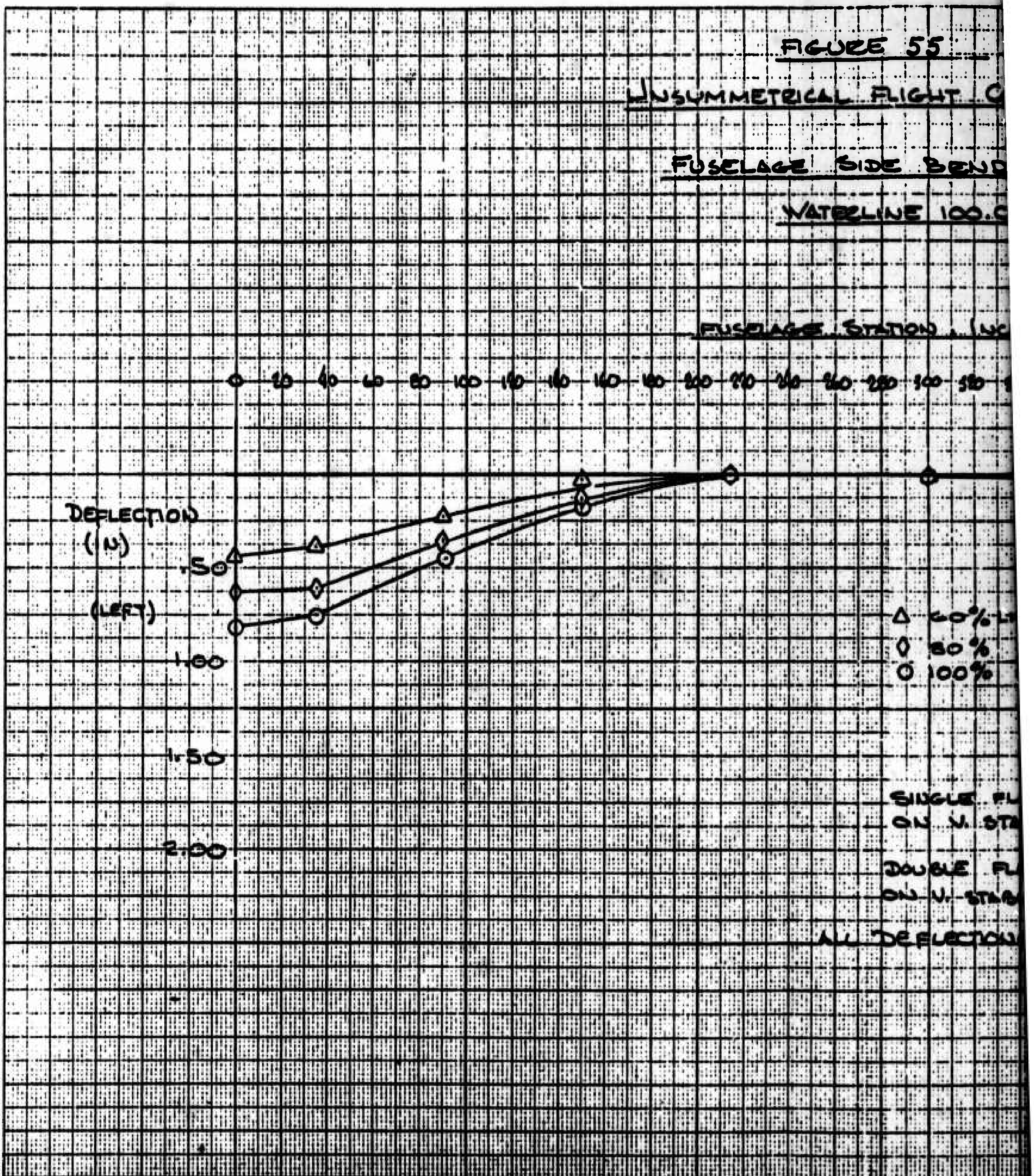


FIGURE 55
UNSUMMETRICAL FLIGHT C
FUSELAGE SIDE BEND
WATERLINE 100.C
FUSELAGE STATION, (INC
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
DEFLECTION
(IN)
(LEFT)
.50
1.00
1.50
2.00
Δ 60%
◊ 80%
O 100%
SINGLE FL
ON V. STA
DOUBLE FL
ON V. STAB
ALL DEFLECTION

A

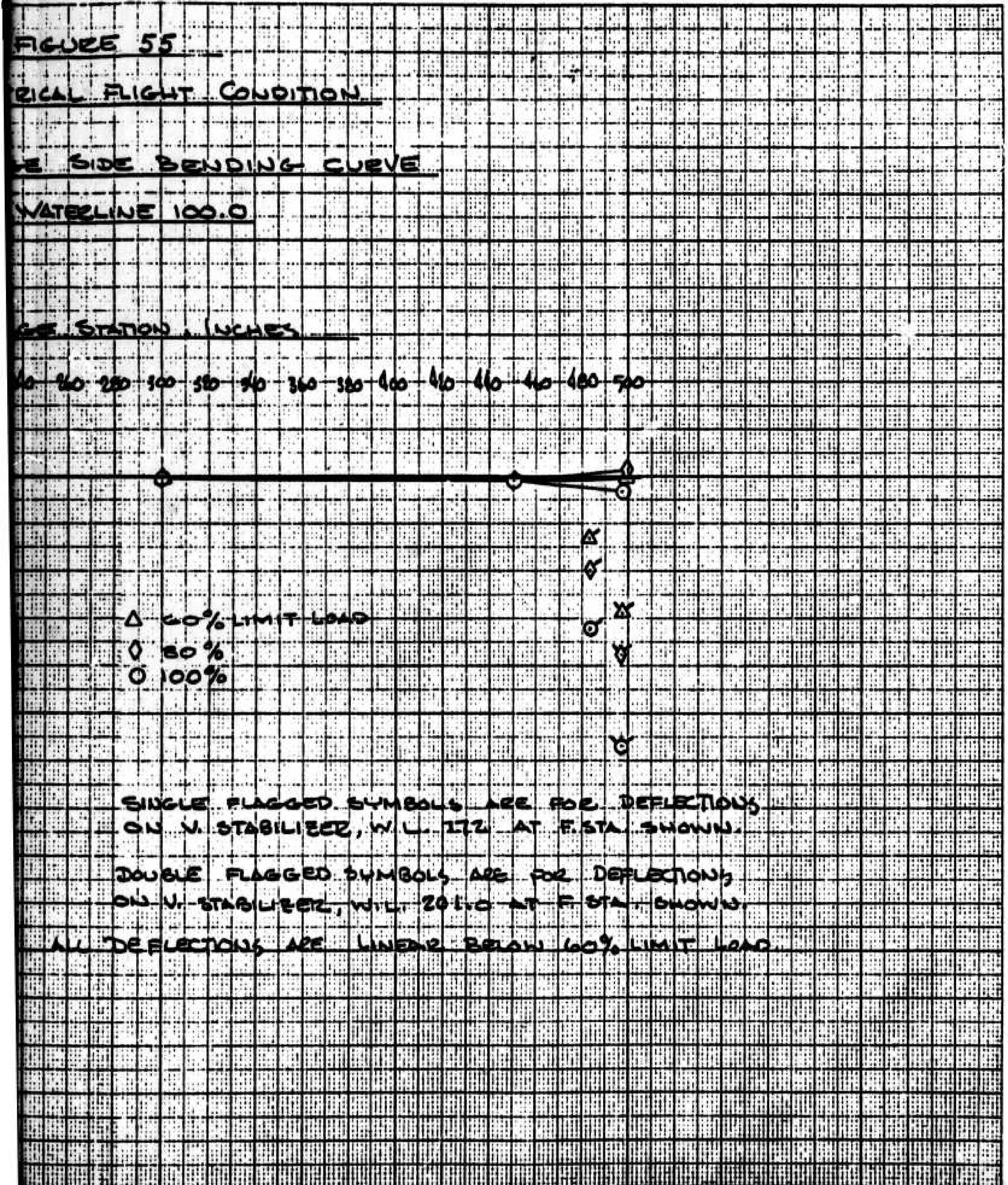


FIGURE 55
RICAL FLIGHT CONDITION
E SIDE BENDING CURVE
WATERLINE 100.0
GE STATION, INCHES
260 280 300 320 340 360 380 400 420 440 460 480 500
Δ 60% LIMIT LOAD
◊ 80%
○ 100%
SINGLE FLAGGED SYMBOLS ARE FOR DEFLECTIONS ON V. STABILIZER, W.L. 172 AT F. STA. SHOWN.
DOUBLE FLAGGED SYMBOLS ARE FOR DEFLECTIONS ON V. STABILIZER, W.L. 201.0 AT F. STA. SHOWN.
ALL DEFLECTIONS ARE LINEAR BELOW 60% LIMIT LOAD.

}

B

FIGURE 56

UNSYMMETRICAL FLIGHT CONDITION

SPACE FRAME STRAIN CURVES

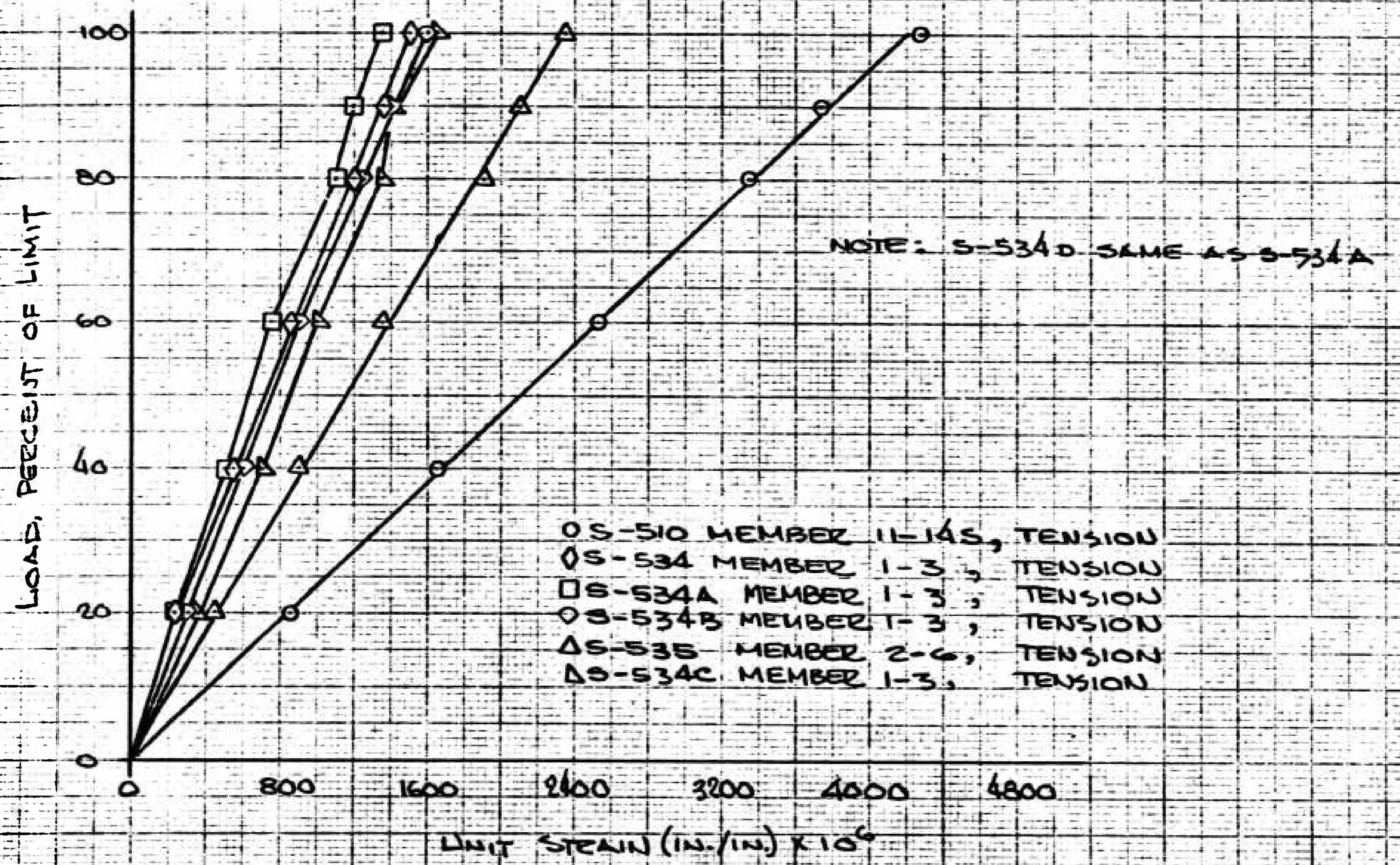


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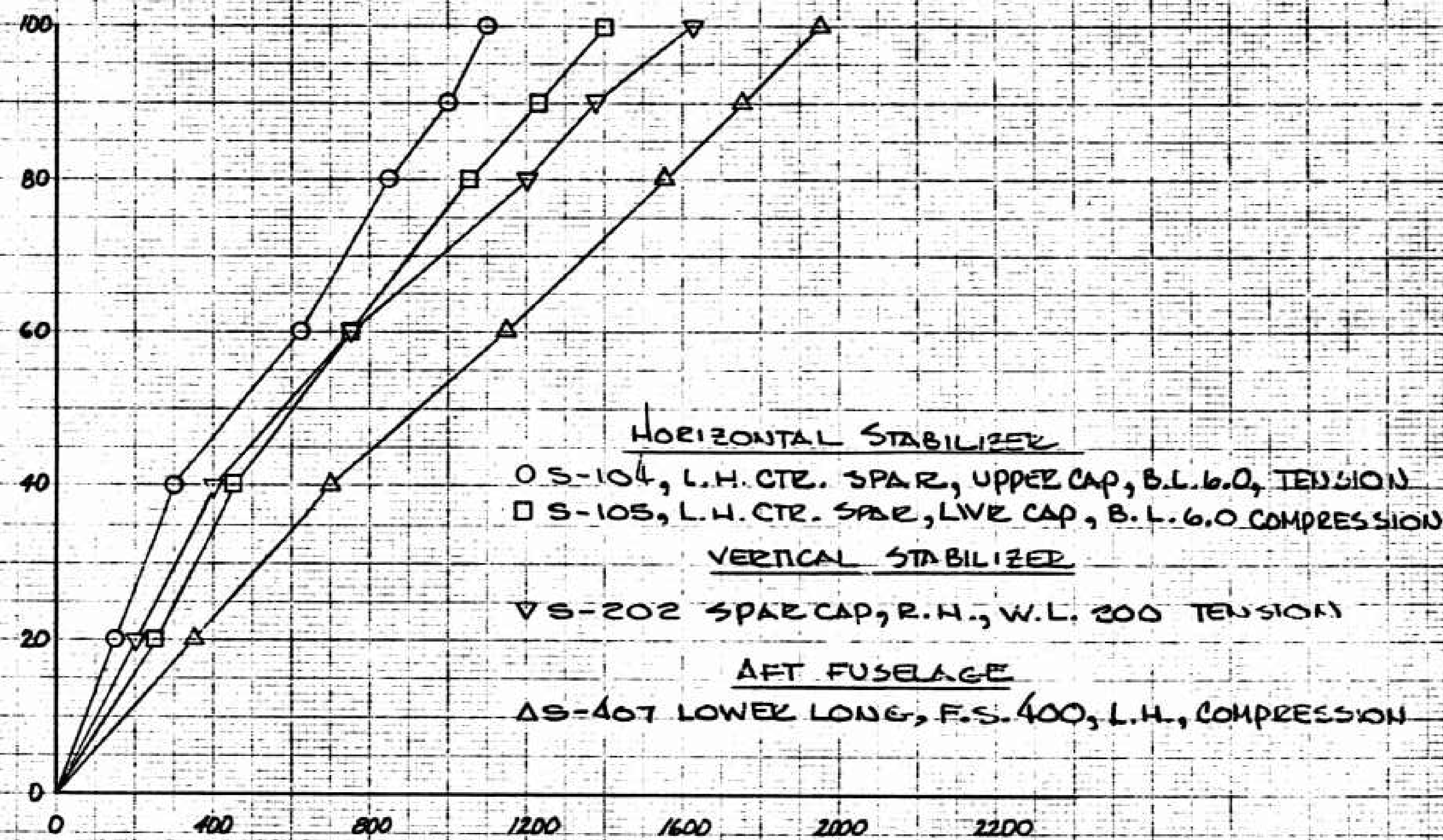
FIGURE 57

UNSYMMETRICAL FLIGHT CONDITION

STRAIN CURVES



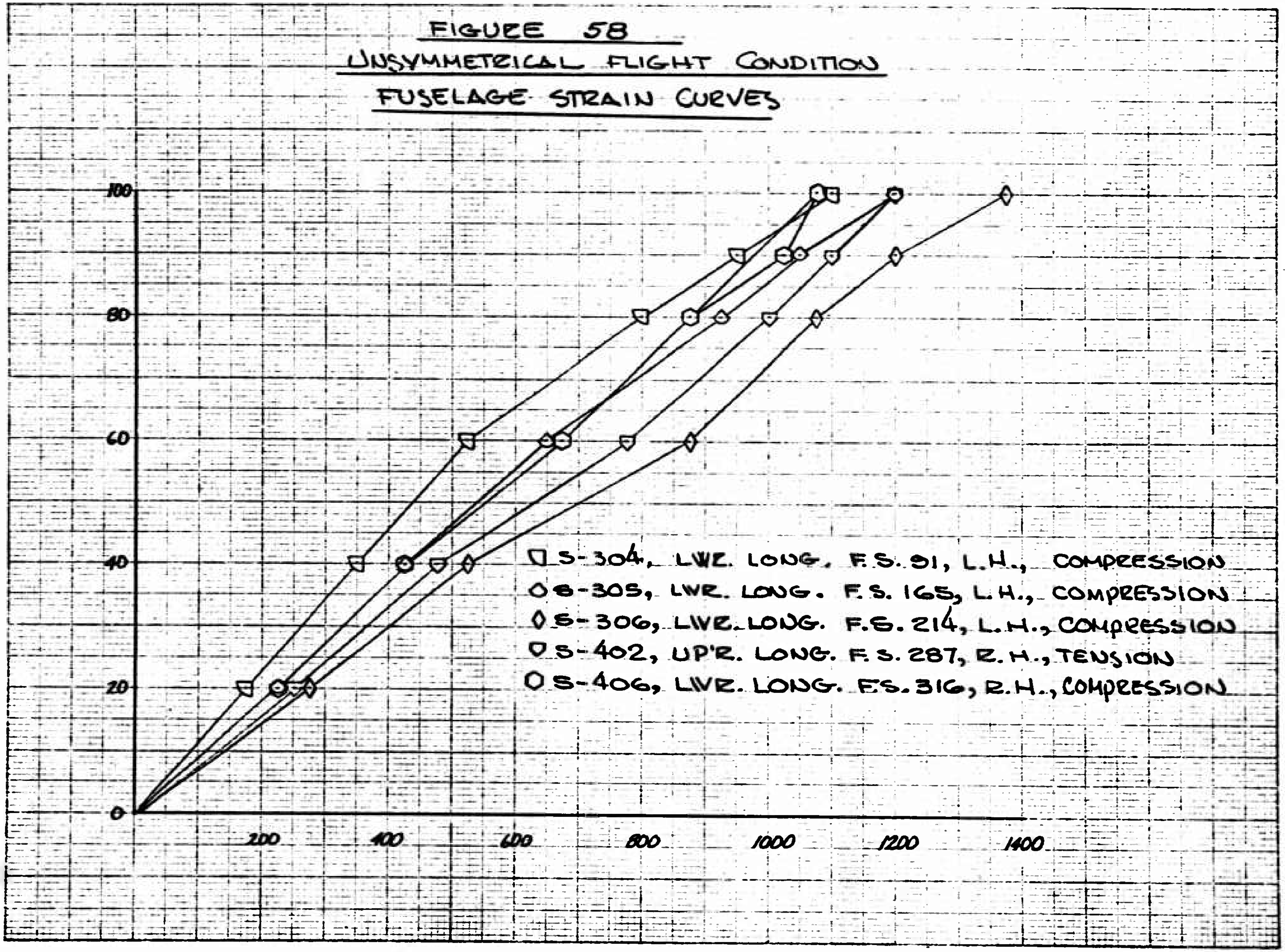
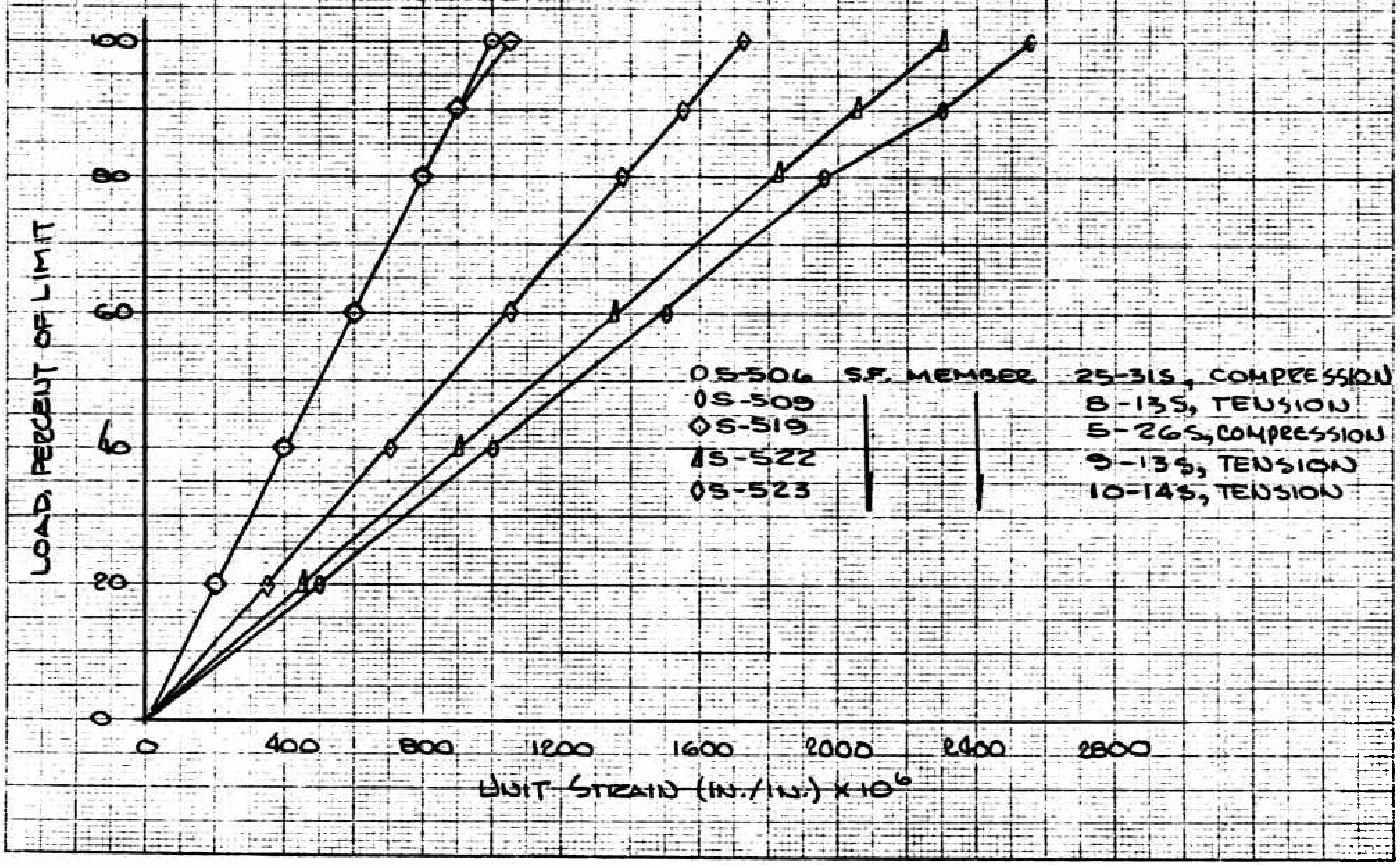


FIGURE 58
UNSYMMETRICAL FLIGHT CONDITION
FUSELAGE STRAIN CURVES
100
80
60
40
20
0
200
400
600
800
1000
1200
1400
S-304, LWR. LONG. F.S. 91, L.H., COMPRESSION
S-305, LWR. LONG. F.S. 165, L.H., COMPRESSION
S-306, LWR. LONG. F.S. 214, L.H., COMPRESSION
S-402, UP'R. LONG. F.S. 287, R.H., TENSION
S-406, LWR. LONG. F.S. 316, R.H., COMPRESSION

FIGURE 59

UNSYMMETRICAL FLIGHT CONDITION

SPACE FRAME STRAIN CURVES



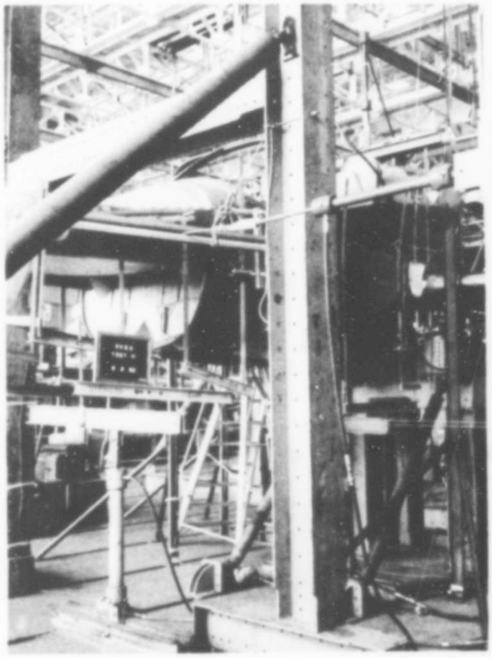


Figure 60
View Showing Forward Fuselage Loading During Simulated Unsymmetric Flight

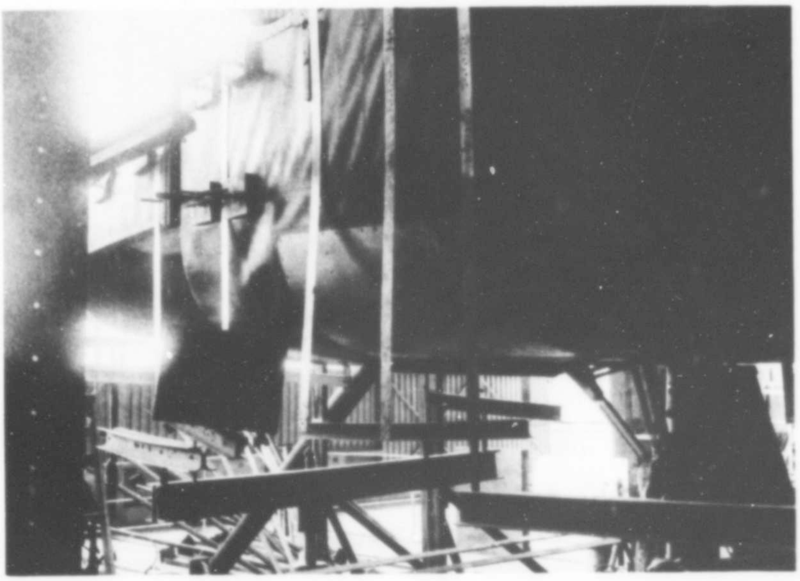


Figure 61 View of Left Forward Side of Fuselage Withstanding 100% Limit Load Due to Unsymmetrical Flight

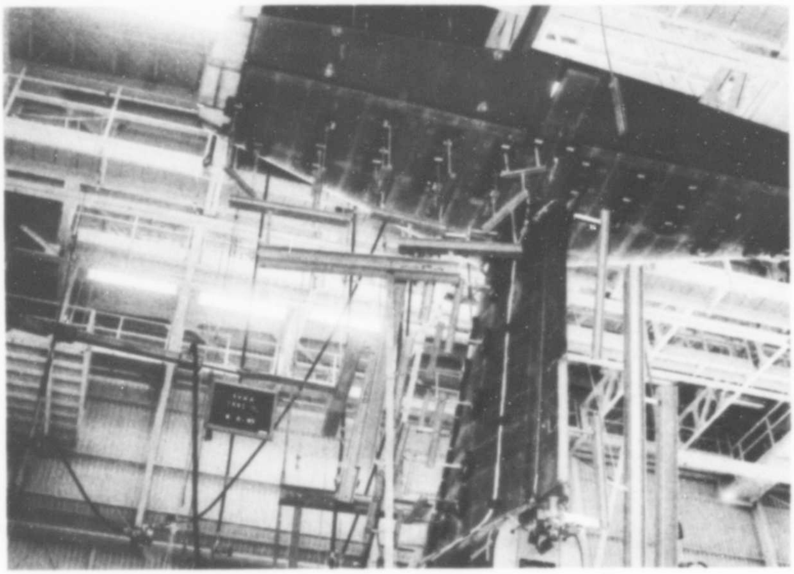


Figure 62 View Showing Aft Vertical and Side Whiffletree Loading Arrangement

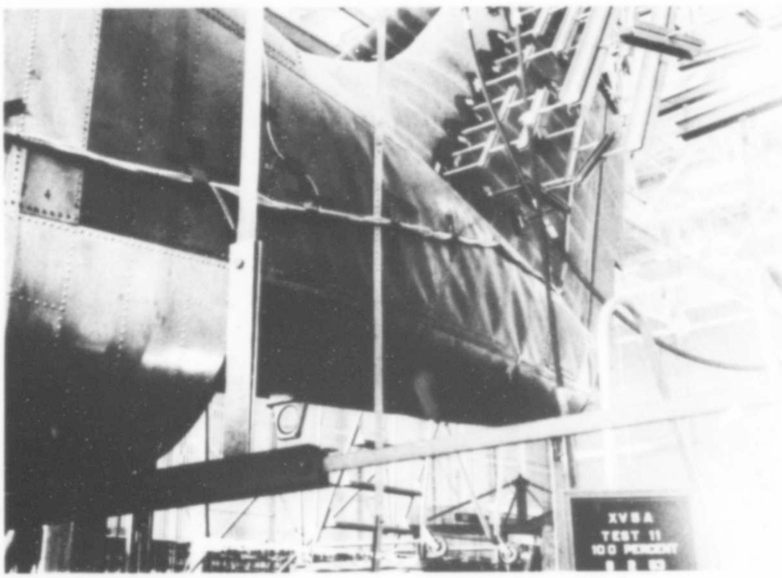


Figure 63 View Showing Aft Fuselage Section Withstanding 100% Limit Load During Simulated Unsymmetrical Flight

3.12 TEST NO. 12 - ENGINE MOUNTS AND SPACE FRAME

3.12.1 Test Condition

Rolling Pull Out

3.12.2 Introduction

This test represents critical loads for the engine mount fittings and supporting tubular structure. The test was conducted according to the test procedures outline with the following exceptions:

> Deflection points D-161 and D-165 were located on the left side instead of the right.

3.12.3 Summary

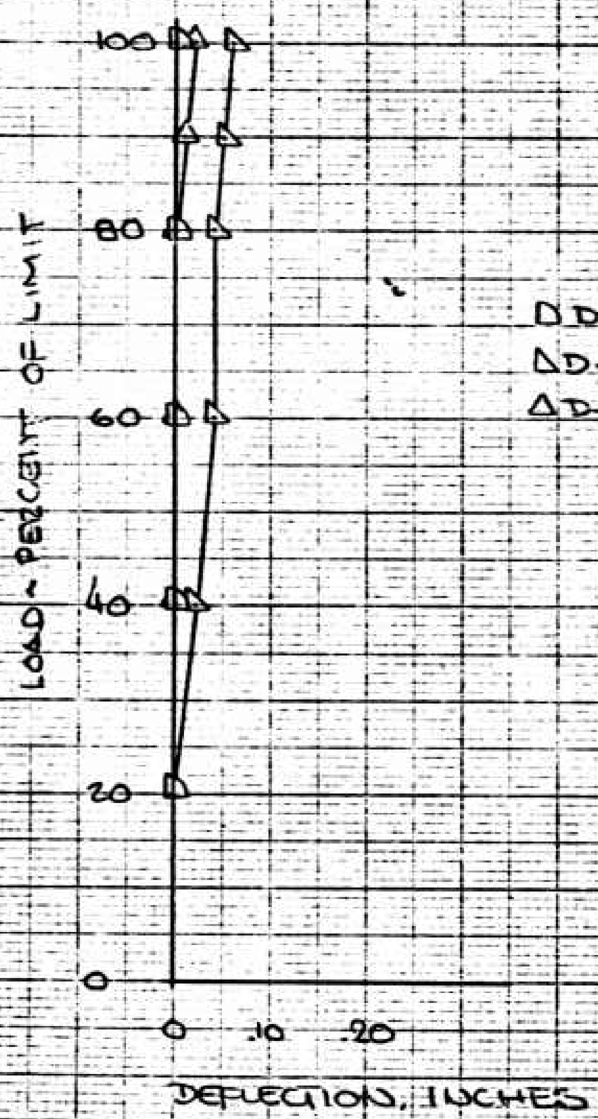
Deflection measurements were recorded and plotted in Figure 64. The longitudinal measurements in the space frame area are referenced to bulkhead 214. Figures 65 and 66 show the loading arrangement.

Maximum strain measured was S-520 reading 360 μ", therefore no strain plots are shown.

FIGURE 64

ENGINE MOUNTS - ROLLING PULLOUT

LONGITUDINAL DEFLECTIONS



□ D-163, F.S. 257.0, B.L. 24 R, W.L. 145
△ D-164, F.S. 257.0, B.L. 2.4 L, W.L. 145
△ D-165, F.S. 257.0, B.L. 20.5 L, W.L. 145

DEFLECTIONS ARE REFERENCED TO BULKHEAD 210.0

INSTRUMENTATION ACCURACY: ±.020

NO PERMANENT SET NOTED WITHIN INSTRUMENTATION ACCURACY

NO VERTICAL DEFLECTIONS NOTED WITHIN INSTRUMENTATION ACCURACY (D-160, 161, & 162)

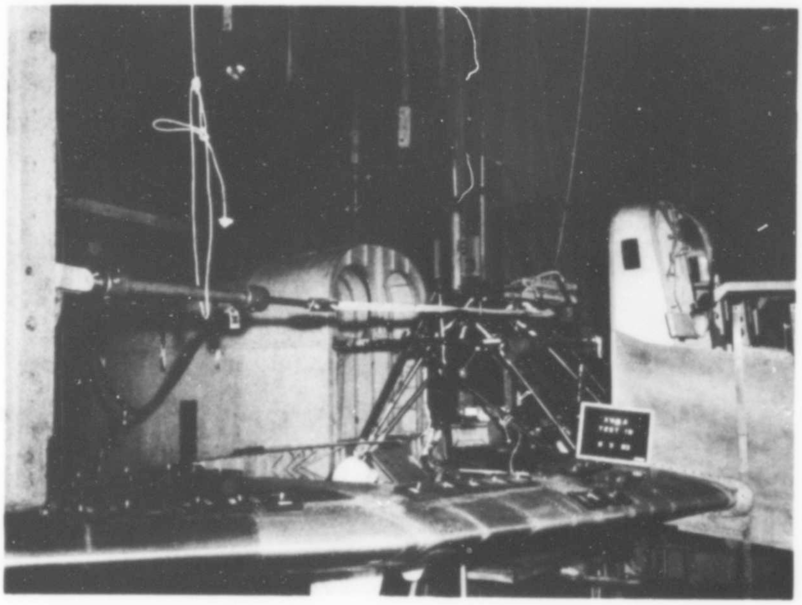


Figure 65 View of Loading Cylinders During Simulated Rolling Pull Out.

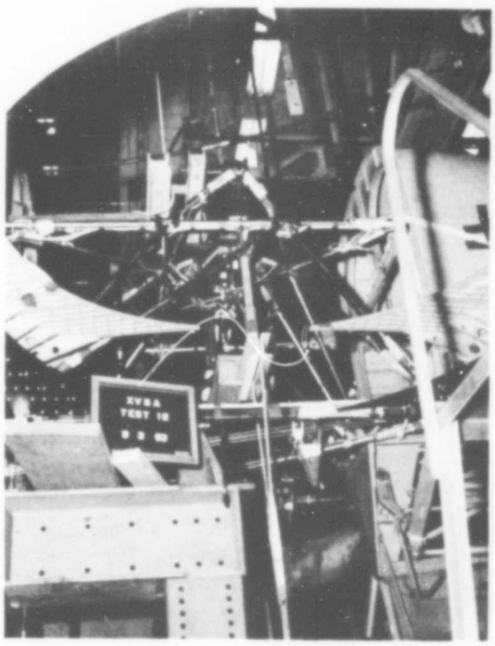


Figure 66
View Showing Down Load Arrangement During Simulated Rolling Pull Out Maneuver

3.13 TEST NO. 13 - ENGINE MOUNTS AND SPACE FRAME

3.13.1 Test Condition

Hovering Flight

3.13.2 Introduction

This test is very similar to Test No. 12 except loads are varied somewhat in magnitude and direction to correspond to the above test condition. The test was completed according to the test procedures outline with the following exception:

> Deflection points D-161 and D-165 were located on the left side instead of the right.

3.13.3 Summary

Measured deflections of the main engine mount were, in all cases, less than that which could be measured with any degree of reliability. Instrumentation accuracies were ± .020 inches.

Strain measurements versus load are plotted in Figure 67. Only S-530 and S-531 were plotted as these exceeded 1000 μ". Figures 68 and 69 show the loading arrangement.

Strain gages S-530 and S-531 were applied to the outboard fibers of members 3-17 and 8-17 where maximum bending strain was measured in addition to member axial strain. Measured strain of 1200 $(10)^{-6}$ inches/inch in member 8-17 is equivalent to a stress level of $1200(10)^{-6}$ $(27)(10)^6$ = 32,400 psi (comp.). This compares with a calculated stress as shown below.

$$\left.\begin{array}{l} M = 2820''\# \\ P_c = -2000\# \end{array}\right\} \text{Ref. Report No. 144 Volume II}$$

$$\left.\begin{array}{l} A = .3982 \text{ in}^2 \\ I = .0841 \text{ in}^4 \\ C_c = .6158 \end{array}\right\} \text{@ Gage Cross-section}$$

$$f_{b_c} = \frac{2820(.6158)}{.0841} = 20,648 \text{ psi}$$

$$f_c = \frac{2000}{.3982} = 5023 \text{ psi}$$

$$\Sigma\ f_c = 25,671 \text{ psi}$$

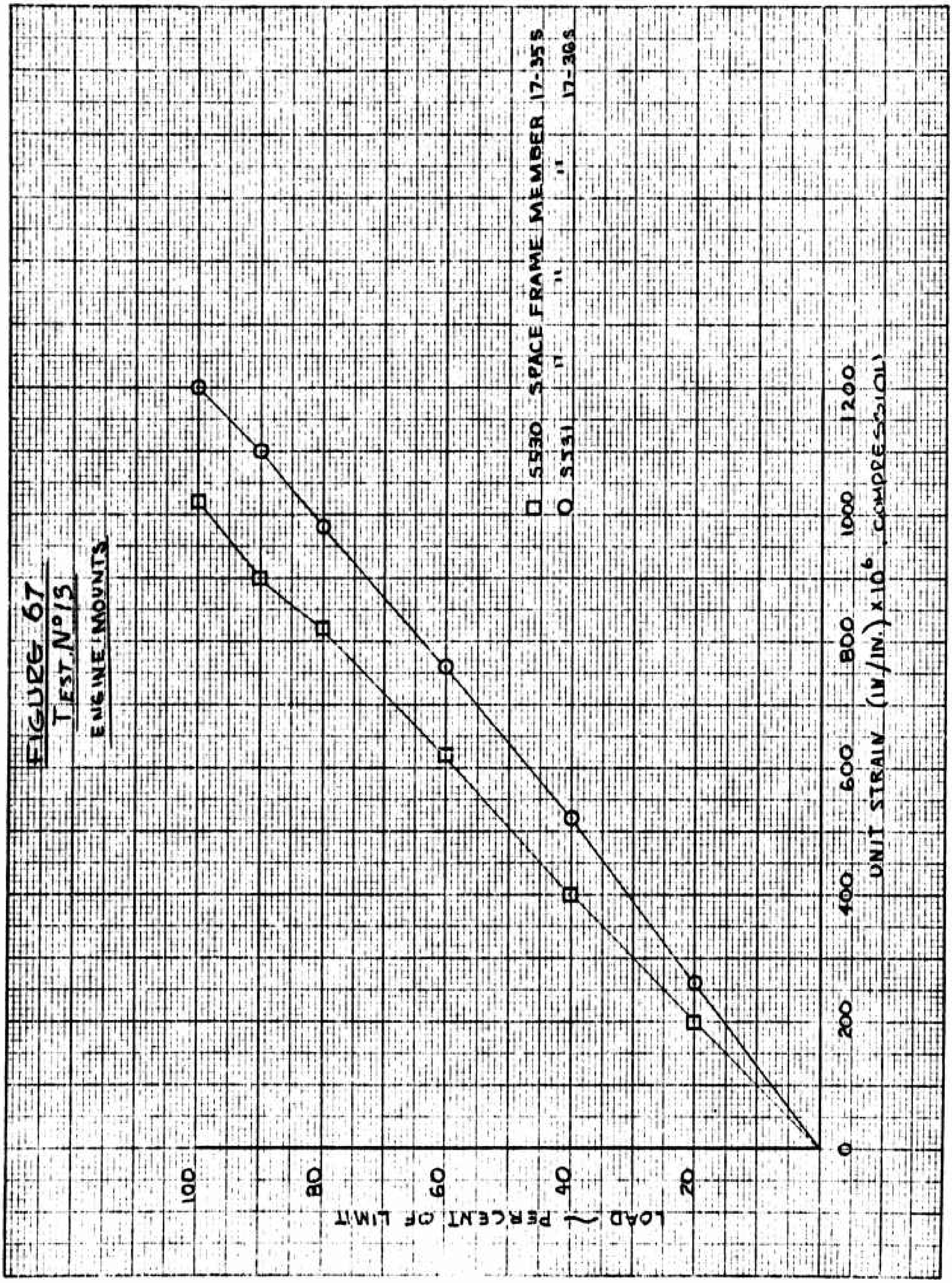


FIGURE 67
TEST No 15
ENGINE MOUNTS
□ S530 SPACE FRAME MEMBER 17-35S
○ S531 " " " 17-36S
LOAD ~ PERCENT OF LIMIT
100
80
60
40
20
0
200
400
600
800
1000
1200
UNIT STRAIN (IN./IN.) x10⁶ COMPRESSION

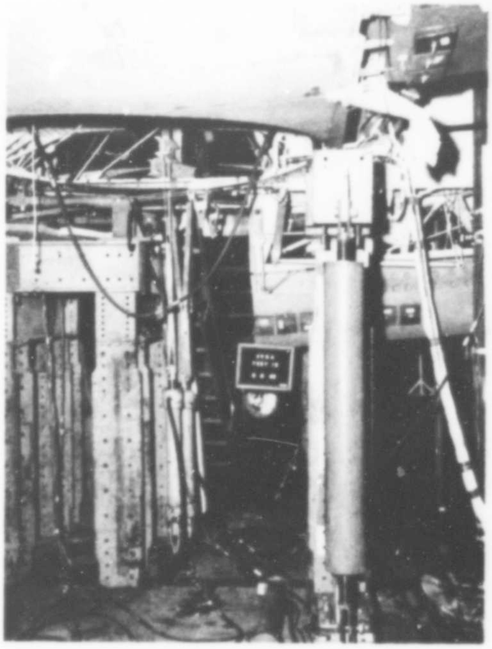


Figure 68
Bottom View of Loading Arrangement of Engine Mounts During Hover Tests

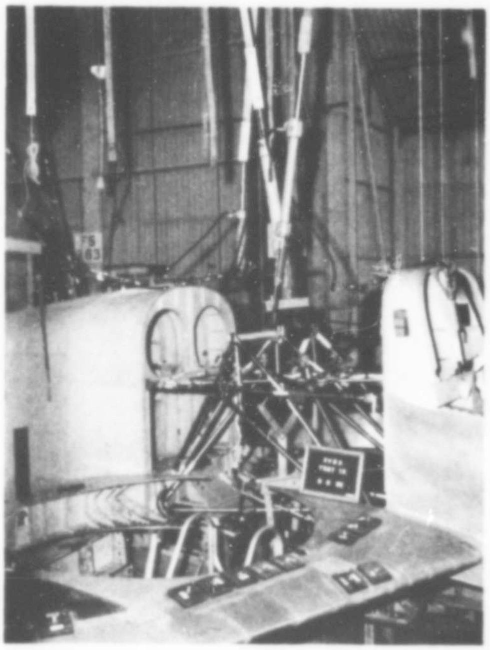


Figure 69
Top View of Engine Mounts During Hover Test

3.14 TEST NO. 14 - WINDSHIELD

3.14.1 Test Condition

High Speed Flight q = 850 psf, 5° Sideslip

3.14.2 Introduction

The windshield was tested to limit load to simulate the above critical condition according to the procedures outline.

3.14.3 Summary

As indicated in Figures 70 and 71, a sudden yielding began to set in at the 40% load point for D-187 and D-188 and at the 60% load point for D-186. Failure of the windshield occurred just as the deflection due to 70% load was locked on the gages. Figures 72 and 73 show the loading arrangement. Figure 74 shows the deflection encountered and Figure 75 shows the failed windshield.

The premature yielding at 40% limit load and the subsequent rupture at 70% limit load occurred on the right hand side of the windshield underneath compression pads. These compression pads, which were used to simulate positive pressure, tend to concentrate load at the corners as deflection of a panel takes place. The distribution which results, then, causes much higher localized stresses than those due to evenly-distributed flight pressures. For this reason the test was a conservative simulation of actual high-speed flight conditions.

Examination of the test results showed that a conservative analytical approach could be used for redesign, thus avoiding the time and expense of additional static testing.

This approach was to consider the right hand side of the windshield as a plate subjected to bending. From the results of the test the allowable bending stress of the plexiglas 55 was found as a function of running moment. This allowable stress was based on the original thickness of .25 inch. The revised limit applied stress was then calculated for a thickness of 7/16 or .437 inch. Since this thickness resulted in a calculated margin of safety of 22%, it was considered more than adequate for the new windshield, which was then constructed from 7/16 inch plexiglas 55. The following is a summary of calculations:

Let M = the applied running moment, $\frac{\text{in.-lb.}}{\text{in.}}$, on the critical cross-section at 100% limit load.

The allowable yield moment then would be .40 M, since yielding of the panel began at 40% limit load.

The allowable yield stress = $.40M/Z_1$, where Z_1 = the running section modulus based on the original thickness of 1/4 inch.

$Z_1 = (.25)^2/6 = .0104 \text{ in.}^3/\text{in.}$ and the allowable yield stress =

$\frac{.40M}{.0104} = 38.46 \text{ M}$

The limit applied stress for the redesigned windshield = $\frac{M}{Z_2}$, where

Z_2 = the running section modulus based on a 7/16 inch thickness.

$Z_2 = (.437)^2/6 = .0318 \text{ in.}^3/\text{in.}$

Limit stress on the redesigned windshield = $\frac{M}{.0318} = 31.45 \text{ M}$

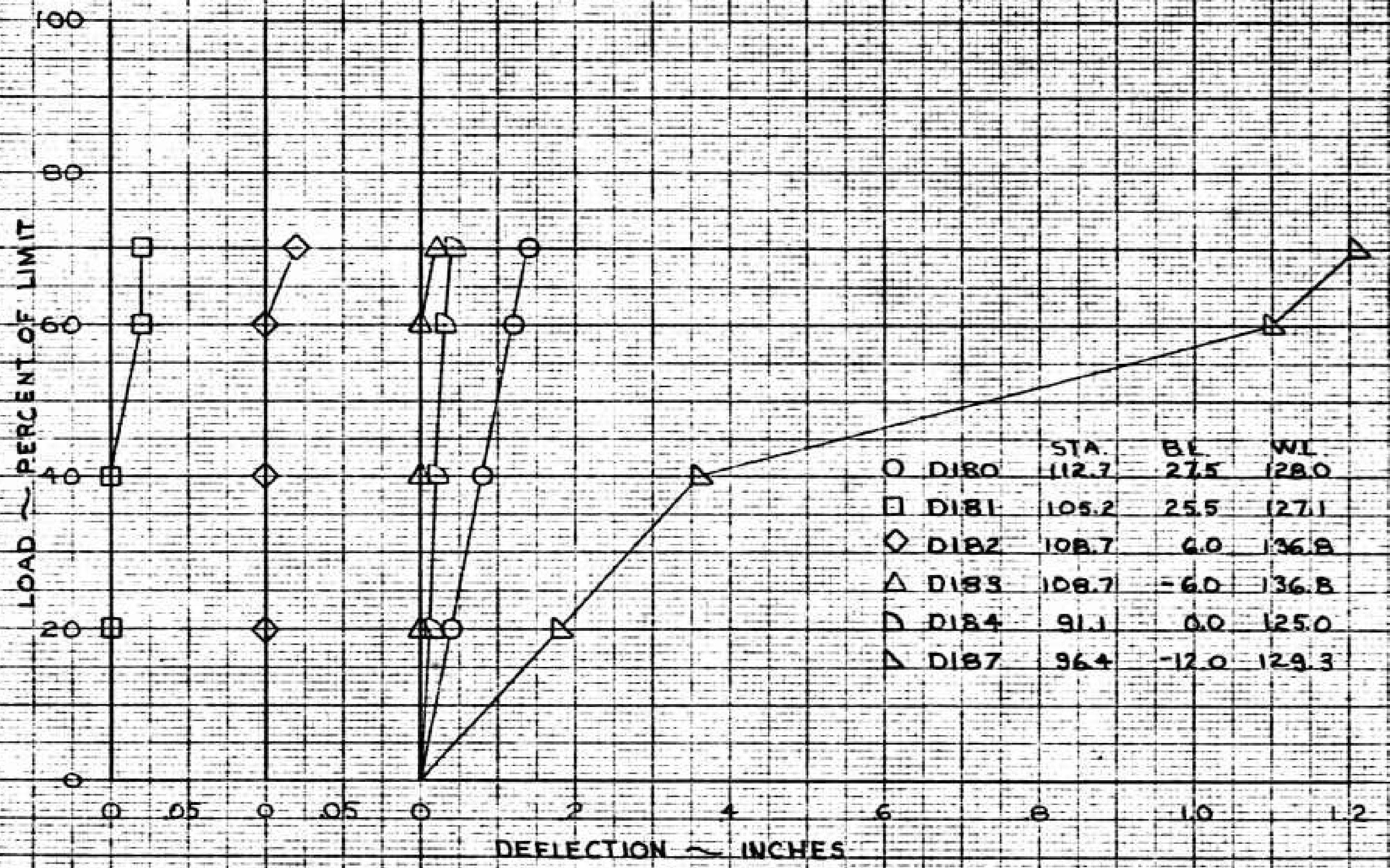
and the margin of safety on a yield basis

$$= \frac{38.46 \text{ M}}{31.45 \text{ M}} - 1 = \underline{\underline{.22}}$$

In a similar way, the margin of safety on an ultimate basis would be:

$$\frac{.70M/.0104}{1.5\ (31.45 \text{ M})} - 1 = \frac{67.31 \text{ M}}{47.18 \text{ M}} - 1 = \underline{\underline{.43}}$$

FIG-70
TEST N°14
WINDSHIELD



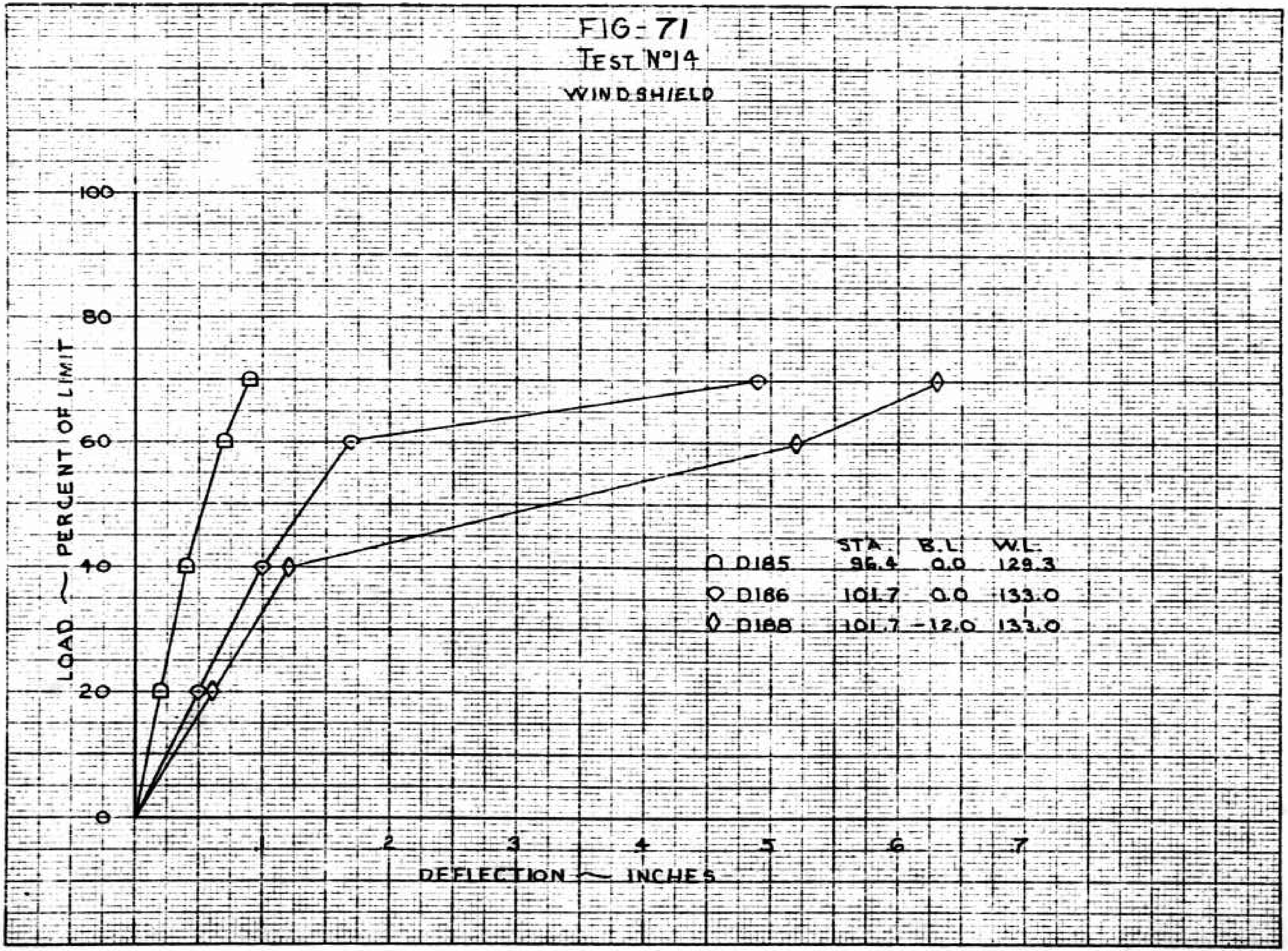


FIG- 71
TEST No 14
WINDSHIELD
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
DEFLECTION ~ INCHES
1
2
3
4
5
6
7
STA. B.L. W.L.
D185 96.4 0.0 129.3
D186 101.7 0.0 133.0
D188 101.7 -12.0 133.0

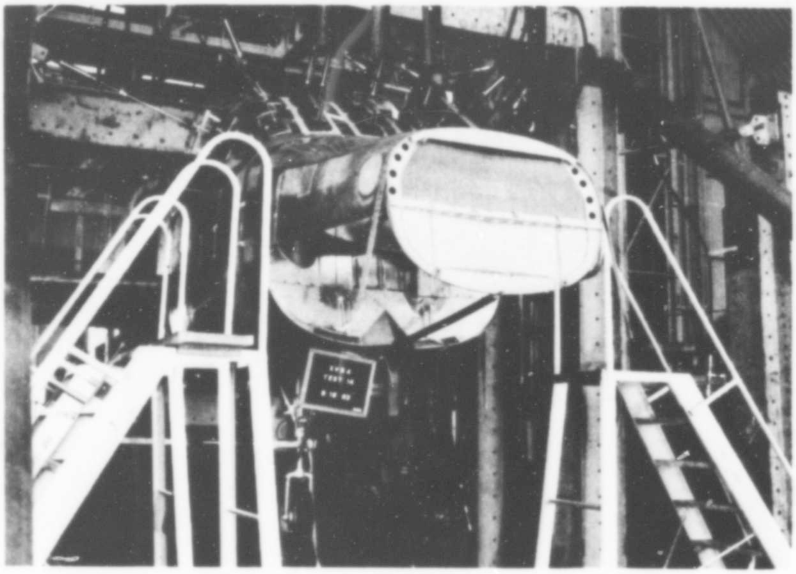


Figure 72 View Showing General Arrangement of Support and Whiffletree Loading Layout for Windshield Test Representing High Speed Flight with 5° Sideslip

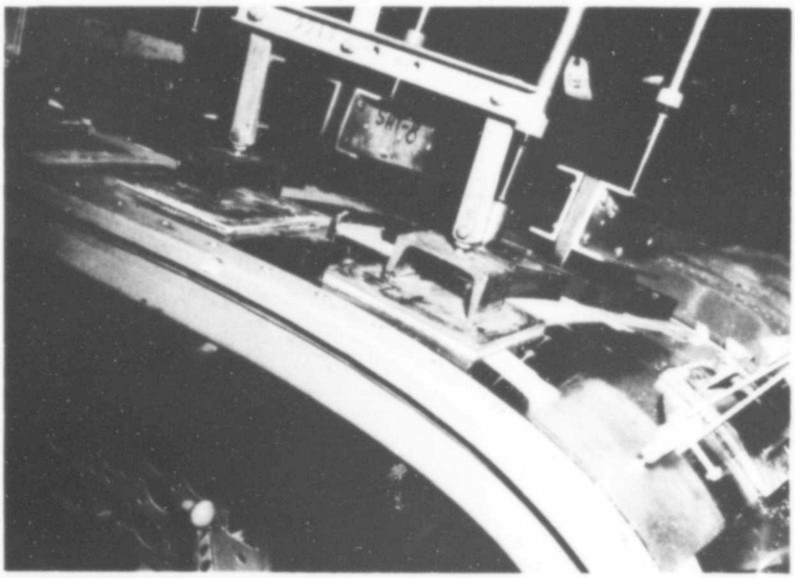


Figure 73 Closeup of Compression Whiffletree Arrangement

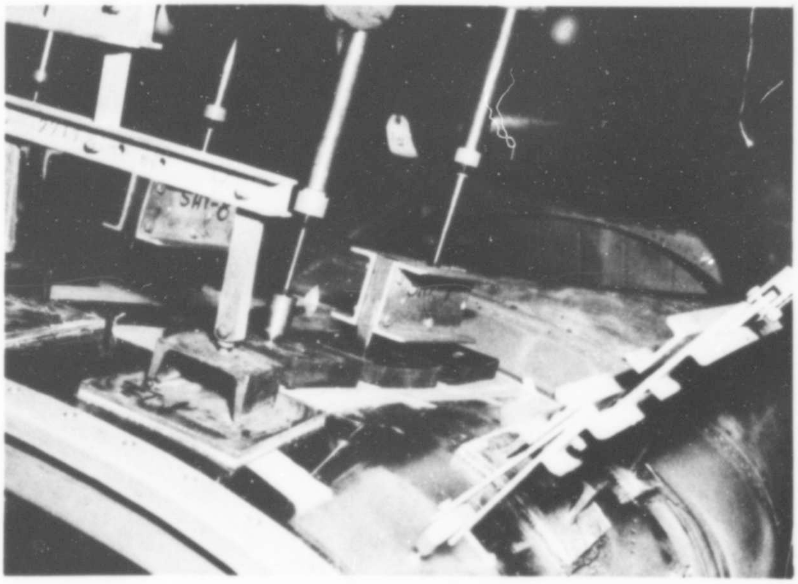


Figure 74 View of Windshield Undergoing Load. Note Sag in the Middle of Forward Flat Section

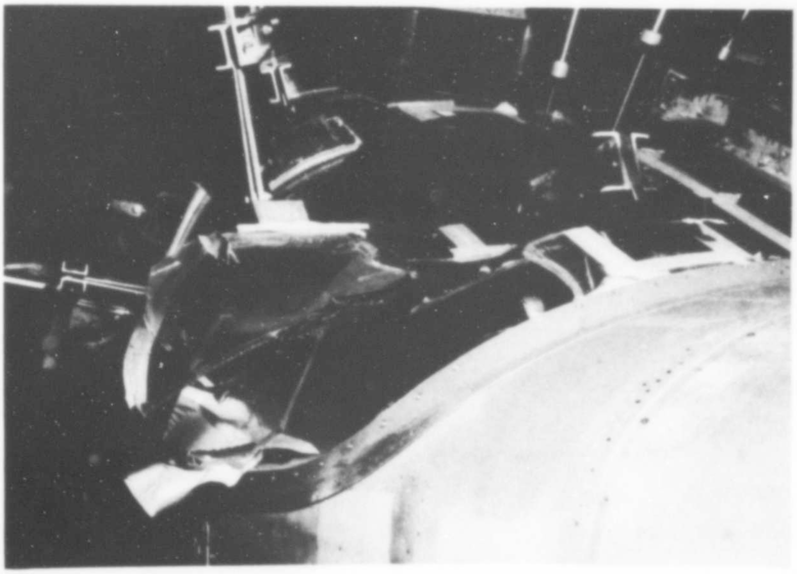


Figure 75 View of Failed Windshield After Withstanding 70% Limit Load.

3.15 TEST NO. 15 - MLG AND LOCAL FITTINGS, FUSELAGE FWD. OF FS 316 INCLUDING SPACE FRAME

3.15.1 Test Condition

Two Wheel, Tail Down Landing - Dynamic Springback

3.15.2 Introduction

This test is representative of one of the critical conditions for the main landing gear support structure, local fittings, forward fuselage and the center section of space frame. The test was initiated and completed as specified in the test procedures outline.

3.15.3 Summary

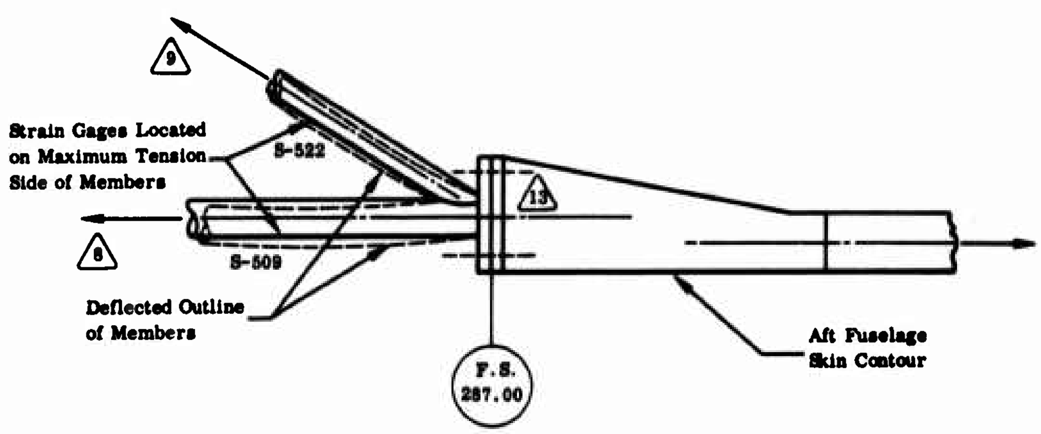
Deflections of the fuselage and main landing gear axle centerlines were recorded and are presented in Figures 76, 77 and 78, respectively. The deflections are referenced to an adjusted fuselage reference plane which accounts for jig movement under load. It will be noted that a variation of approximately .20 inches exists between the vertical movement of the left and right axle centerlines. It is believed that this was caused by slight compression of the oleo. The oleo struts were bled and filled with oil during the test, however, not all of the air could be removed. The 100% load point for longitudinal deflections on the right hand landing gear was unreliable, so the curve was extrapolated to the 100% point. Strains that exceeded 1000μ" are plotted versus per cent of limit load in Figures 79 through 85; the remaining gages indicated lower strains and were not plotted. Figures 86 and 87 show the loading arrangement.

Jack fitting down reactions were as follows:

% Load	Jack Fitting
60	800 pounds
80	1100 pounds
90	1175 pounds
100	1213 pounds

In general all of the aft fuselage measured stress values are well below the allowable stresses, and in most cases are less than calculated values. It is believed that the calculated stresses are higher because secondary structure was neglected and more skin is effective at limit load than that calculated for ultimate stress levels.

The measured strains in the space frame members are generally lower than calculated values. The exceptions are in strains measured by gages S-509, S-510, S-522 and S-523 which indicate higher than calculated stresses in members 8-13, 11-14, 9-13 and 10-14 respectively. It is believed that these members were subjected to induced bending and that the strain gages measured the tension due to bending in addition to axial tension strains. This effect can be seen in the sketch below



View Looking Down, L. H. Side, Upper Longeron

The measured strain of 6000 $(10)^{-6}$ inches/inch in member 8-13 at 100% limit load is equivalent to a stress level of $6000(10)^{-6}(27)(10)^{6}$ = 162,000 psi. The calculated stress level in this member at 100% limit load, neglecting bending, is 93,120 psi (Ref. 3). Assuming these values are valid, an analysis of the member is shown for axial load plus bending.

	Limit Stress	Ultimate Stress
AXIAL, f_t	93,120 psi	139,680 psi
BENDING, f_b	68,880 psi	103,320 psi
TOTAL	162,000 psi	243,000 psi

F_{t_u} = 230,000 psi (F_{t_u} @ 300 Deg. F., Ref. 5)

F_{b_u} = 1.21 (230,000) = 278,300 psi

$$R_{t_u} = \frac{139,680}{230,000} = .607$$

$$R_{b_u} = \frac{103,320}{278,300} = .371$$

$$M.S._u = \frac{1}{.607 + .371} - 1 = \underline{\underline{+.02}}$$

Space frame members 25-30 and 26-29 (strain gages S-503 and S-504) which make up the lower plane "X" act primarily as tension members in reacting unsymmetrical fuselage loads. For this test condition these members, loaded in compression, bow as columns at the critical column load which was calculated to be 1675 pounds in Report No. 144.

Member 25-31 apparently reached critical column load at 40-60 per cent of limit loading with a strain reading of $530(10)^{-6}$ inches/inch which is equivalent to $530(10)^{-6}(27)(10)^{6}(.1336)$ = 1912 pounds. As the lower longerons compress under increased load these members then continue to bow further while sustaining approximately the same load. This accounts for the high deflections at the center of the lower cross members as shown on Figure 76 for loads over 60 per cent of limit.

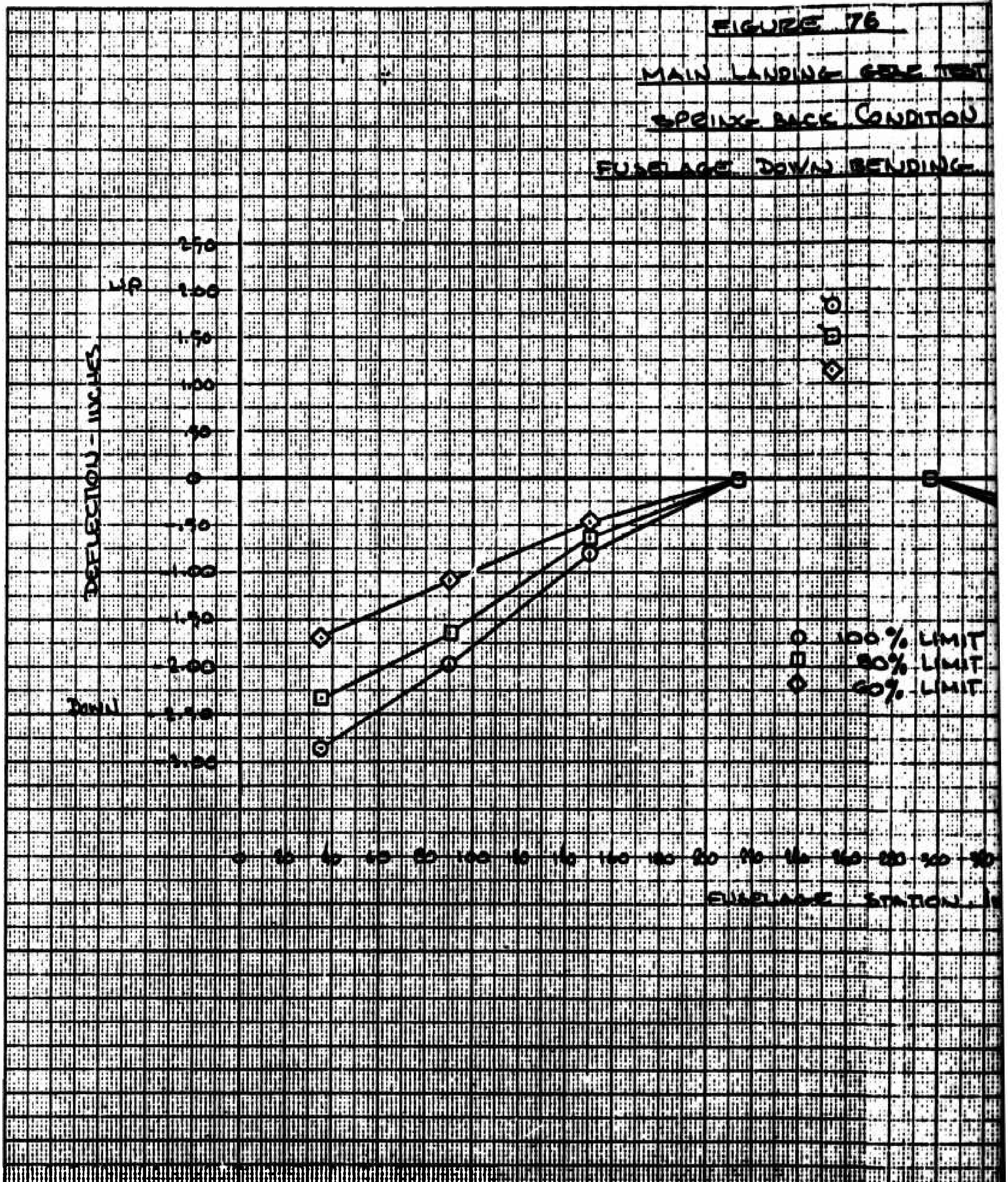
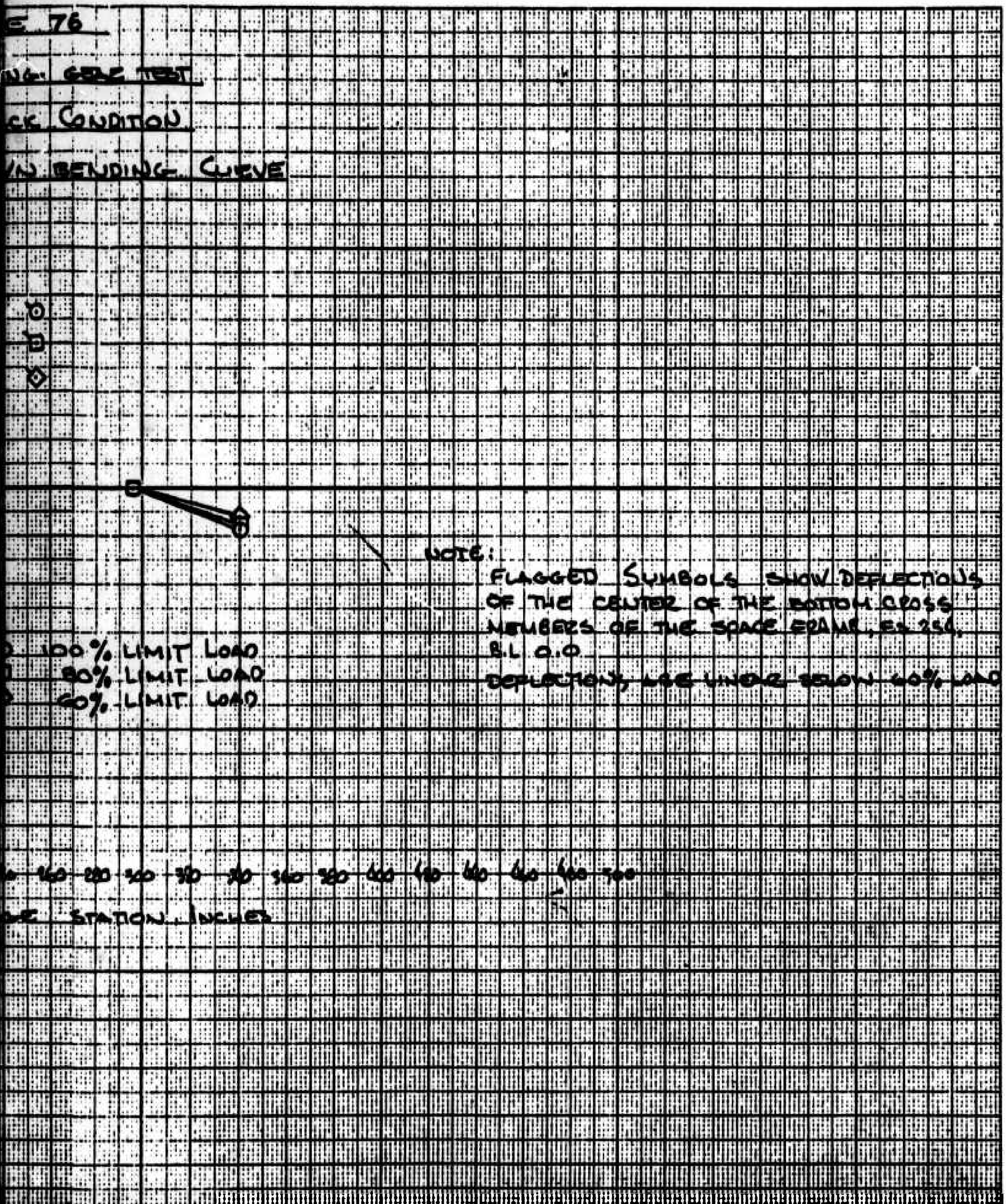


FIGURE 76
MAIN LANDING GEAR TEST
SPRING BACK CONDITION
FUSELAGE DOWN BENDING
DEFLECTION - INCHES
UP
DOWN
2.50
2.00
1.50
1.00
.50
0
-.50
-1.00
-1.50
-2.00
-2.50
-3.00
100% LIMIT
80% LIMIT
60% LIMIT
FUSELAGE STATION

A



CK CONDITION
N BENDING CURVE
100% LIMIT LOAD
80% LIMIT LOAD
60% LIMIT LOAD
NOTE:
FLAGGED SYMBOLS SHOW DEFLECTIONS OF THE CENTER OF THE BOTTOM CROSS MEMBERS OF THE SPACE FRAME, FS 254, B.L 0.0
DEFLECTIONS ARE LINEAR BELOW 60% LOAD
STATION, INCHES

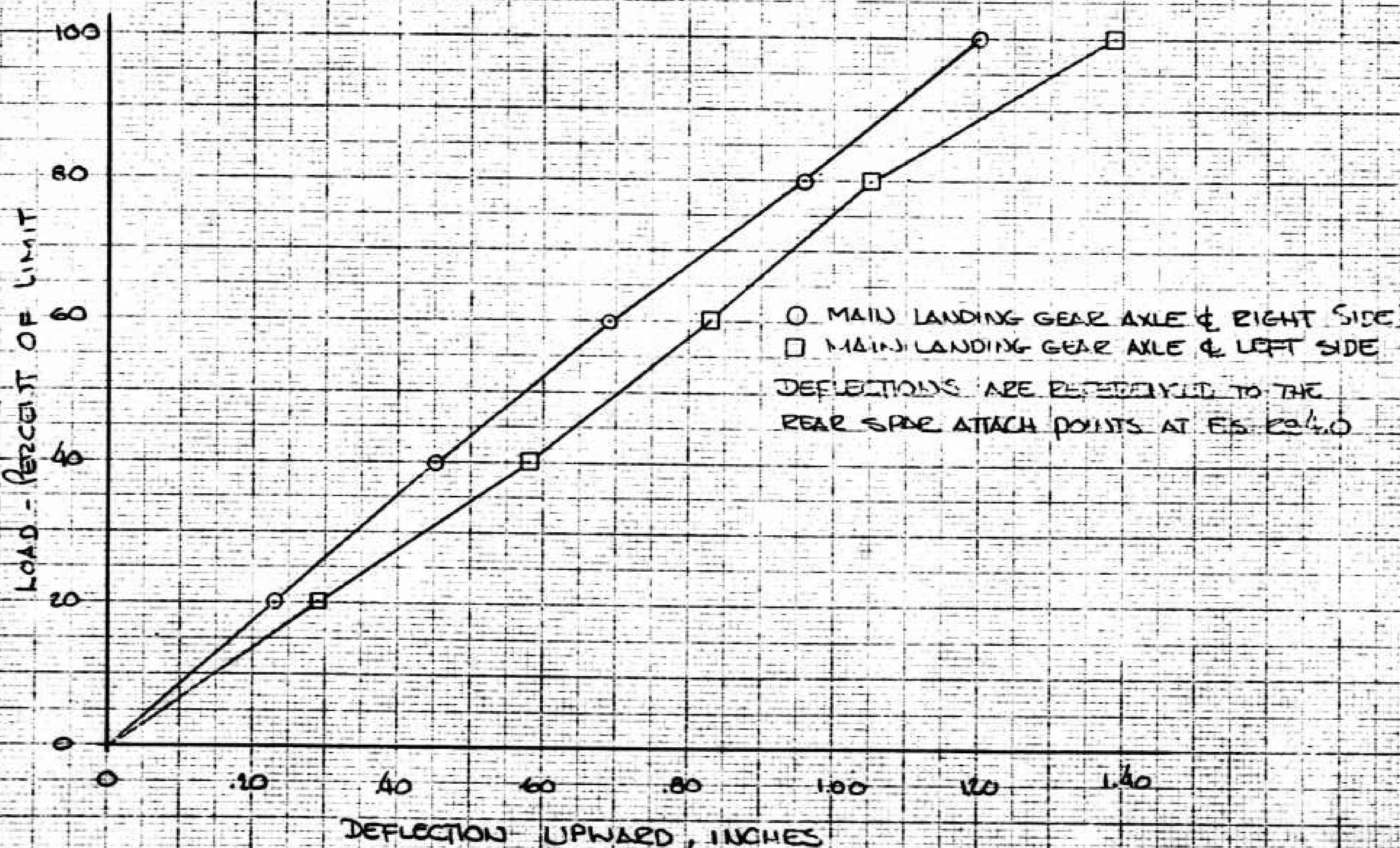
B

FIGURE 77

MAIN LANDING GEAR TEST

SPRINGBACK CONDITION

VERTICAL DEFLECTIONS M.L.G. AXLE ℄'s



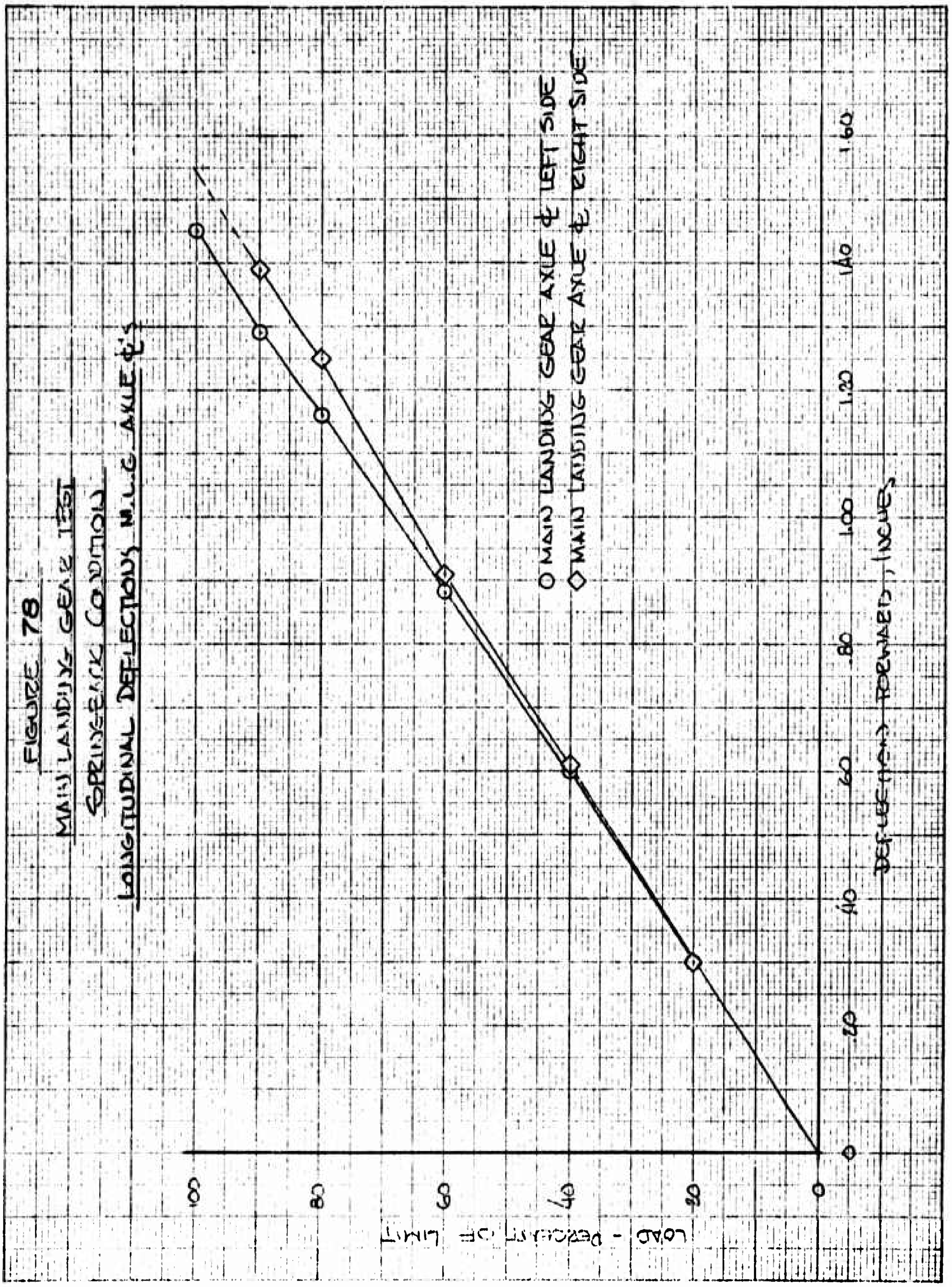


FIGURE 78
MAIN LANDING GEAR TEST
SPRINGBACK CONDITION
LONGITUDINAL DEFLECTIONS M.L.G. AXLE ℄'s
○ MAIN LANDING GEAR AXLE ℄ LEFT SIDE
◇ MAIN LANDING GEAR AXLE ℄ RIGHT SIDE
LOAD - PERCENT OF LIMIT
0
20
40
60
80
100
DEFLECTION FORWARD, INCHES
0
.20
.40
.60
.80
1.00
1.20
1.40
1.60

FIGURE 79
MAIN LANDING GEAR (SPRINGBACK)
FUSELAGE STRAIN CURVES

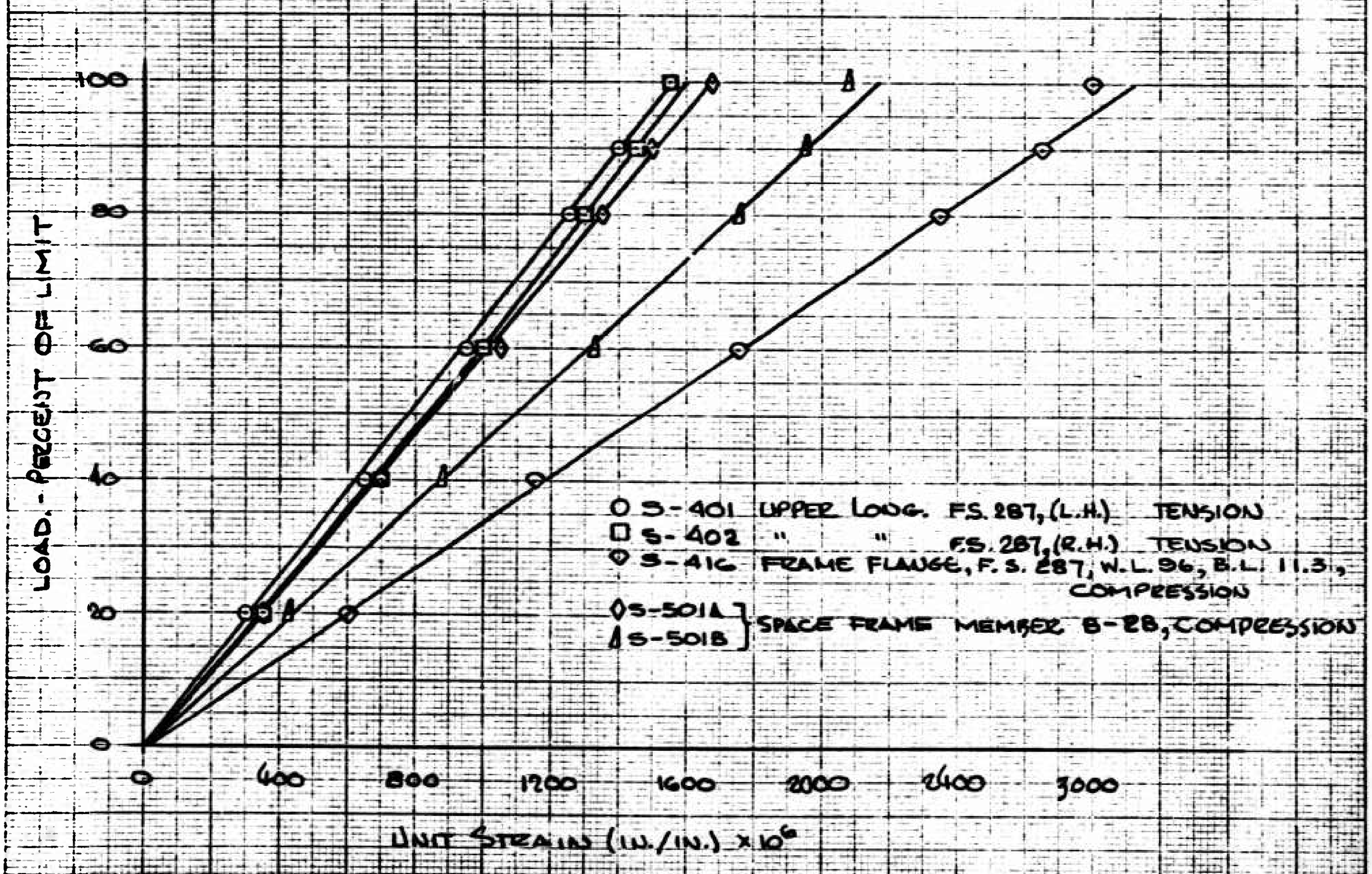


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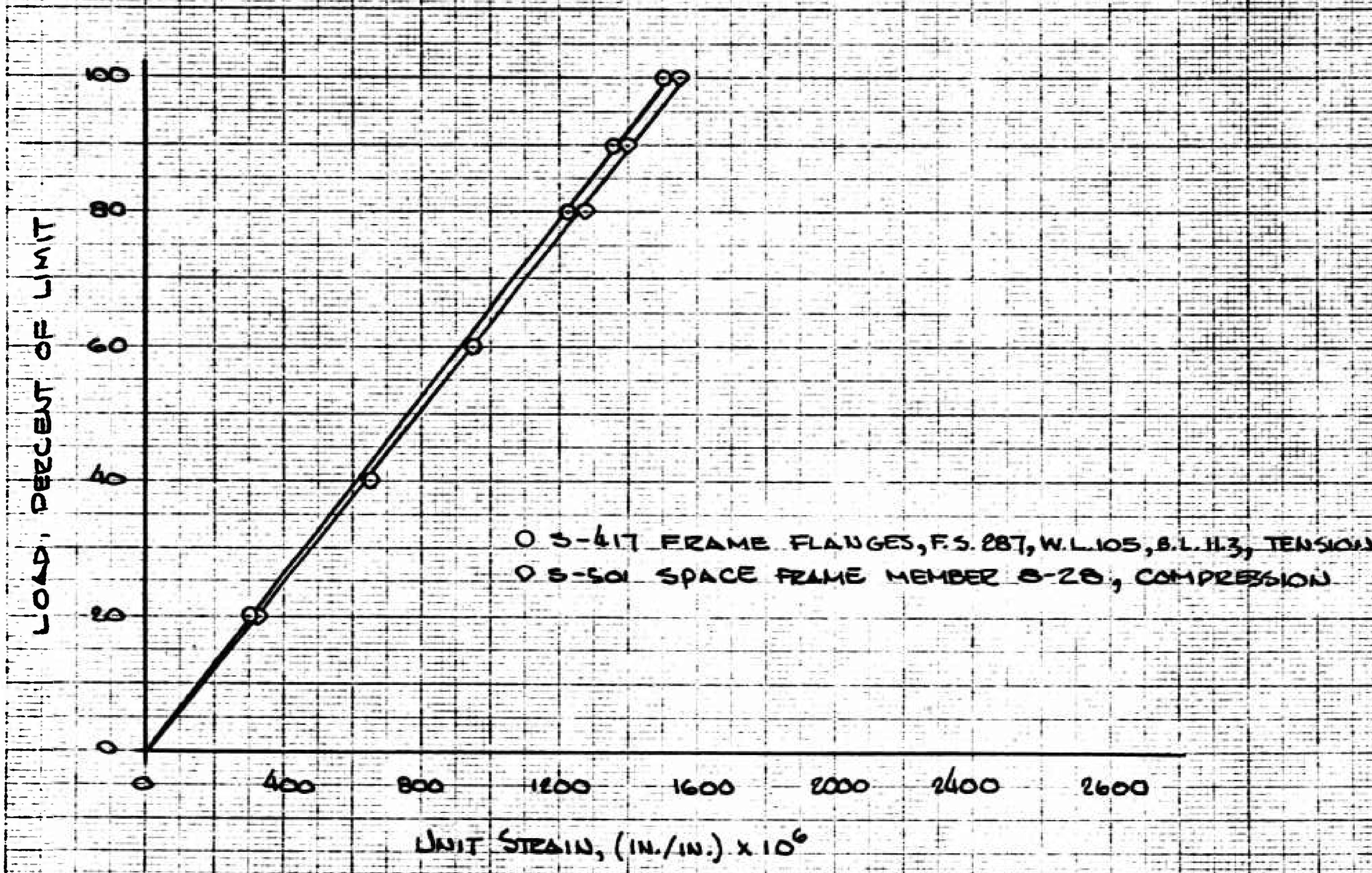
FIGURE 80

MAIN LANDING GEAR (SPRINGBACK)

FUSELAGE STRAIN CURVES



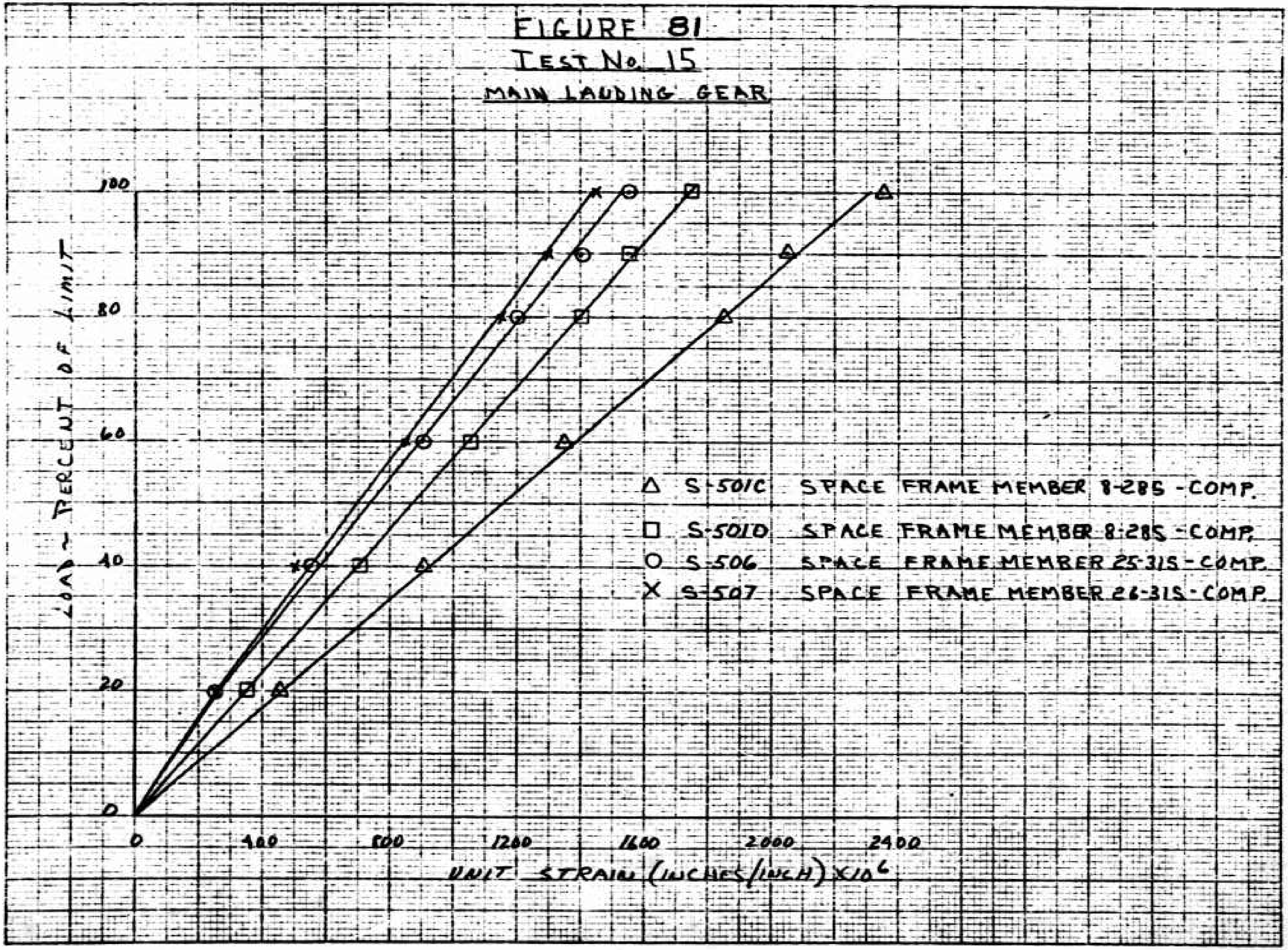
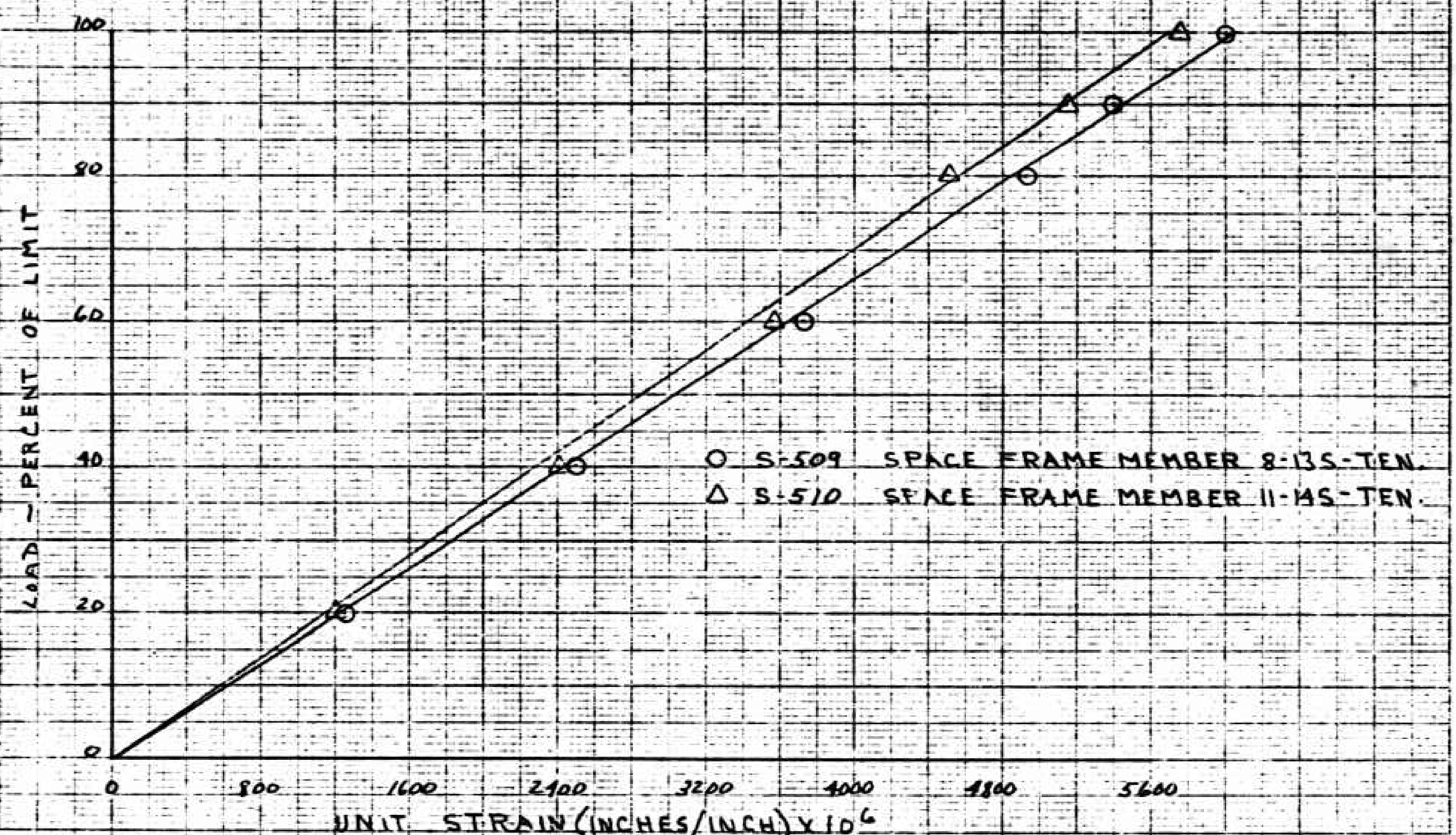


FIGURE 81
TEST No. 15
MAIN LANDING GEAR

FIGURE 82

TEST N° 15

MAIN LANDING GEAR



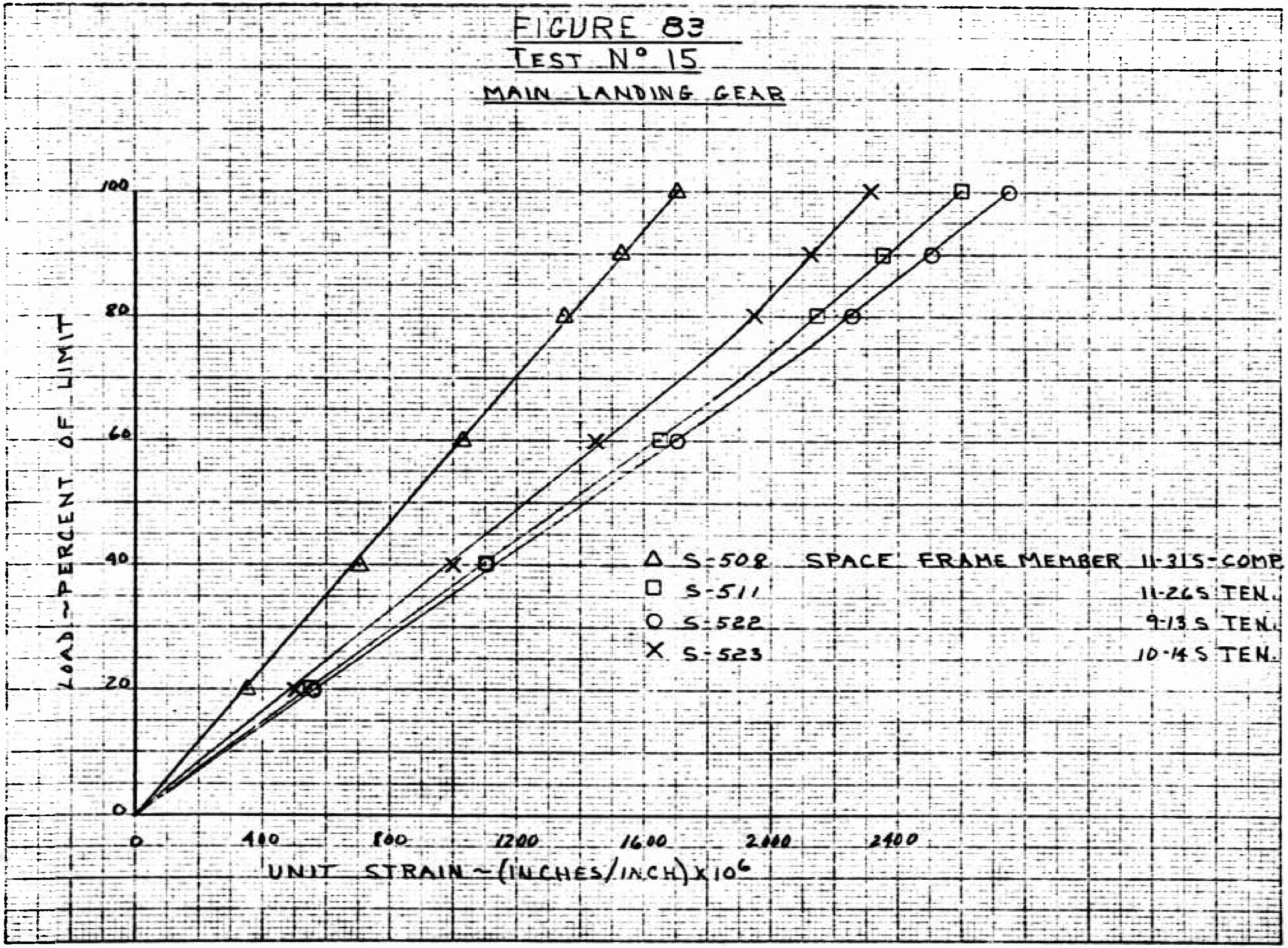


FIGURE 83
TEST N° 15
MAIN LANDING GEAR
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
0
400
800
1200
1600
2000
2400
UNIT STRAIN ~ (INCHES/INCH) X 10^6
△ S-508 SPACE FRAME MEMBER 11-31S-COMP.
□ S-511 11-26S TEN.
○ S-522 9-13 S TEN.
X S-523 10-14 S TEN.

FIGURE 84
TEST N° 15
MAIN LANDING GEAR

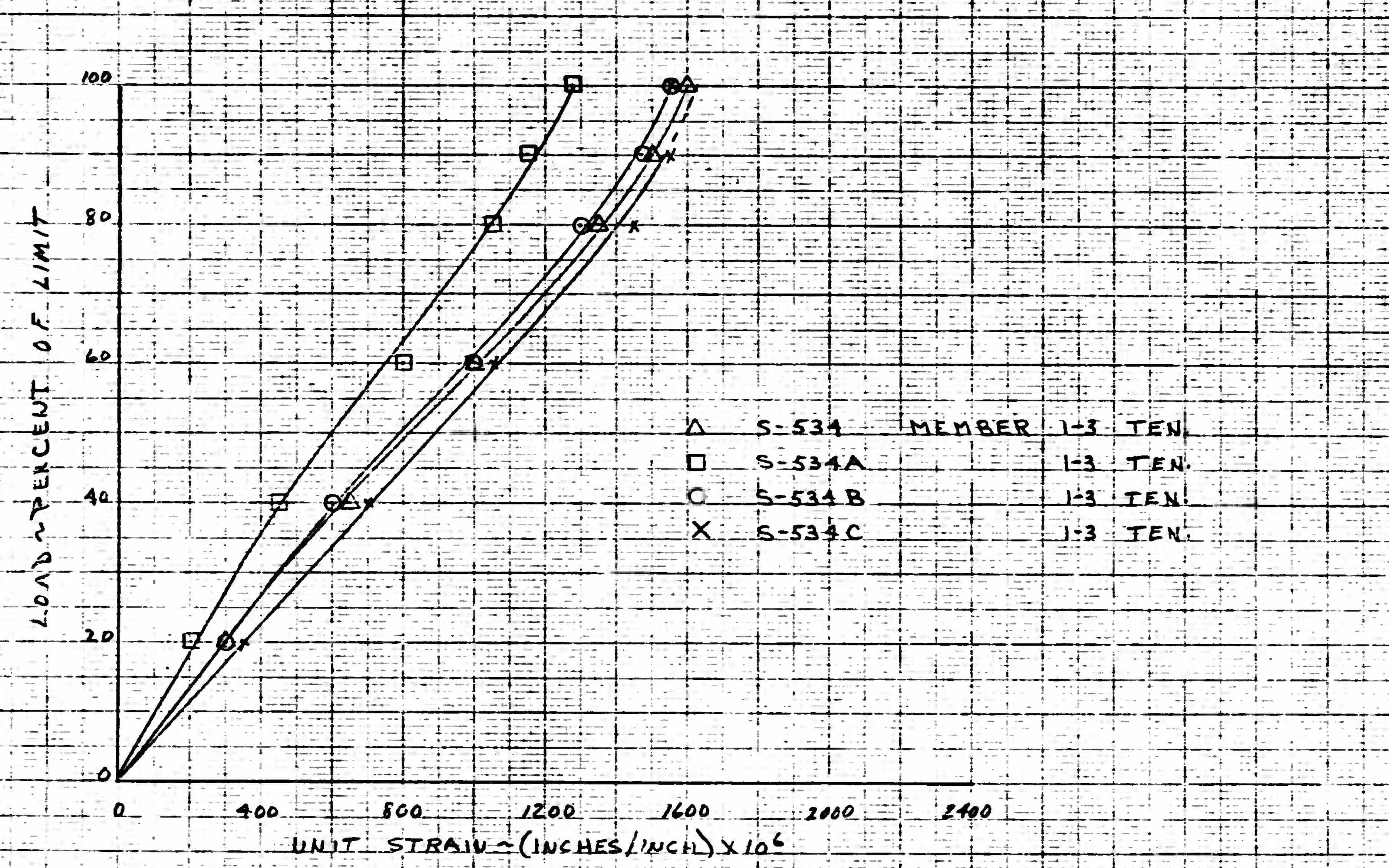
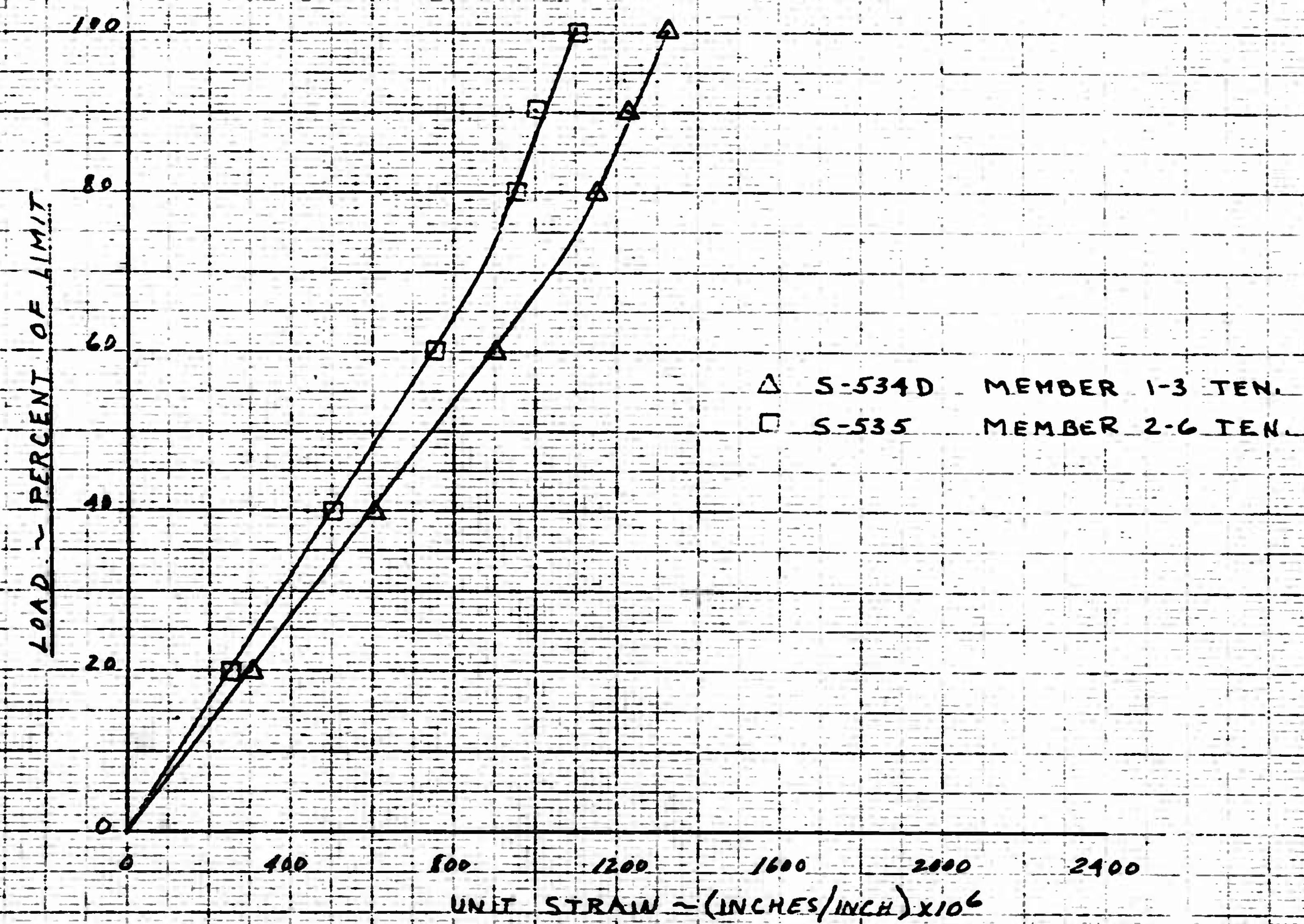


FIGURE 85
TEST N° 15
MAIN LANDING GEAR



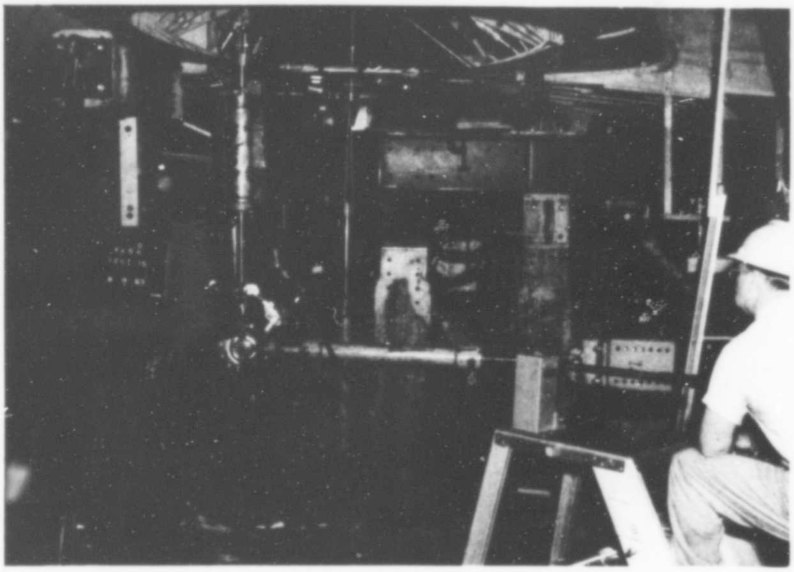


Figure 86 Main Landing Gear Springback Test

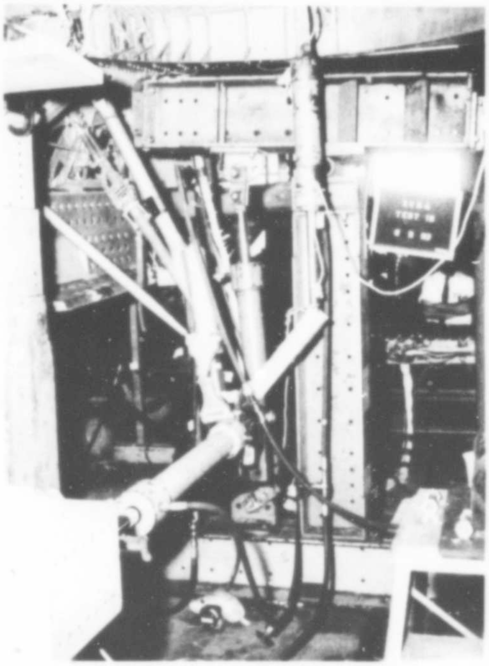


Figure 87
Closeup of MLG Looking Aft During Springback Test

3.16 TEST NO. 16 - MLG, LOCAL FITTINGS AND FUSELAGE CENTER SECTION

3.16.1 Test Condition

Drift Landing

3.16.2 Introduction

This test is representative of critical conditions for the main landing gear local support structure and fuselage center section. The test was completed according to the test procedures outline.

3.16.3 Summary

Measured main landing gear axle centerline deflections are plotted in Figures 88 and 89 versus the applied load.

Additional strain gages were installed due to the possibility of bending effects in the space members 1-3 and 8-28 labeled S-501 and S-534. Additional gages S-501-A, -B, -C, -D, and S-534-A, -B, -C, -D were evenly spaced around the periphery at the same location as the unlettered gage. However, only gages S-501-B, -C, and -D indicated strains exceeding 1000μ". These strains were plotted in Figures 90 and 91. Gage S-503 indicates bending above the 80% load point in Figure 90. Figures 92 and 93 show the loading arrangement.

Jack fitting down loads were as follows:

% Load	React Load
40	100 pounds
60	450 pounds
80	900 pounds
90	1150 pounds
100	1363 pounds

Figures 94 and 95 show two views of bearing shift in the rod end of the main landing gear brace. This end slipped in the direction shown where it remained. Figure 96 is a view showing the location of a broken bolt in the gear brace bracket (bolt hole is almost exact center of picture). This bolt failure was observed after the test was completed.

The slippage of the bearings was attributed to inadequate staking. A modification was incorporated changing the type of staking to ring swaging. It was not considered necessary to retest after this fix.

Metalurgical examination of the failed bolt and a similar bolt indicated that failure was caused by hydrogen embrittlement due to improper hard chrome plating. A similar bolt was installed in a laboratory fixture to the specified torque preload. This bolt failed as a result of only the static preload. Therefore, it was concluded that the bolt failure resulted from the installation torque and not from any loads applied during static test. The type of plating was changed to electroless nickel and the laboratory preload test was successfully completed on the modified bolt.

In the space frame, strain gages S-509 and S-522, members 8-13 and 9-13, indicate higher loads than calculated values. This was explained in the summary of Test No. 15 of the lower plane "X". Member 26-29 was loaded in tension and member 25-30, strain gage S-503, was loaded in compression. Member 25-30 apparently bows as a column at a strain reading of $1320(10)^{-6}$ inches/inch and sustains load at a strain reading of $1100(10)^{-6}$ inches/inch. These strains are equivalent to member loads of 4762 pounds and 3968 pounds. The calculated critical column load for this member per Report No. 144 is 5156 pounds.

FIGURE 88
MAIN LANDING GEAR TEST
DRIFT LANDING CONDITION
LATERAL DEFLECTION

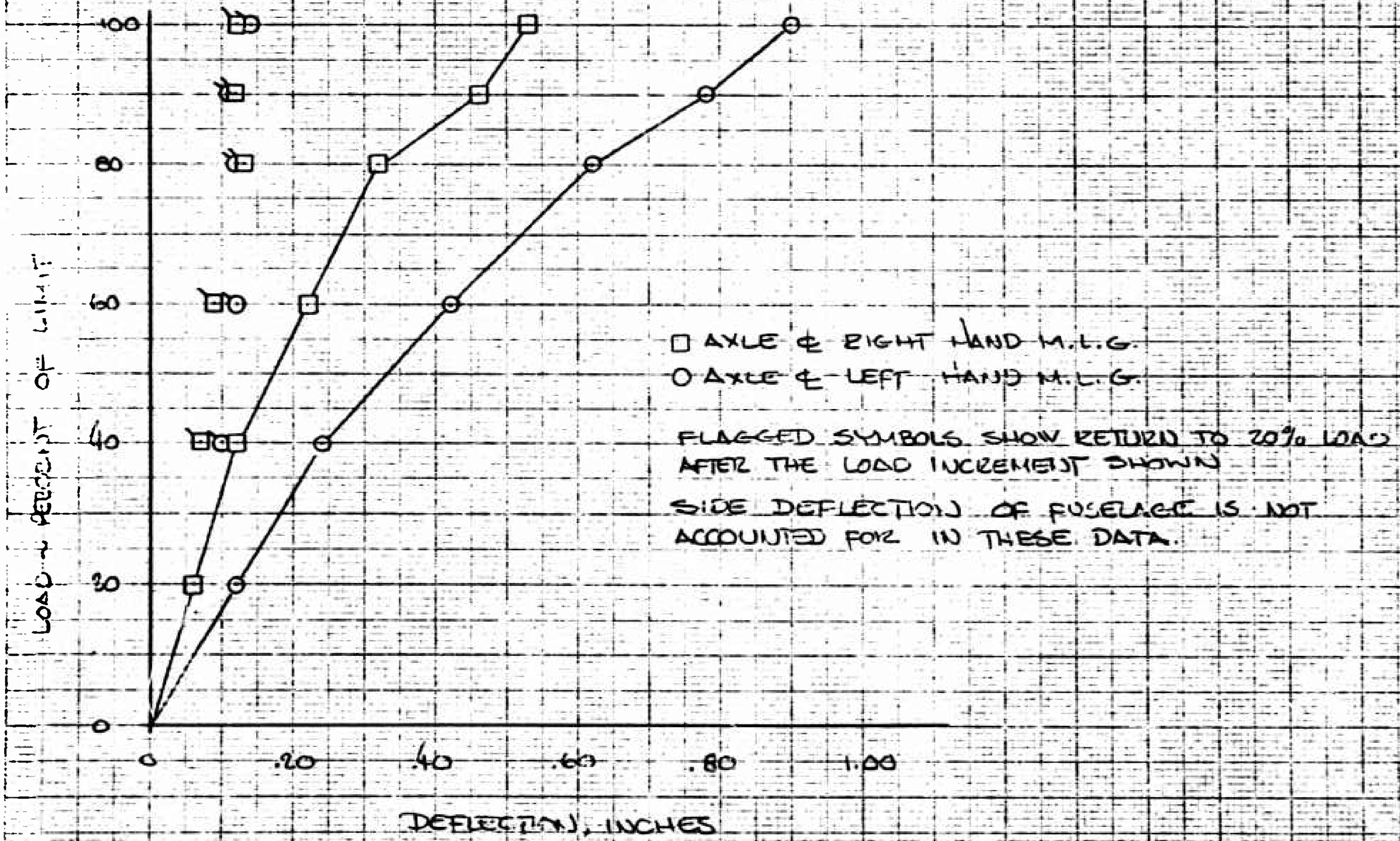
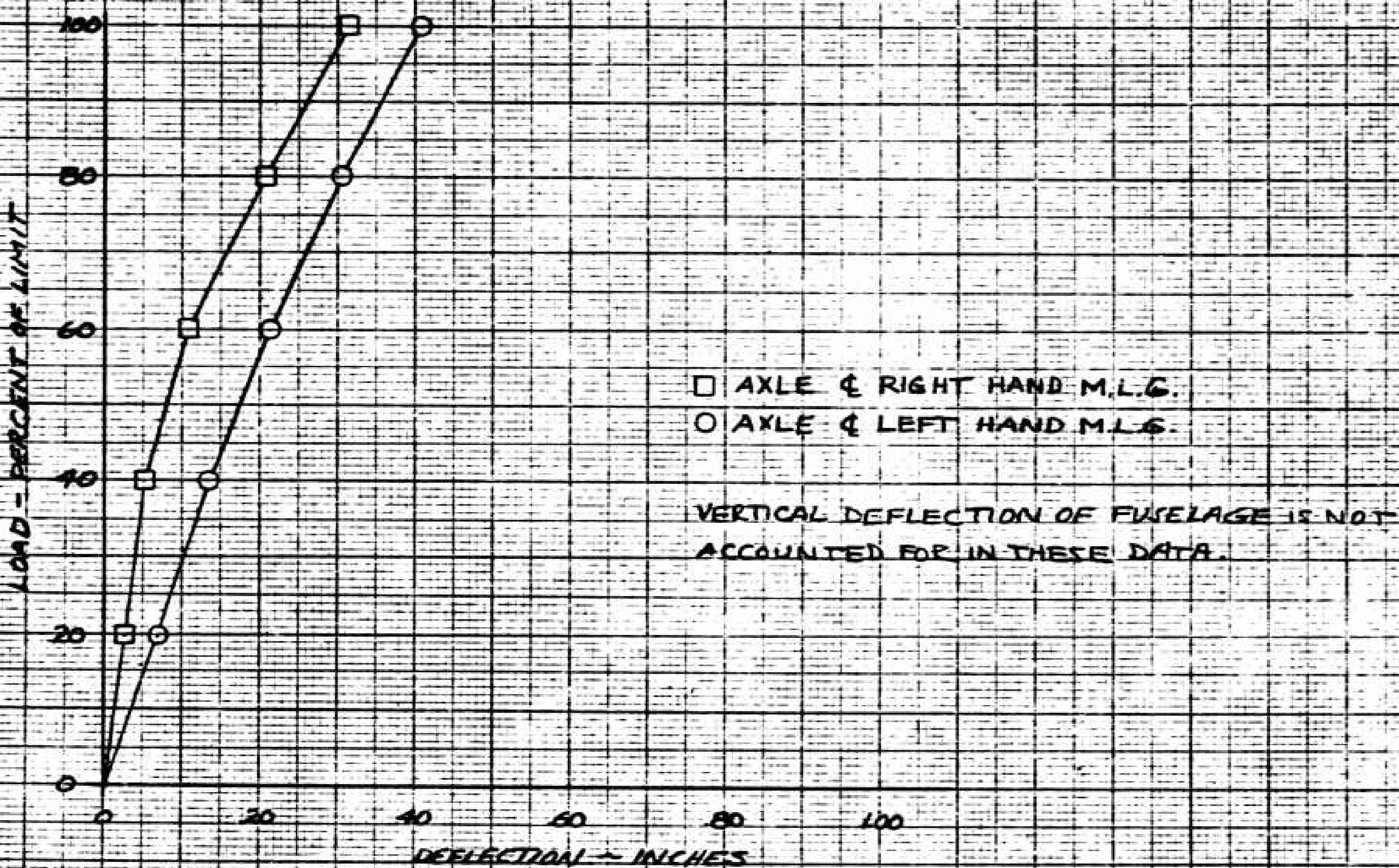


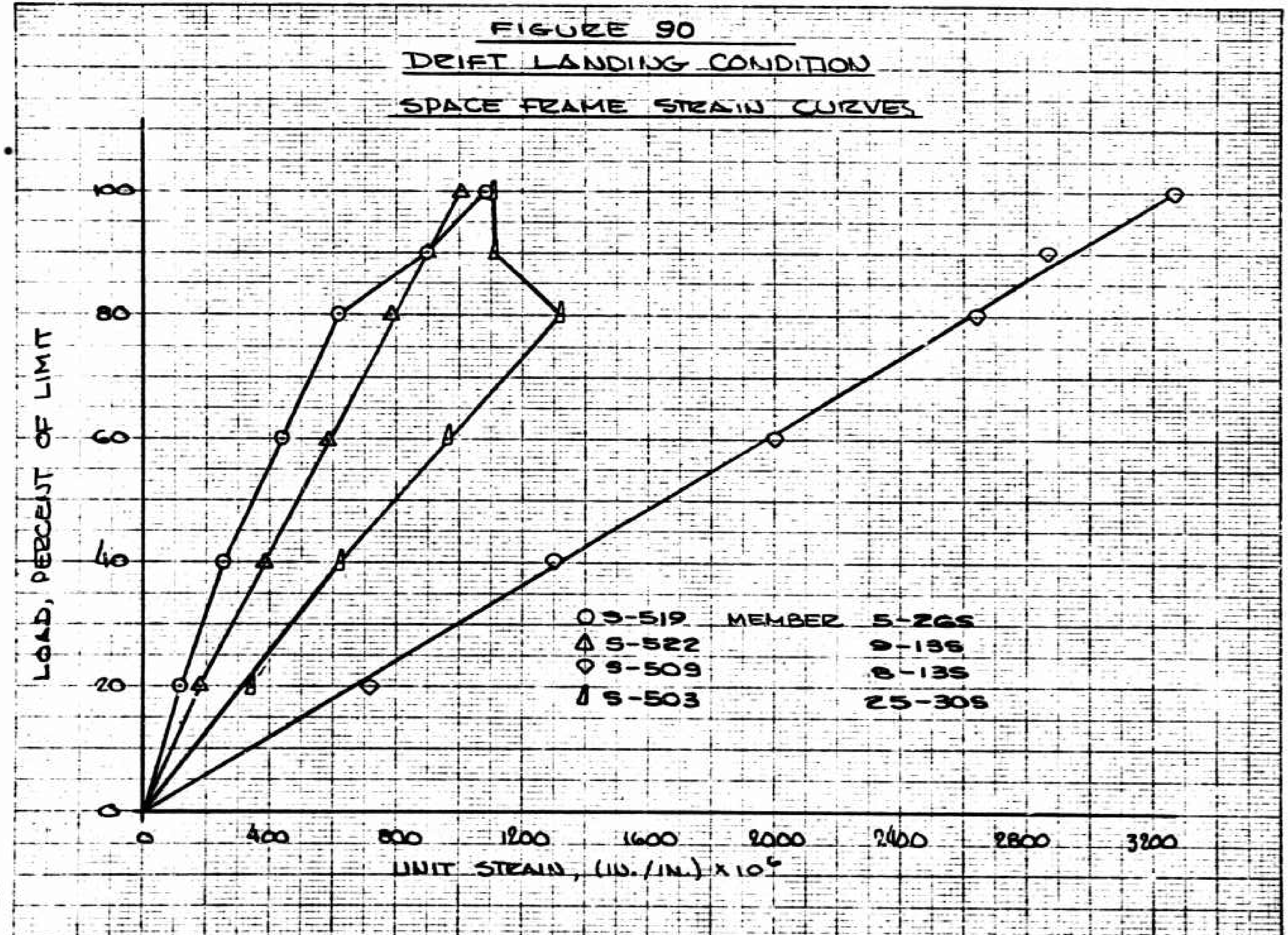
FIGURE 89

MAIN LANDING GEAR TEST

DRIFT LANDING CONDITION

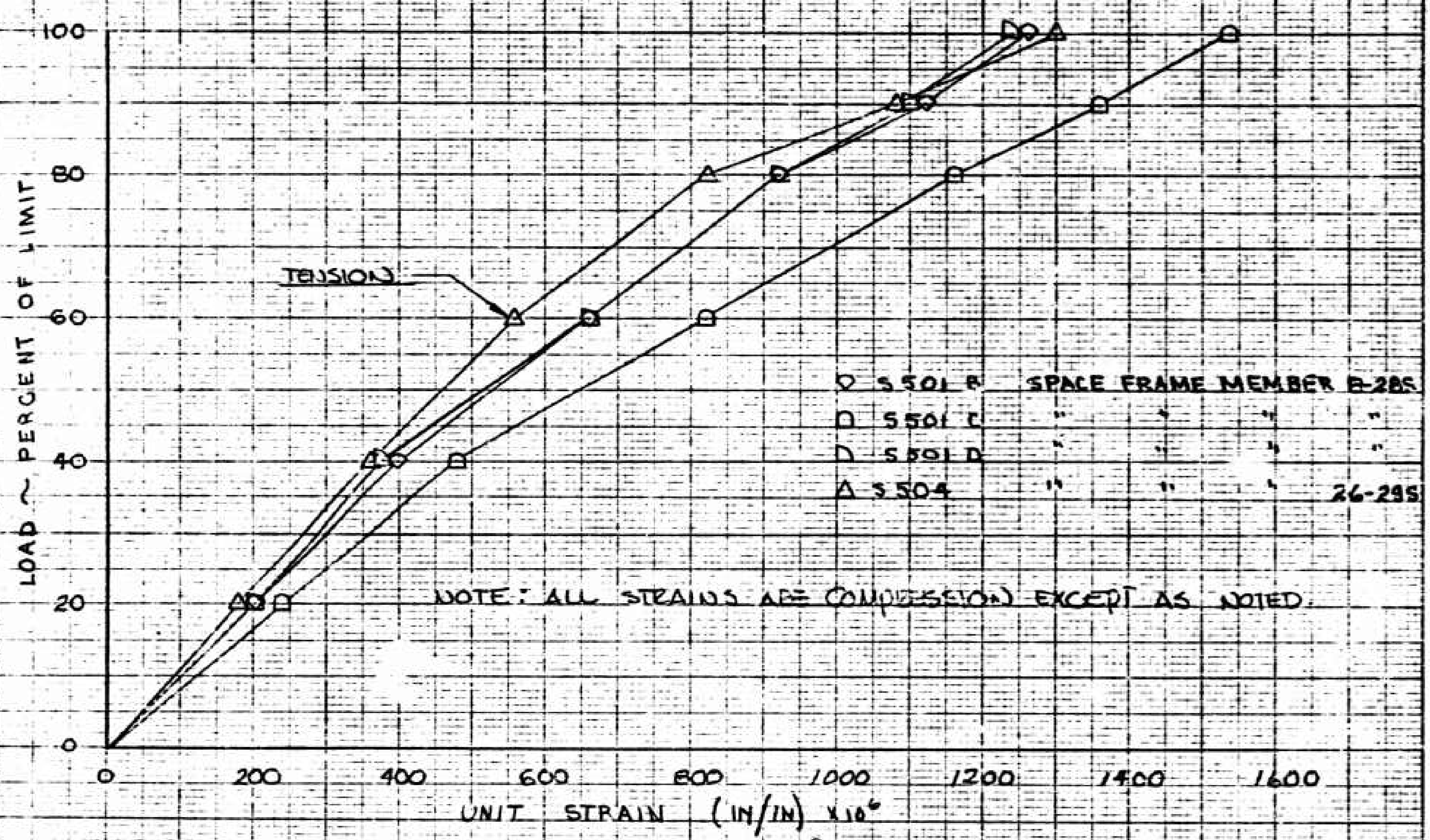
VERTICAL DEFLECTION





REVISED 1-23-64

FIGURE 91
TEST N° 16
MAIN LANDING GEAR
DRIFT LANDING CONDITION



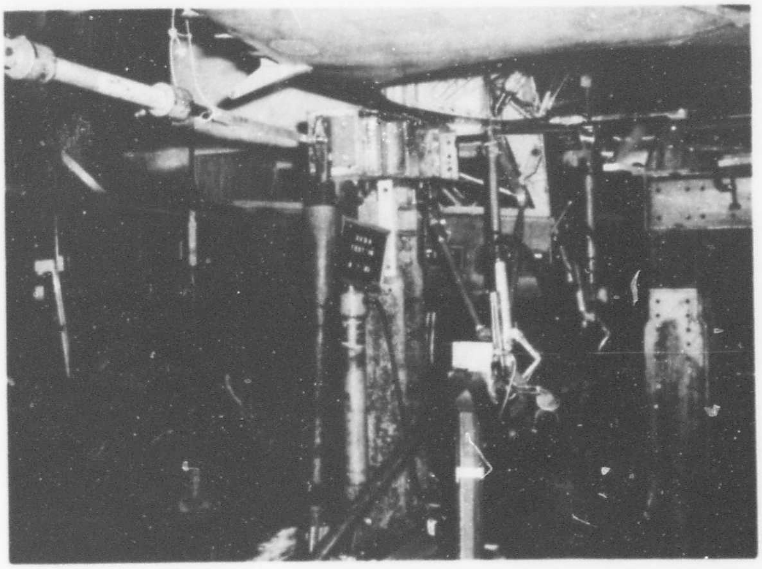


Figure 92 Drift Landing Test Setup

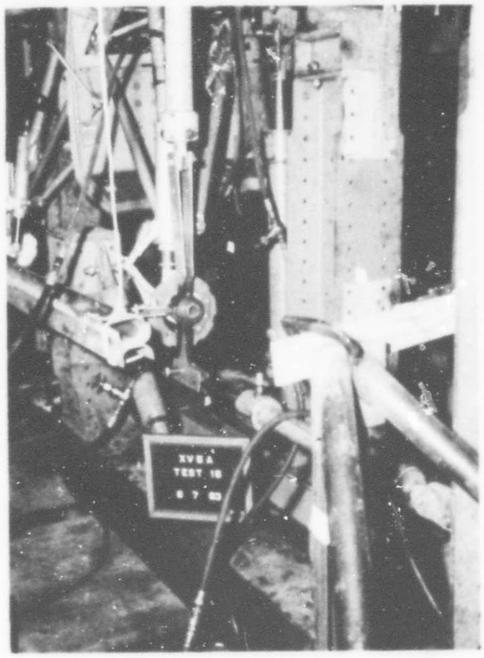


Figure 93
Closeup Showing Load Cylinders to Main Gear for Drift Landing

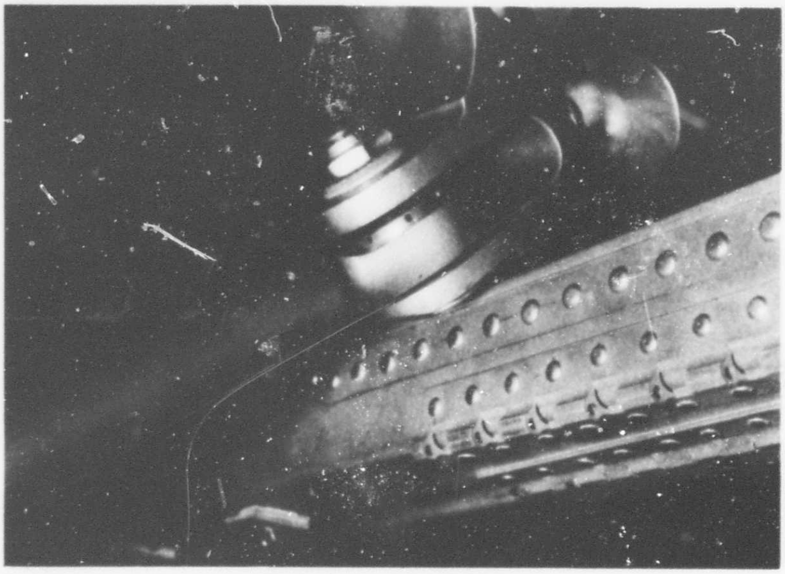


Figure 94 Oblique View of Rod End Bearing Shift in MLG

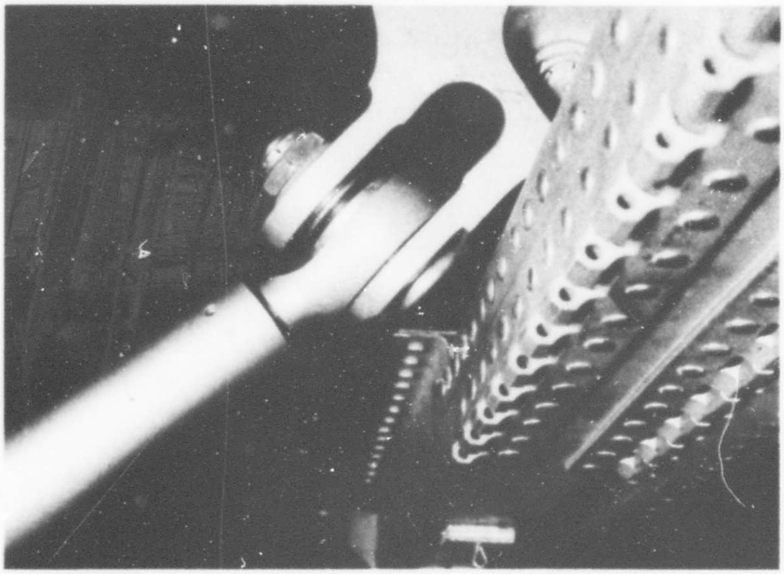


Figure 95 Front View of Same Rod End Showing Bearing Slippage

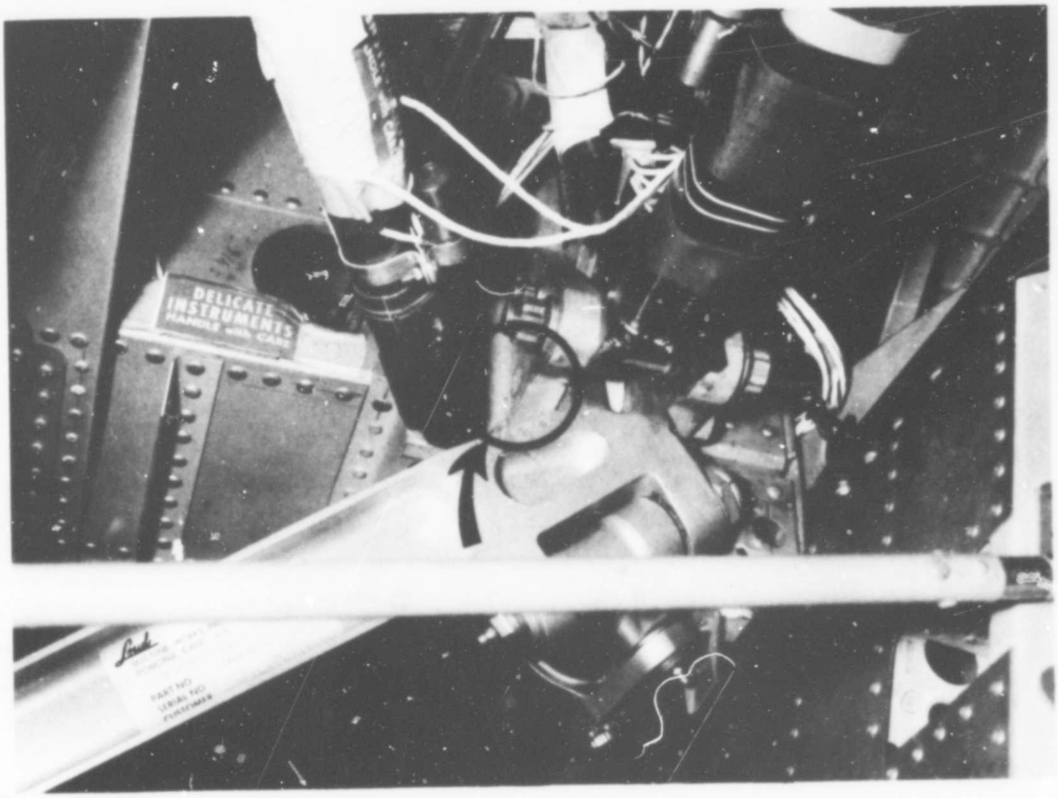


Figure 96 View Showing Failed Bolt on Landing Gear Brace Bracket (Approximate Center of Picture)

3.17 TEST NO. 17 - MLG DOOR (L/H) AND ASSOCIATED HARDWARE

3.17.1 Test Condition

Opening Pressures on Door in High Speed Flight. V = 500 knots @ S. L. q = 850 psf.

3.17.2 Introduction

This test represented the proof test to limit load as indicated in the above listed test condition. The test was carried out according to the test procedures outline.

3.17.3 Summary

The MLG was retracted and the main landing gear doors closed and latched. Outer and inner panels of the left hand main landing gear door were loaded as specified and deflections measured and recorded.

Due to the magnitude of the deflections, this test was postponed until the main landing gear door linkage could be redesigned.

The M. L. G. doors were retested on 1/3/64 and satisfactorily withstood the test loads. Door gap deflections were measured and are plotted in Figures 97 and 98 versus applied limit load. Figure 99 shows the loading arrangement.

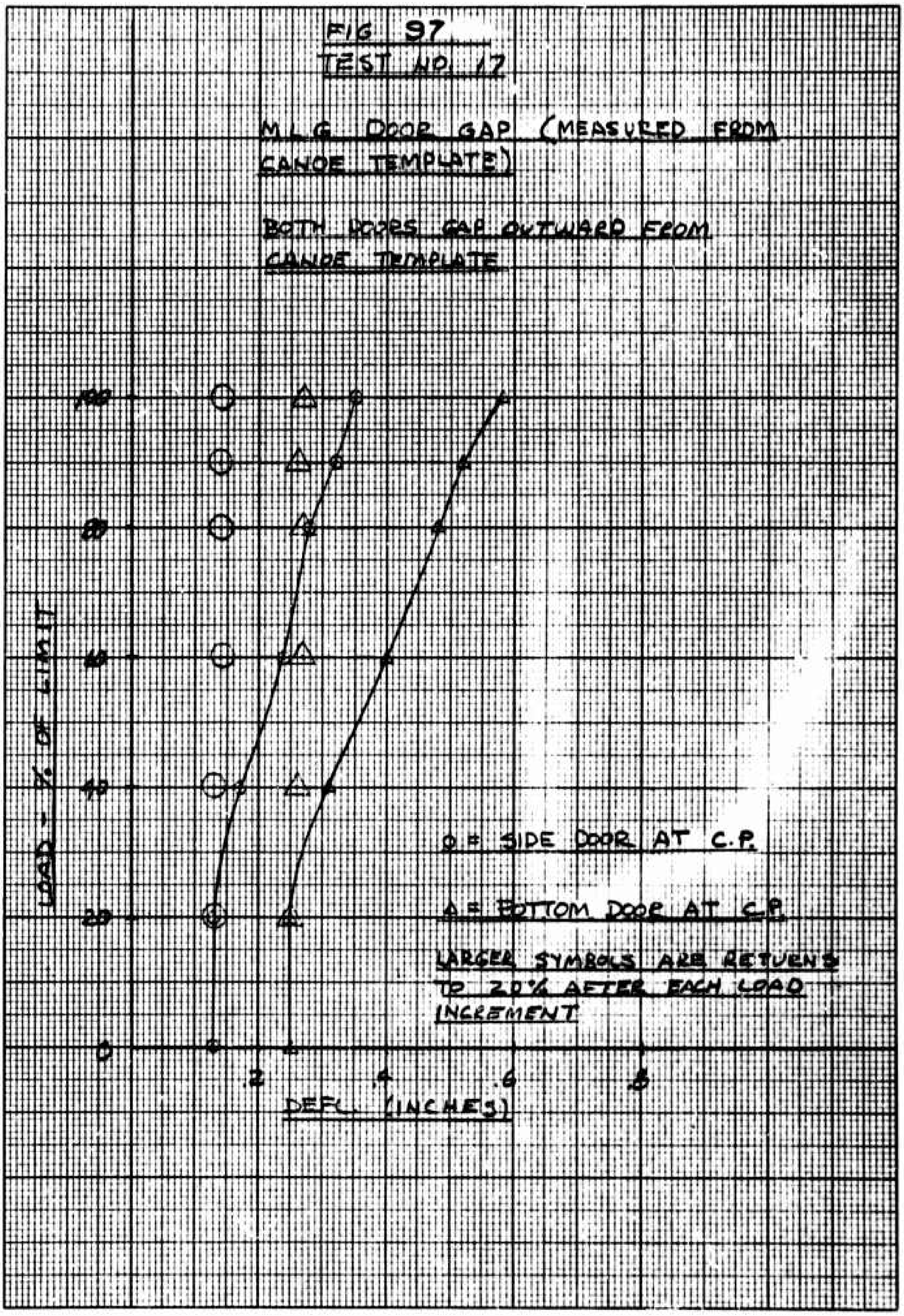


FIG 97
TEST NO. 17
M.L.G. DOOR GAP (MEASURED FROM CANOE TEMPLATE)
BOTH DOORS GAP OUTWARD FROM CANOE TEMPLATE
LOAD - % OF LIMIT
100
80
60
40
20
0
.2
.4
.6
.8
DEFL. (INCHES)
○ = SIDE DOOR AT C.P.
△ = BOTTOM DOOR AT C.P.
LARGER SYMBOLS ARE RETURNS TO 20% AFTER EACH LOAD INCREMENT

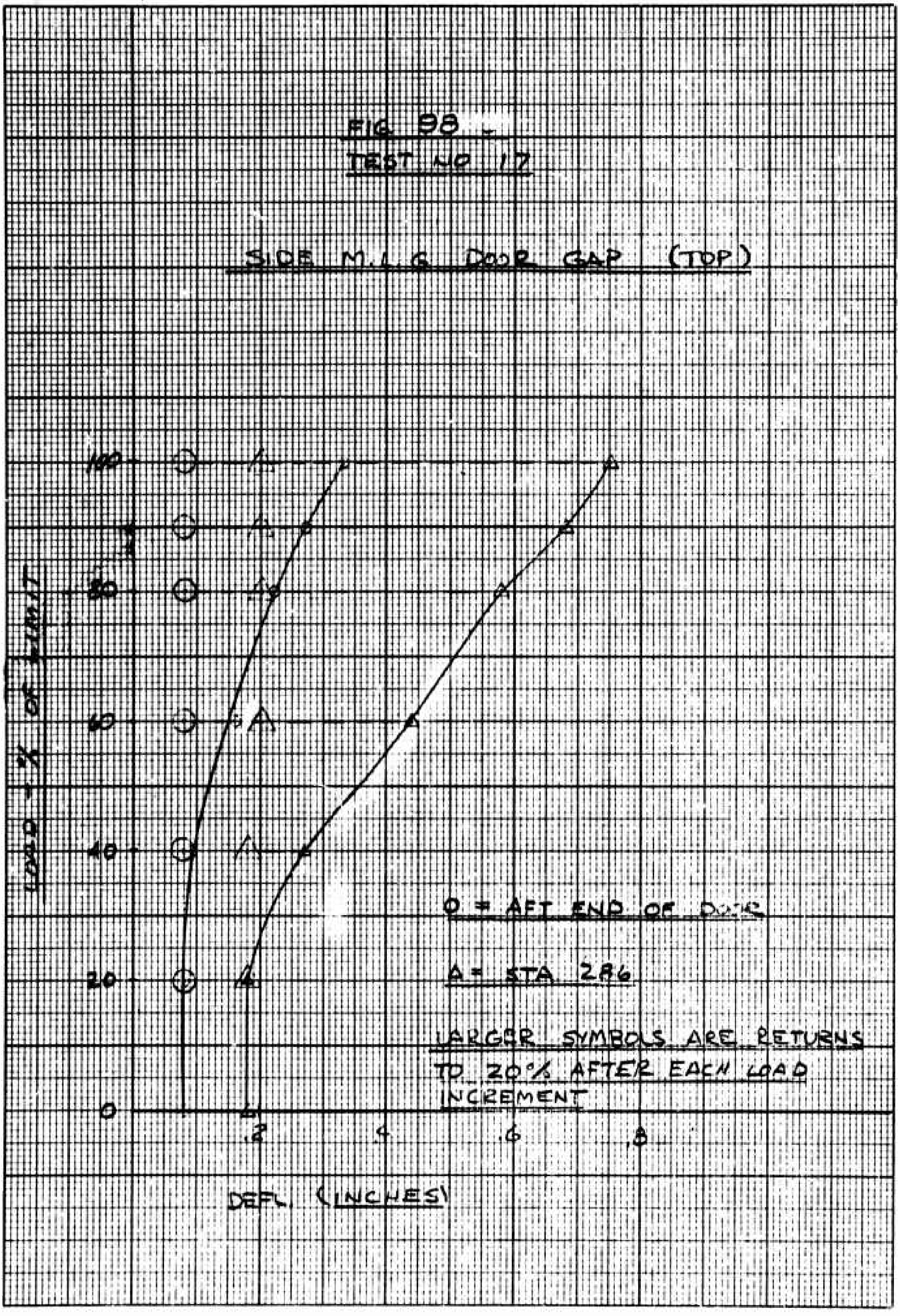


FIG 98
TEST NO 17
SIDE M.L.G. DOOR GAP (TOP)
LOAD - % OF LIMIT
100
80
60
40
20
0
.2
.4
.6
.8
O = AFT END OF DOOR
A = STA 286
LARGER SYMBOLS ARE RETURNS TO 20% AFTER EACH LOAD INCREMENT
DEFL. (INCHES)

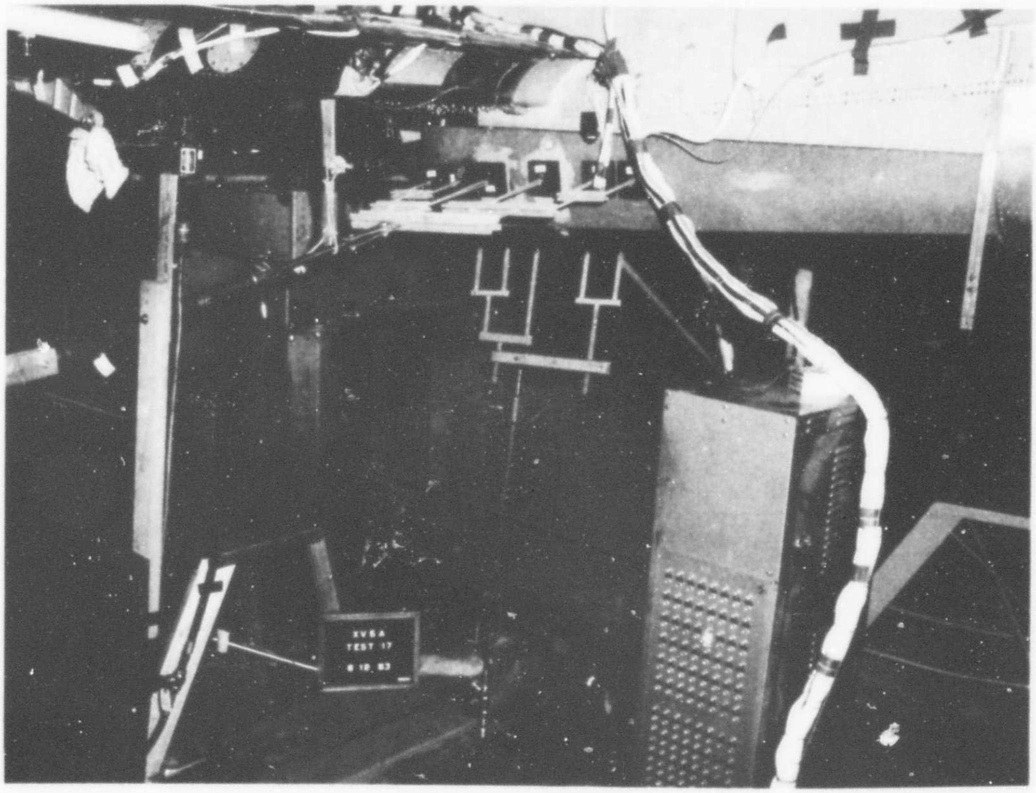


Figure 99 View Showing Whiffletree Loading Arrangment Before Load is Applied

3.18 TEST NO. 18 - WING FLAP, HINGE AND ACTUATOR FITTING

3.18.1 Test Condition

Flap Fully Deflected V = 180 knots

3.18.2 Introduction

This test represents a critical condition for the wing flap. The flap was removed from the aircraft and mounted in a suitable fixture. The link simulating the actuator was calibrated to measure the reacting axial load. The flap was positioned as called for in the test procedures and percentages of limit load applied incrementally as specified.

3.18.3 Summary

Deflection measurements were taken at three positions; leading edge, mid-chord, and trailing edge, all at the mid-span position. Figure 100 shows the resulting deflection versus per cent of limit load. The flagged symbols represent the return to 20% load at the indicated deflection. These deflections are all at 20% applied load but spread out along the ordinate for better separation.

Figure 100 also contains a plot of the actuator load versus the applied simulated aerodynamic load. With the exception of the load curve, all deflection curves were extrapolated to the origin and contain the zero load increments. Figures 101, 102 and 103 show the loading arrangement.

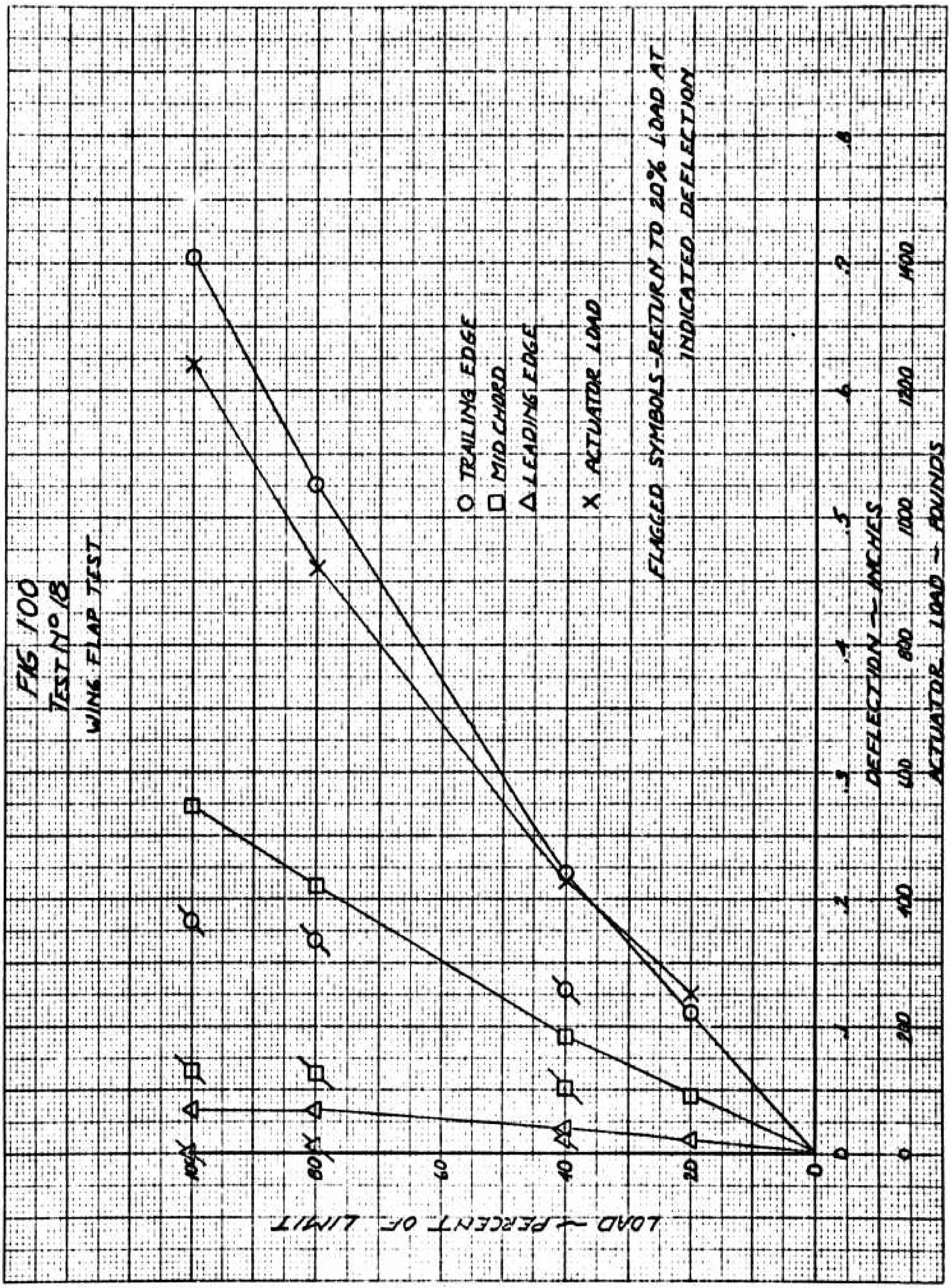


FIG 100
TEST No 18
WING FLAP TEST
O TRAILING EDGE
□ MIDCHORD
△ LEADING EDGE
X ACTUATOR LOAD
FLAGGED SYMBOLS-RETURN TO 20% LOAD AT INDICATED DEFLECTION
LOAD — PERCENT OF LIMIT
0
20
40
60
80
100
DEFLECTION — INCHES
0
.1
.2
.3
.4
.5
.6
.7
.8
ACTUATOR LOAD — POUNDS
0
200
400
600
800
1000
1200
1400

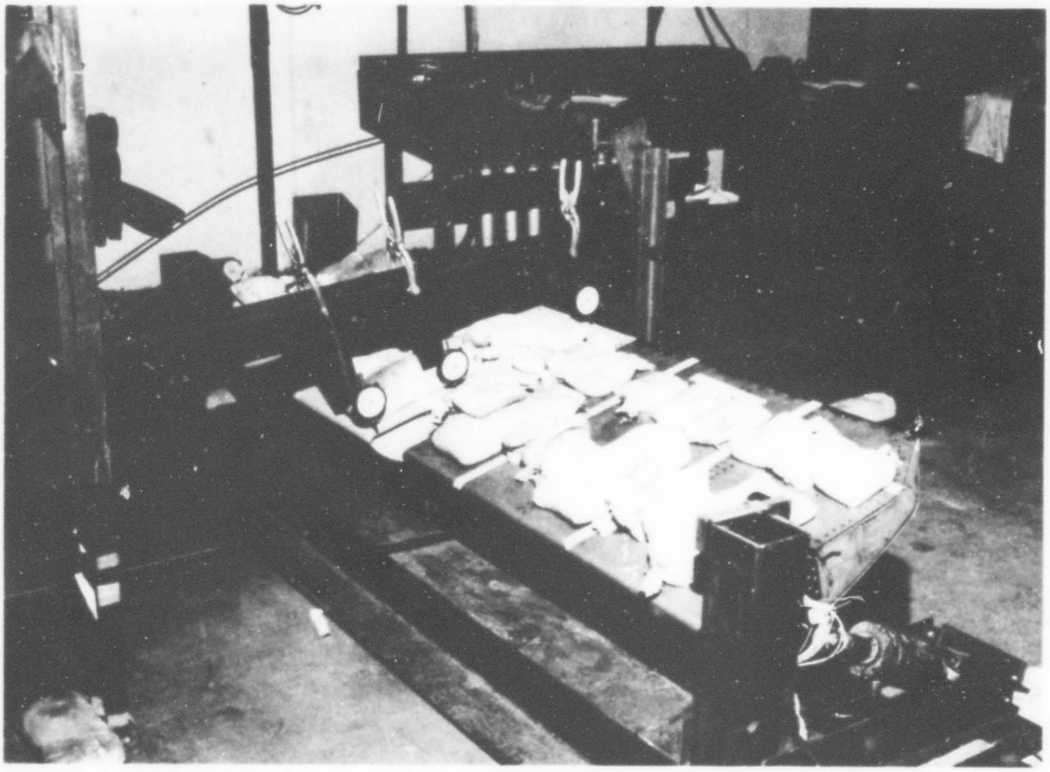


Figure 101 View of Wing Flap During Load Test. Picture Shows the Three Deflection Gages Mounted Along the Chord at Mid-span. The Shot Bags Pictured Represent 25% Limit Load.

Figure 102 View of Flap Undergoing 100% Limit Load

Figure 103 View of Flap Trailing Edge While 100% Limit Load is Applied

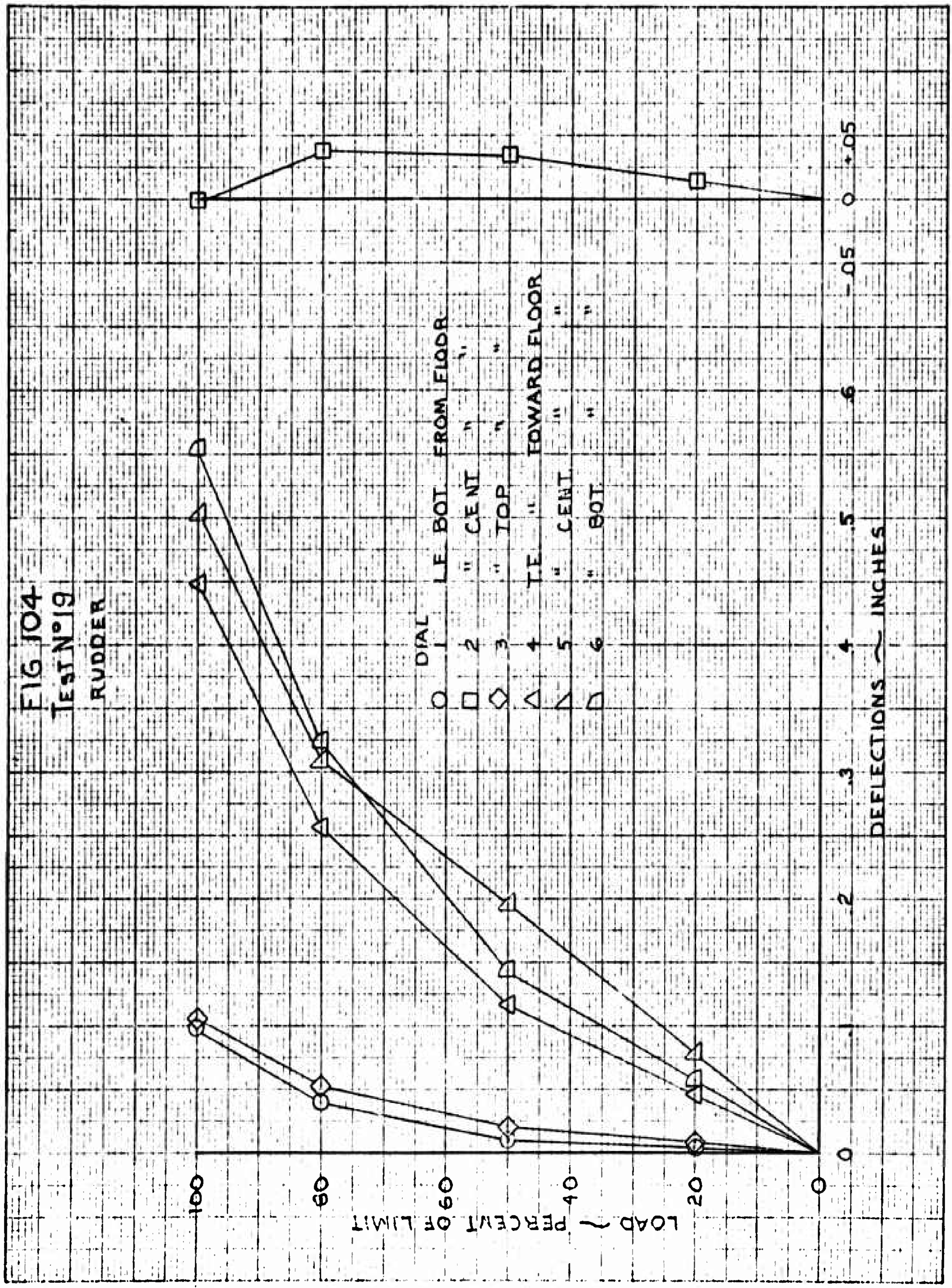


FIG 104
TEST N°19
RUDDER
DIAL
1 L.E. BOT. FROM FLOOR
2 " CENT " "
3 " TOP " "
4 T.E. " TOWARD FLOOR
5 " CENT " "
6 " BOT " "
LOAD ~ PERCENT OF LIMIT
0
20
40
60
80
100
DEFLECTIONS ~ INCHES
0
.1
.2
.3
.4
.5
.6
-.05
0
+.05

3.19 TEST NO. 19 - RUDDER HINGE FITTINGS AND CONTROL ROD

3.19.1 Test Condition

Maximum Pilot Effort Rudder Hinge Moment for Rudder Induced Sideslip

3.19.2 Introduction

The rudder was removed from the airplane and mounted chord plane horizontal in a test fixture. This test rig accommodated the two hinges and provided a torque reaction for the rudder torque tube. The loads were applied as called for in the test procedures.

3.19.3 Summary

Shot bags were employed to simulate the load distribution. Deflections were noted and recorded. These, in turn, were plotted in Figure 104 versus the applied load. Figure 105 shows the rudder in the test jig and Figure 106 shows the load application.

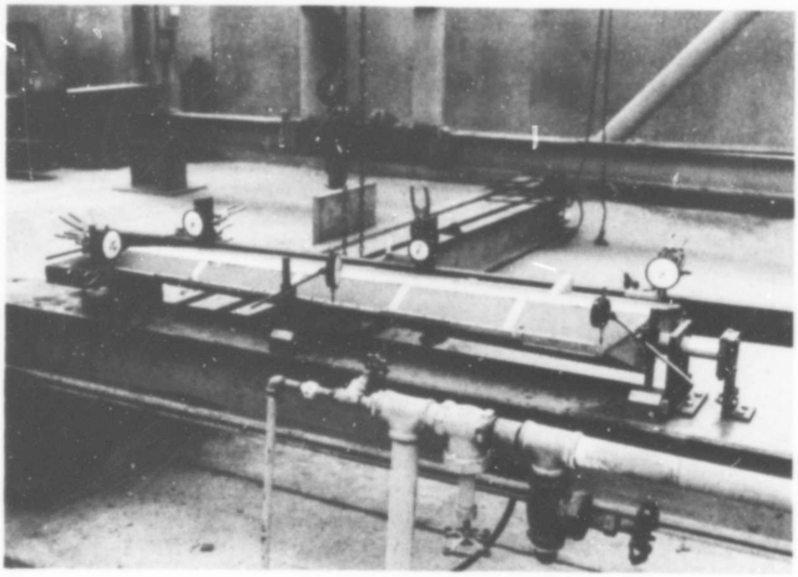


Figure 105 View Showing Rudder Accommodating Jig and Deflection Measurement Setup. Note Torque Tube Tie In.

Figure 106 View of Rudder in Jig with Load Applied

3.20 TEST NO. 20 - CANOPY AND FRAME

3.20.1 Test Condition

High Speed Flight q ° 850 psf, 5° Sideslip

3.20.2 Introduction

The canopy was mounted in a fixture to simulate aircraft hardware such as shear fittings and hinge supports. The test was then carried out according to the test procedures outline.

3.20.3 Summary

Canopy deflections and latch loads were measured and recorded at 0, 20, 40, 55, 66.6, and 80% of ultimate load. (The 100 per cent ultimate load was held for only 40 seconds before the canopy failed. No other data was obtained in that time.) Deflections were measured by strain gage beams. Strain gages were used to measure the latch loads (which are tabulated in Table IV).

The forward R/H shear fitting failed on the inboard top side at 20% of ultimate load. Additional forward shear fittings were installed on the longerons and the test was rerun. The canopy was then strengthened by overlaps of Fiberglas on the center spar and forward arches. The canopy test was then rerun up to 100% of ultimate. Failure occurred after maintaining 100% ultimate for approximately forty (40) seconds.

Deflection data of the various points were plotted and are presented in Figures 107 and 108 versus ultimate load. Figures 109 and 110 show the model used to determine the method of distributing the static test loads on the windshield and canopy. Figure 111 shows the method of load application, and Figures 112 and 113 show the failed canopy.

TABLE IV

CANOPY LATCH LOADS

%	Pounds (Right)	Pounds (Left)
20	7,350	5,640
40	17,010	12,900
20	7,440	5,760
55	24,630	18,360
20	8,160	6,660
66.6	30,000	22,740
20	8,040	6,840
80	Gage Lost	27,540
20	8,100	6,750

FIG. 107
TEST N° 20
CANOPY

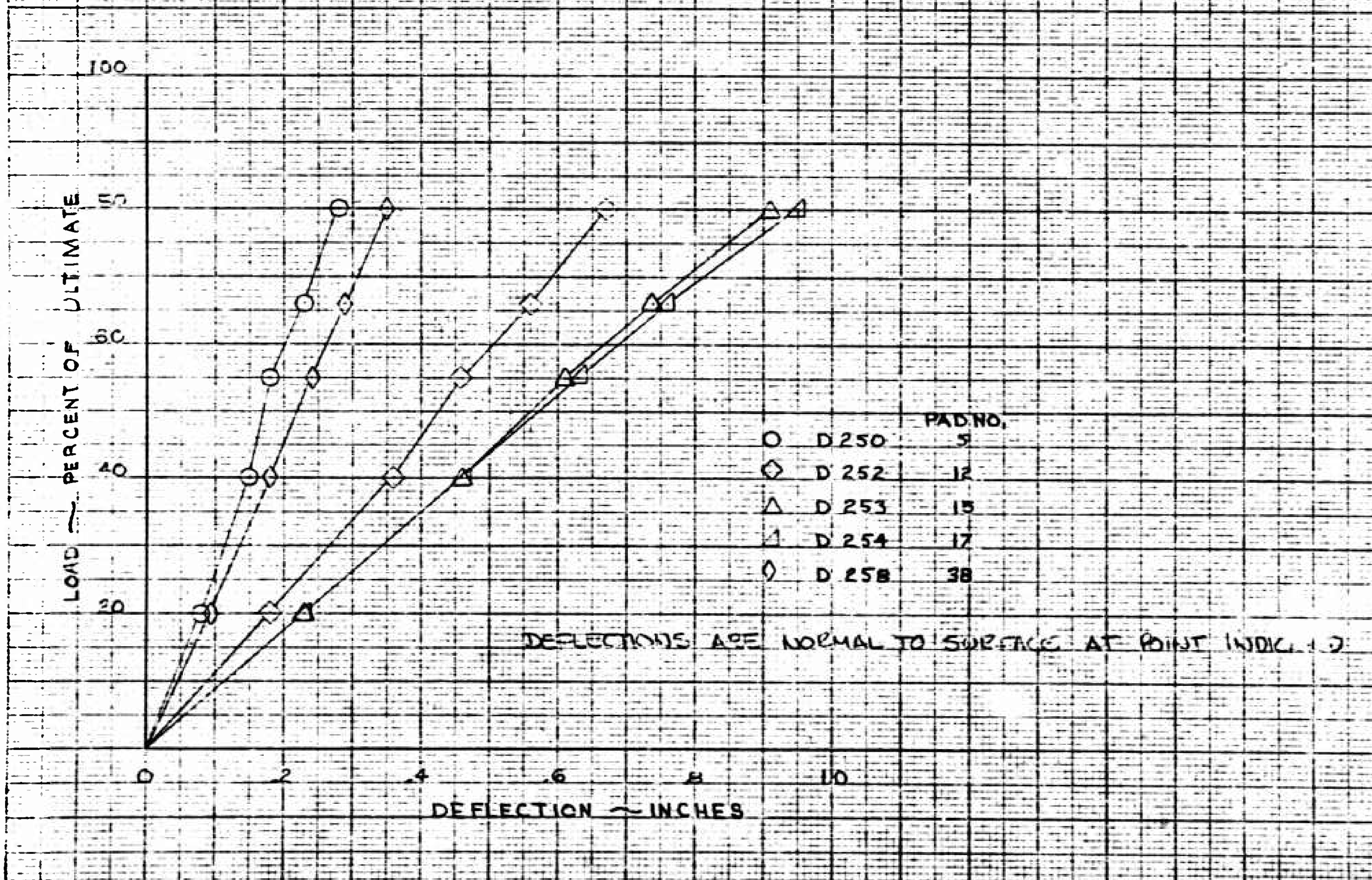
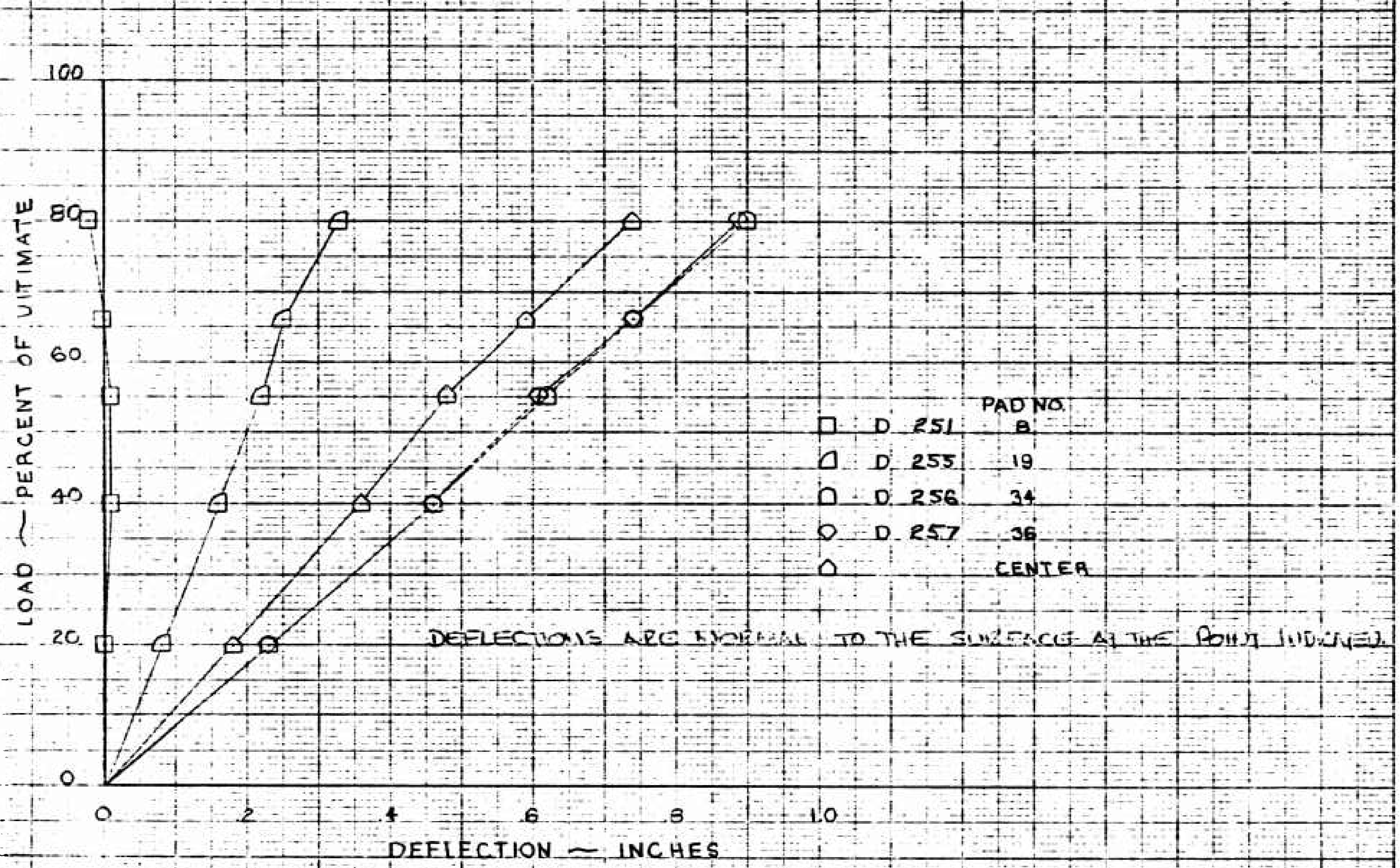


FIG 108
TEST N° 20
CANOPY



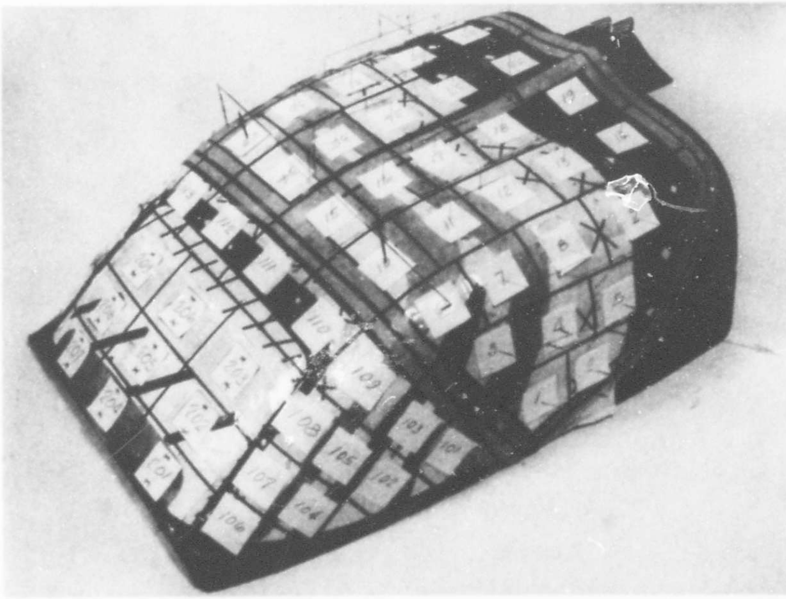


Figure 109 View of Forward Left Side of Windshield and Canopy Deflection Pad Numbers

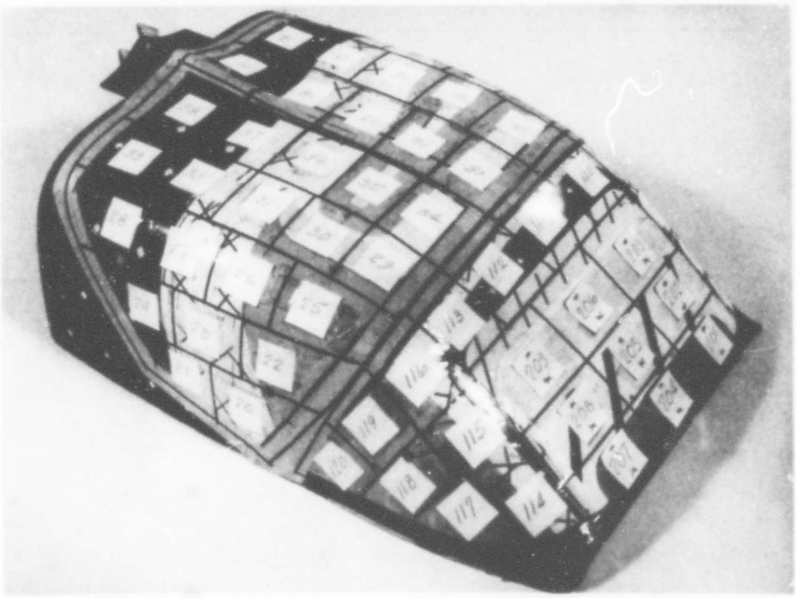


Figure 110 View of Forward Right Side of Windshield and Canopy Deflection Pad Numbers

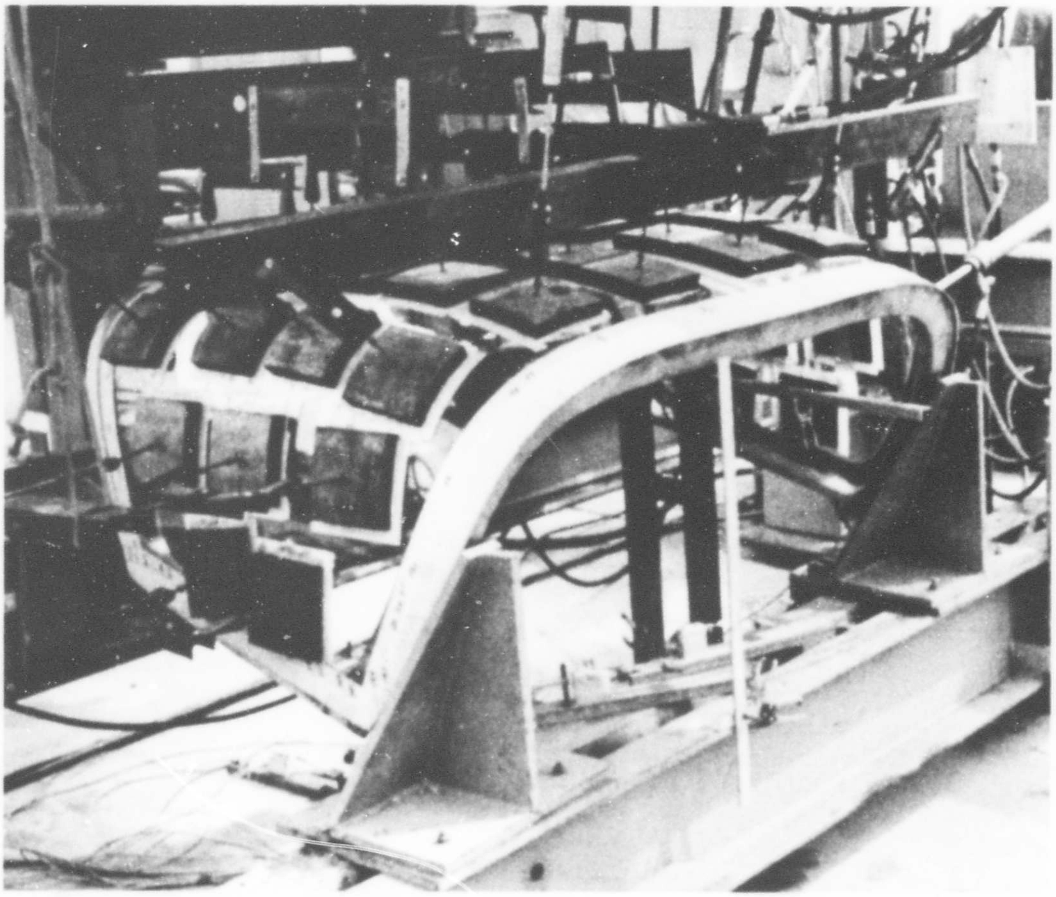


Figure 111 View of Canopy Test Whiffletree Setup and Supporting Structure - Forward Edge in Foreground

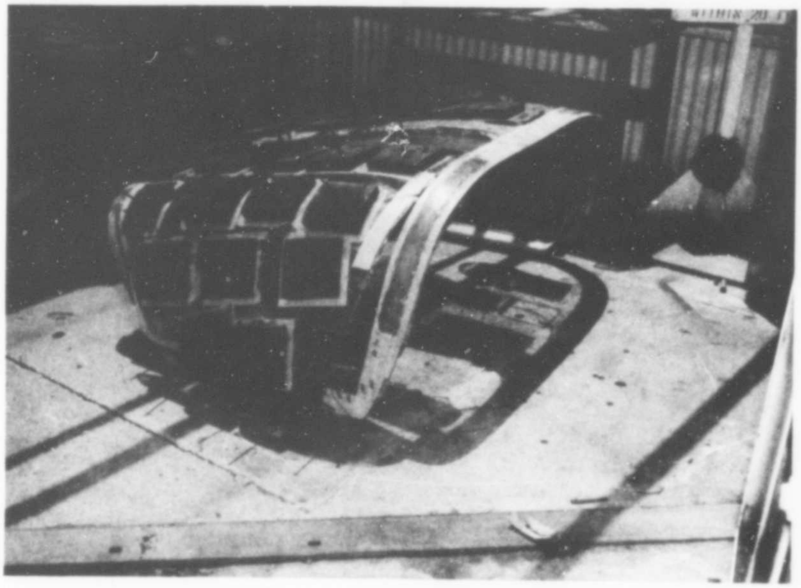


Figure 112 View of Right Front Side of Failed Canopy

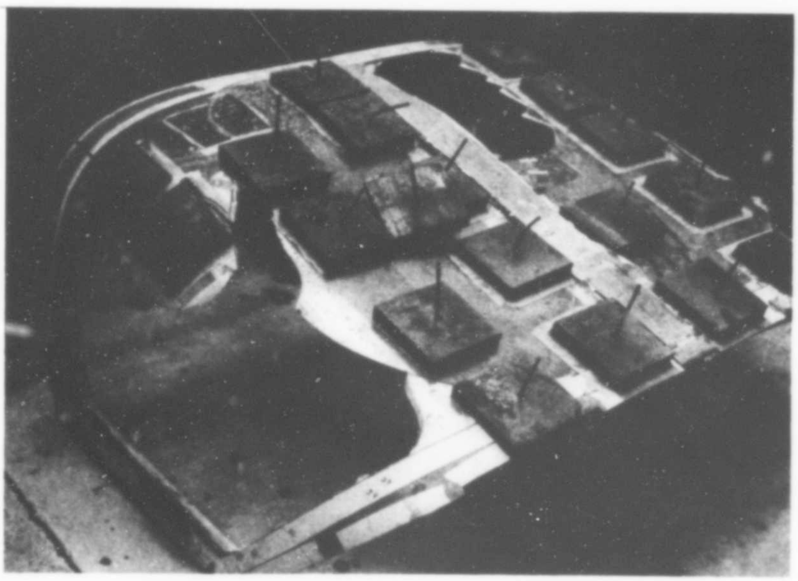


Figure 113 View of Left Rear Side of Failed Canopy

3.21 TEST NO. 21 - ELEVATOR, AILERON AND RUDDER CONTROL SYSTEMS

3.21.1 Test Conditions

Maximum Pilot Effort

3.21.2 Introduction

The test was conducted according to the procedures outline with the following deviations:

a. A spring scale was used to apply lateral stick loads instead of a Bimba hydraulic cylinder.

b. Pilot effort loads were applied to the controls in CTOL mode only.

c. The collective control stick was loaded to 150 pounds in both up and down directions.

d. In the VTOL mode, the control stick and both rudder pedals were displaced to their extreme positions (separately) with hydraulic power on and held firmly as hydraulic power was shut off. A spring scale was used to pull the stick or rudder pedal in the opposite direction of which it was displaced and the force recorded to bring it to the cockpit stops.

Results:

Stick - 35 lbs. to lateral stops
5 lbs. to long. stops

Rudder Pedals - 88.4 lbs. to L/H stop
132 lbs. to R/H stop

e. In VTOL mode, the control stick was restrained in the full aft position by a 150-pound force. With the horizontal stabilizer in the full L.E. down position, an increasing down load was applied to the elevators until the control stick just cleared the aft stop. The elevator moved down 6° before first movement of stick occurred.

f. A 75-pound aft load was applied to both throttles (separately) with the load reacted by bottoming of the lower throttle mechanism. The outboard throttle handle deflected 5/8 inch aft and the pivot 1/8 inch downward. The inboard throttle handle deflected 1/8 inch aft with no noticeable movement of the pivot.

3.21.3 Summary

The elevator aileron and rudder control systems and collective control stick successfully withstood the applied pilot effort loads.

During the lateral stick loading, the control stick pivot tube pulled out of its aft bearing support. A fix was made and the load was successfully withstood.

The elevator, aileron and rudder control system deflection data appear in Figures 114, 115, 116 and 117, respectively.

FIG. 114

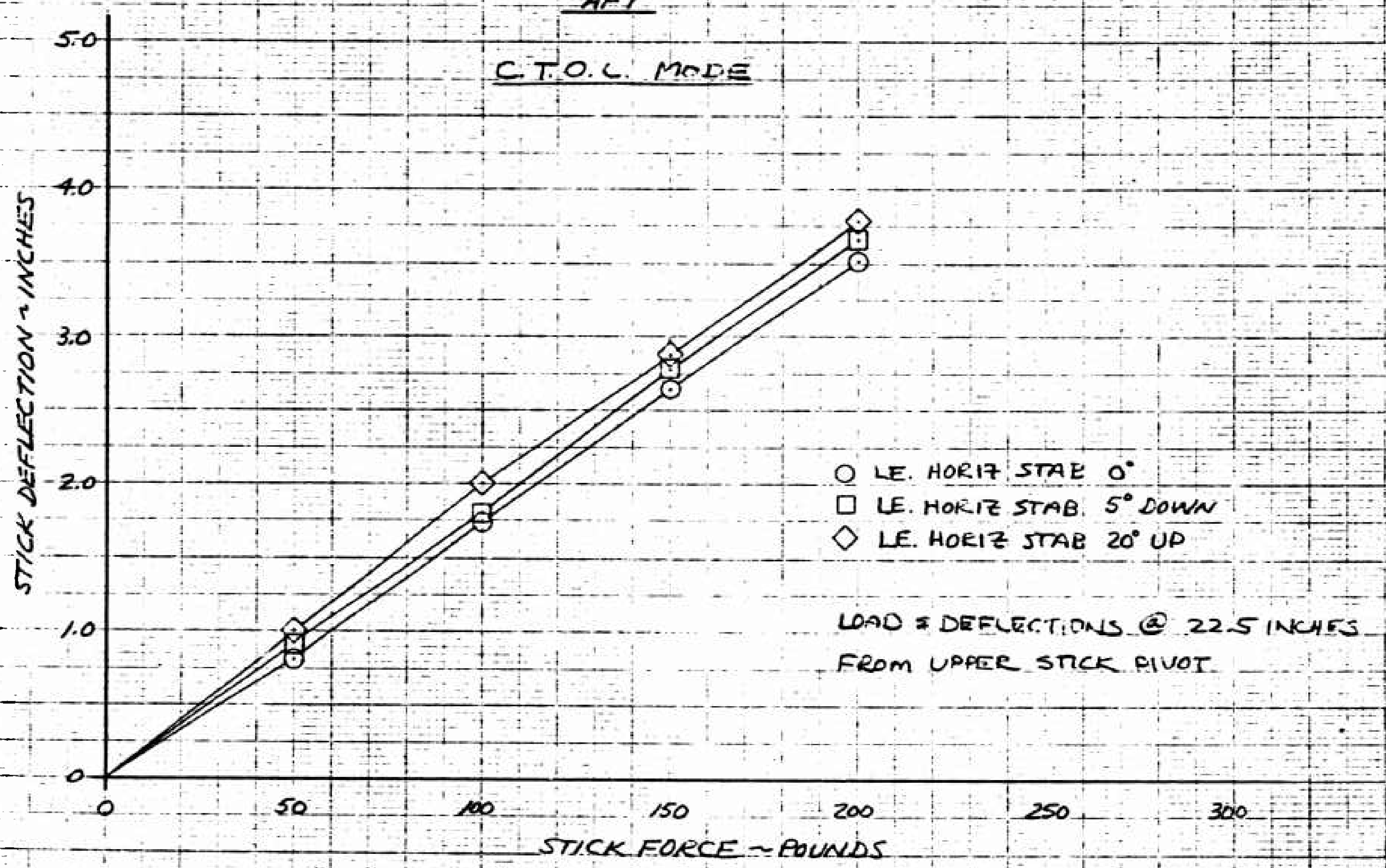
ELEVATOR CONTROL SYSTEM

MAXIMUM PILOT EFFORT

LONGITUDINAL STICK

AFT

C.T.O.L. MODE



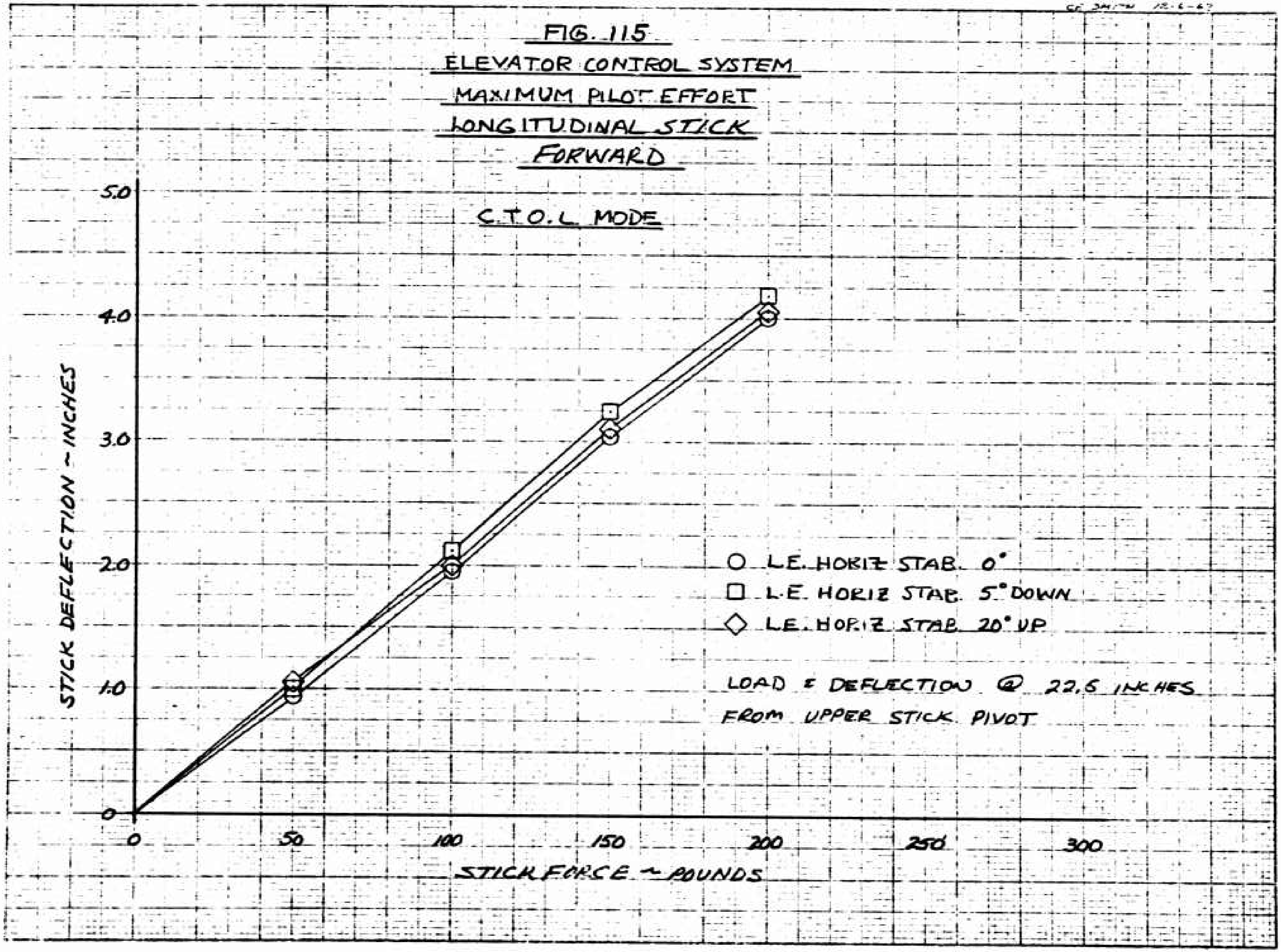


FIG. 115
ELEVATOR CONTROL SYSTEM
MAXIMUM PILOT EFFORT
LONGITUDINAL STICK
FORWARD

C.T.O.L. MODE

FIG. 116

AILERON CONTROL SYSTEM

MAXIMUM PILOT EFFORT

LATERAL STICK

C.T.O.L. MODE

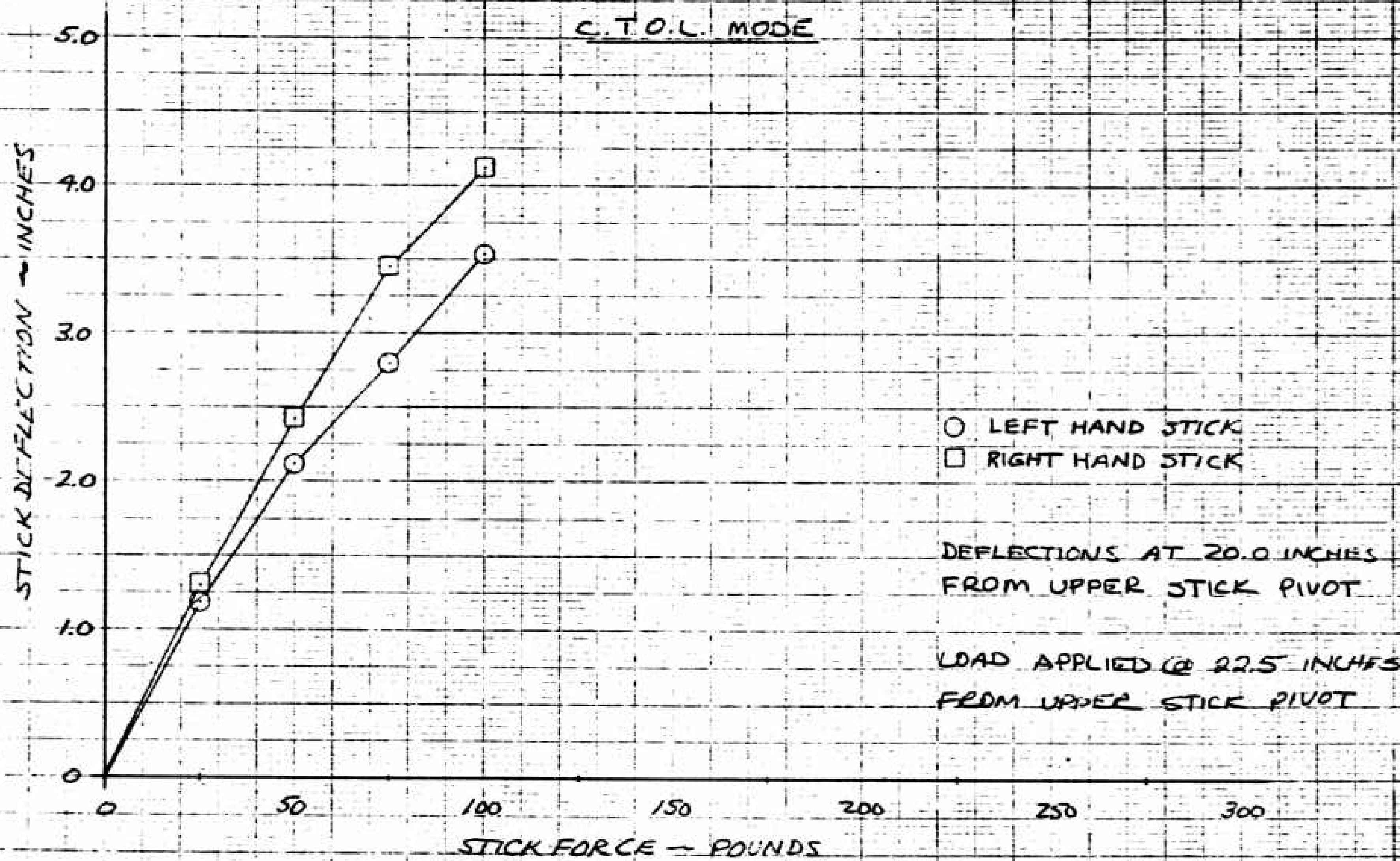
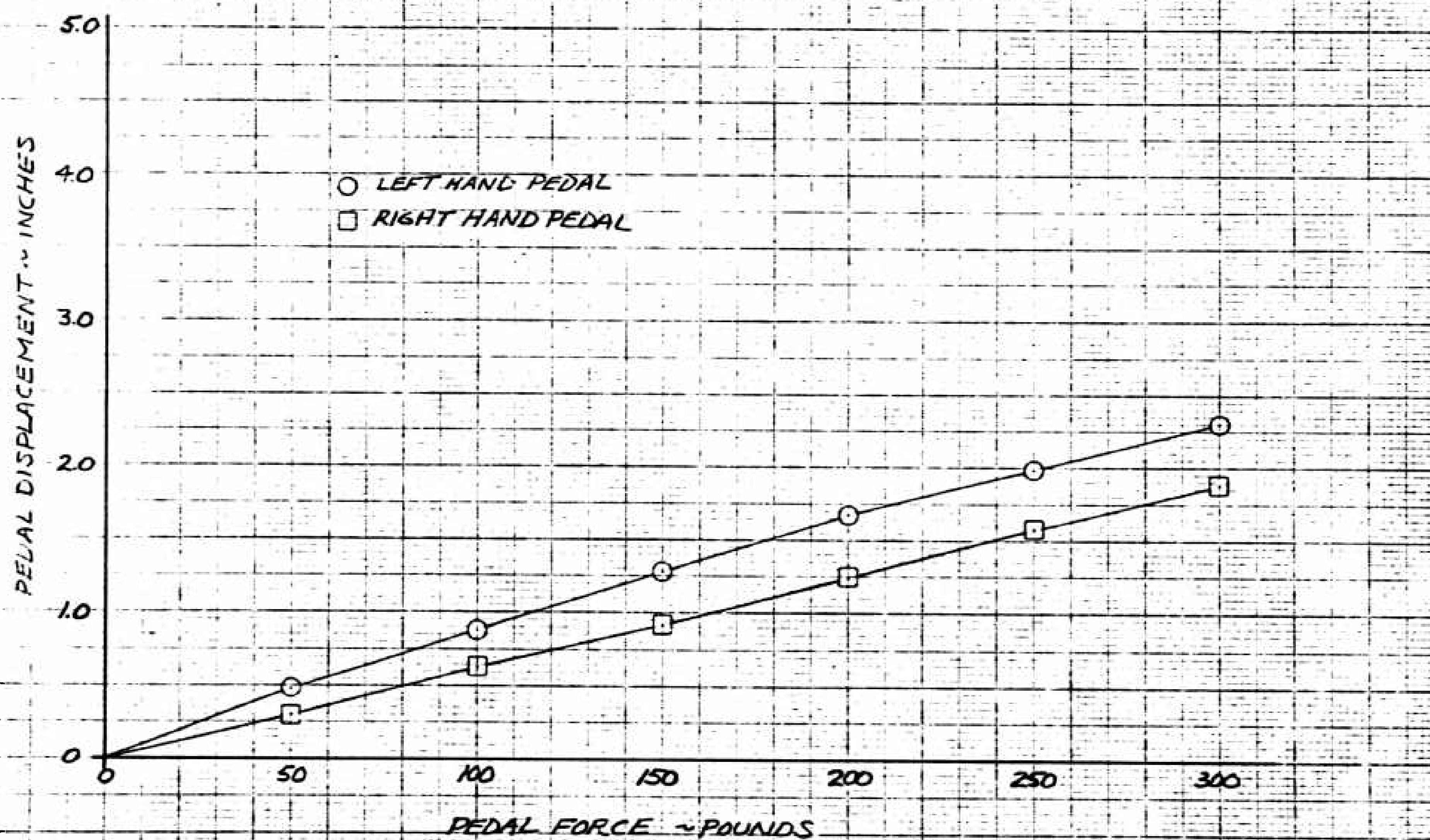


FIG. 117

RUDDER CONTROL SYSTEM

MAXIMUM PILOT EFFORT

C.T.O.L. MODE



3.22 TEST NO. 22 - WING FAN DOORS AND ACTUATING HARDWARE

3.22.1 Test Condition

High Speed Flight n_z = 4.0, Mach = 0.8, q = 850 psf Max Wing Fan Door Loading

3.22.2 Introduction

This test represents a critical structural check of the wing fan door, door actuator arms, outrigger arms, support structure, G.E. fan hub and supporting struts. The test was conducted in three steps.

a. All actuators functioning normally.

b. With only inboard forward actuator and outboard aft actuators functioning normally.

c. With only inboard aft actuator and outboard forward actuator functioning normally.

The application of loading was completed and measurements of deflection were made according to the test procedures outline.

3.22.3 Summary

Deflections of the closed fan doors due to a simulated 4 g load with all actuators pressurized at 3000 psi are plotted in Figures 118 thru Figure 120. This applied 4 g load was added incrementally in six steps.

Condition b is a repeat of the above except the doors are restrained by only two pressurized actuators. For this case, the inboard forward and outboard aft actuators were pressurized. The fan door deflections obtained for this condition appear in Figures 121 through Figure 123.

At the conclusion of this test condition, testing was stopped until a suitable explanation could be found for the high loads being shown by the Number 3 strainsert bolt. See Table V. (It was noted before the start of testing that certain of the strainsert bolts indicated considerable load transfer between door actuator brackets and the fan "record player", with only the actuators pressurized and no external airloads to the doors.

The doors were removed and an attempt was made to determine if there were any clearance problems between the top of the actuator brackets and the hinge attach points. No clearance problems were found which would tend to cause load transfer to the "record player" structure.

Upon reassembly of doors and hinges, it was found that there was considerable bolt binding in the actuator support-hinge bracket assembly. Measures were taken to correct the bolt binding situation; but upon reassembly, it was noted that the strainsert bolt loads continued to give indications of large loads while pressurizing the actuators with no external load on the doors. A table of indicated strainsert bolt load versus actuator hydraulic pressure is given in Table VII. Attempts were again made to apply the airloads to the doors in a retest of the condition, but the bolt loads tended to duplicate the previous loads.

Condition C represents the same loading condition except with the opposite actuators, outboard forward and inboard aft pressurized at 3000 psi. The measured deflections of the fan doors for this condition appear in Figure 124 through Figure 126.

The side bending of the forward strut due to the above three conditions is plotted in Figure 127 as unit strain versus the applied load.

Outrigger hinge pin loads for the same three conditions are plotted in Figure 128. These loads appear as tension loads at low values of applied load due to high (3000 psi) actuator pressures reacting against the fan door seats. However, as the applied load is increased, the link tension load is alleviated, and as can be seen in Figure 128, can go in the compressive direction.

Table V is a tabulation of the strainsert bolt loads due to the above three restraining methods. Table VI gives strainsert bolt load during a rerun of Condition b. This was done as check on all the bolts but mainly as a drift check on Bolt No. 3. This rerun of Condition b did not indicate as high a reading on Bolt No. 3, and the drift was much lower.

Figures 129 through 131 show the fore and aft mount and outboard and inboard door latch deflections due to the applied load. The figures represent the deflections due to aforementioned three restraining methods, e.g., Condition a, b, c, respectively. Figure 132 shows the method of load application and Figure 133 shows deflection of the wing fan door edges.

TABLE V

TEST NO. 22 - STRAINSERT BOLT LOADS - POUNDS

%	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8		
Preload	220	230	220	220	230	210	200	230		
20	416	412	742	619	388	407	312	326		
40	426	444	790	645	407	434	321	329	22-I	All actuators active
60	420	464	800	635	428	462	323	331		
80	432	487	840	653	461	514	324	334		
90	443	490	865	662	478	533	332	336		
100	443	490	873	658	494	546	338	335		
20	470	193	1190	190	404	158	324	222		
40	491	197	1300	190	432	171	339	227	22-II	Outboard aft Inboard fwd active
60	510	201	1350	192	462	200	355	235		
80	544	201	1470	201	500	231	370	243		
90	554	214	1520	207	516	265	378	268		
100	570	204	1560	203	536	279	378	238		
20	187	636	9	755	292	564	170	304		
40	183	717	2	786	277	573	157	313	22-III	Inboard aft Outboard fwd active
60	175	710	15	795	300	613	174	320		
80	156	710	40	782	338	637	194	313		
90	136	710	50	794	365	642	188	318		
100	156	712	59	802	382	666	192	318		

TABLE VI

TEST NO. 22 - SECOND STRAINSERT BOLT READING PART II - POUNDS

%	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	
Preload	220	230	220	220	230	210	200	230	
20	488	191	960	173	404	171	310	225	Rerun
40	505	186	1035	188	422	183	321	230	Part
60	516	191	1066	173	447	207	323	233	II
80	538	193	1091	188	478	245	332	218	

TABLE VII

TEST NO. 22 - ACTUATING PRESSURE VS. APPARENT BOLT (8) LOAD - POUNDS

Actuating Pressure	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8
650	226	235	360	235	270	255	215	250
1175	268	245	460	280	300	275	230	280
1650	330	295	530	370	320	310	255	300
2100	395	335	625	470	340	335	260	340
2600	425	410	720	590	375	380	280	325
3000	440	450	770	650	395	400	300	335
Bolt Preload	220	230	220	220	230	210	200	230

Bolt tension loads measured with fan doors fully closed and latched with hydraulic actuators holding doors against latches.

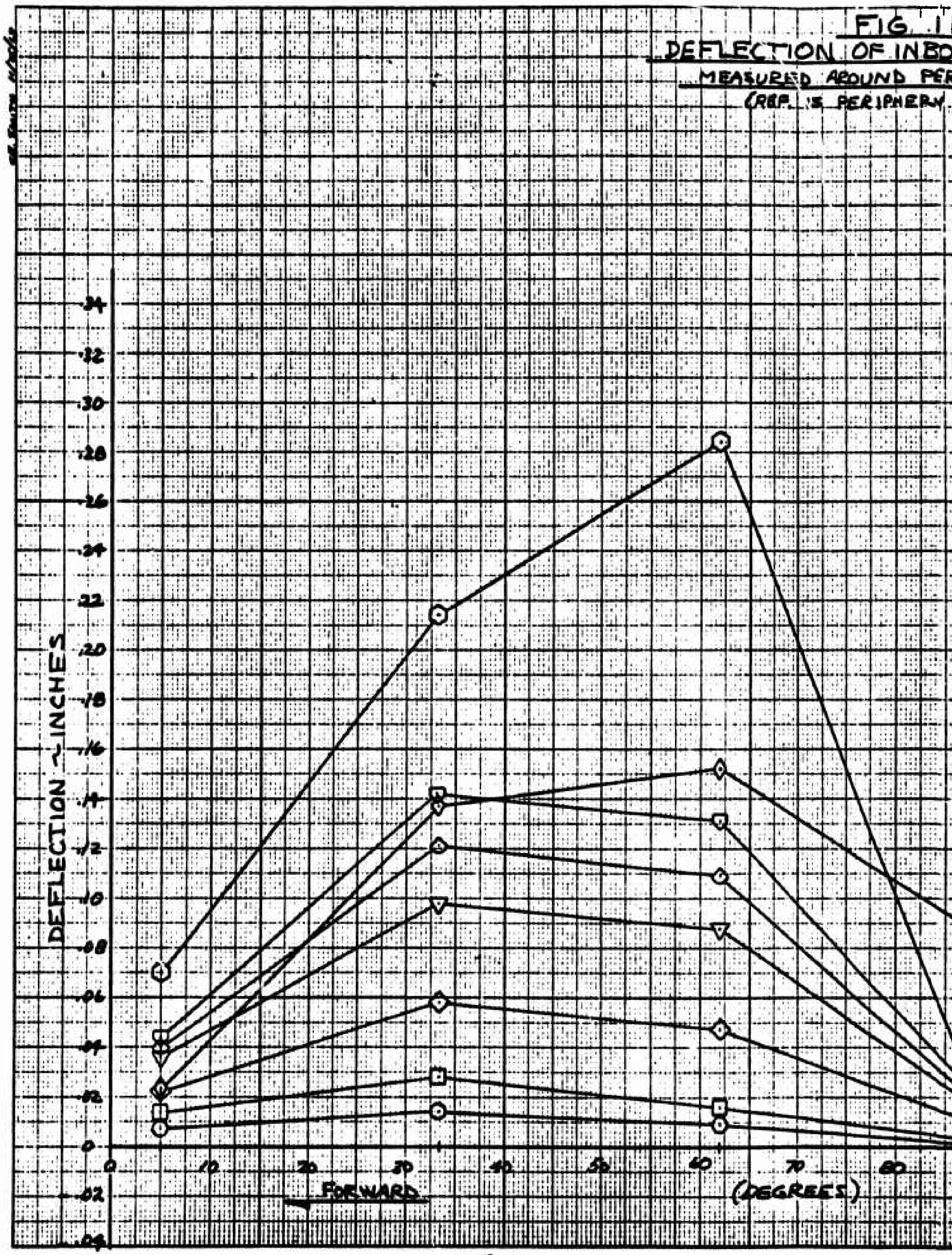


FIG. 1
DEFLECTION OF INBO
MEASURED AROUND PER
(REF. IS PERIPHERY.
DEFLECTION ~ INCHES
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
-.04
0
10
20
30
40
50
60
70
80
FORWARD
(DEGREES)

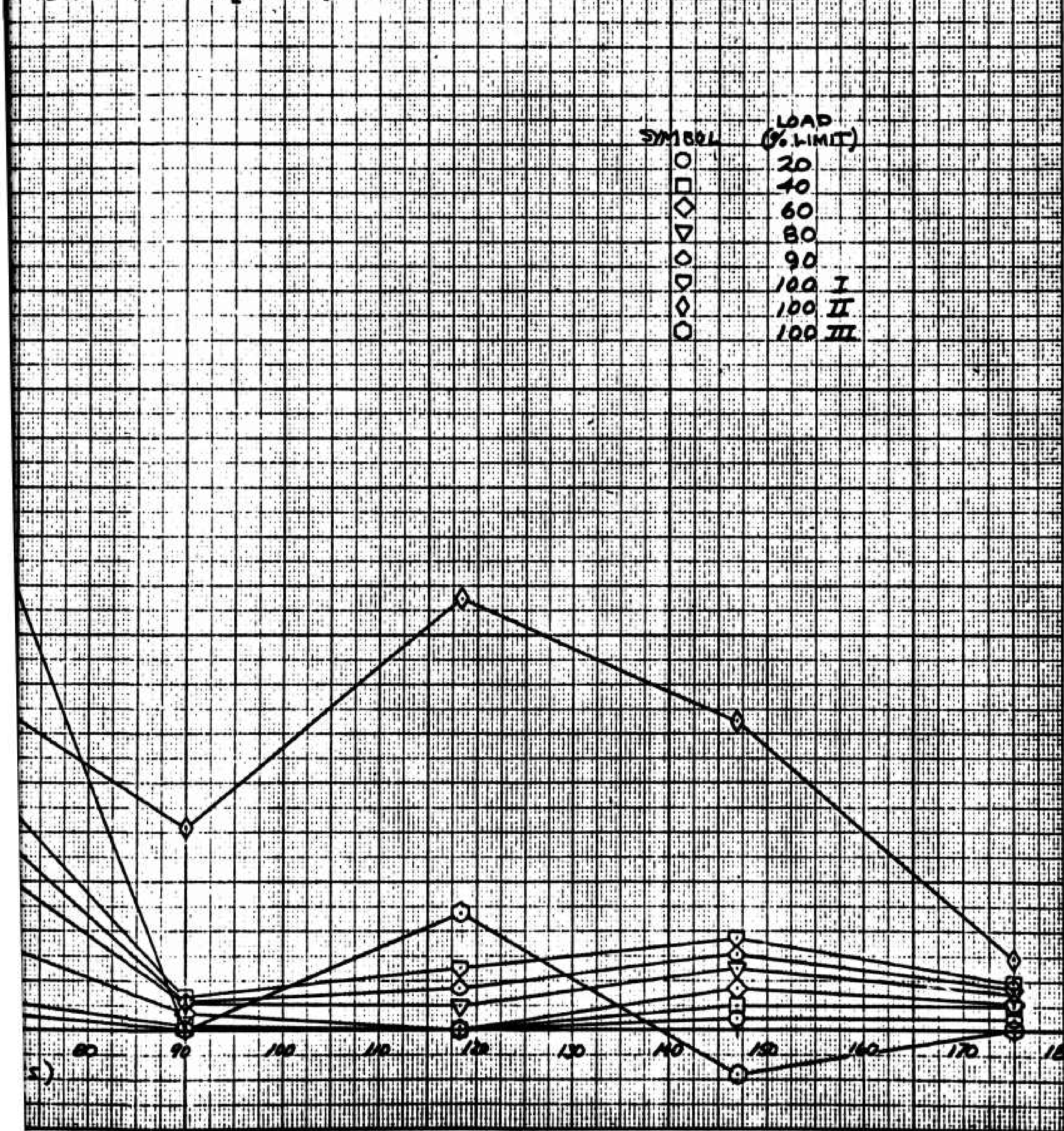
A

FIG. 118

ON OF INBOARD DOOR-TEST NO. 22 I

AROUND PERIPHERY OF DOOR

(PERIPHERY OF BELLMOUTH)



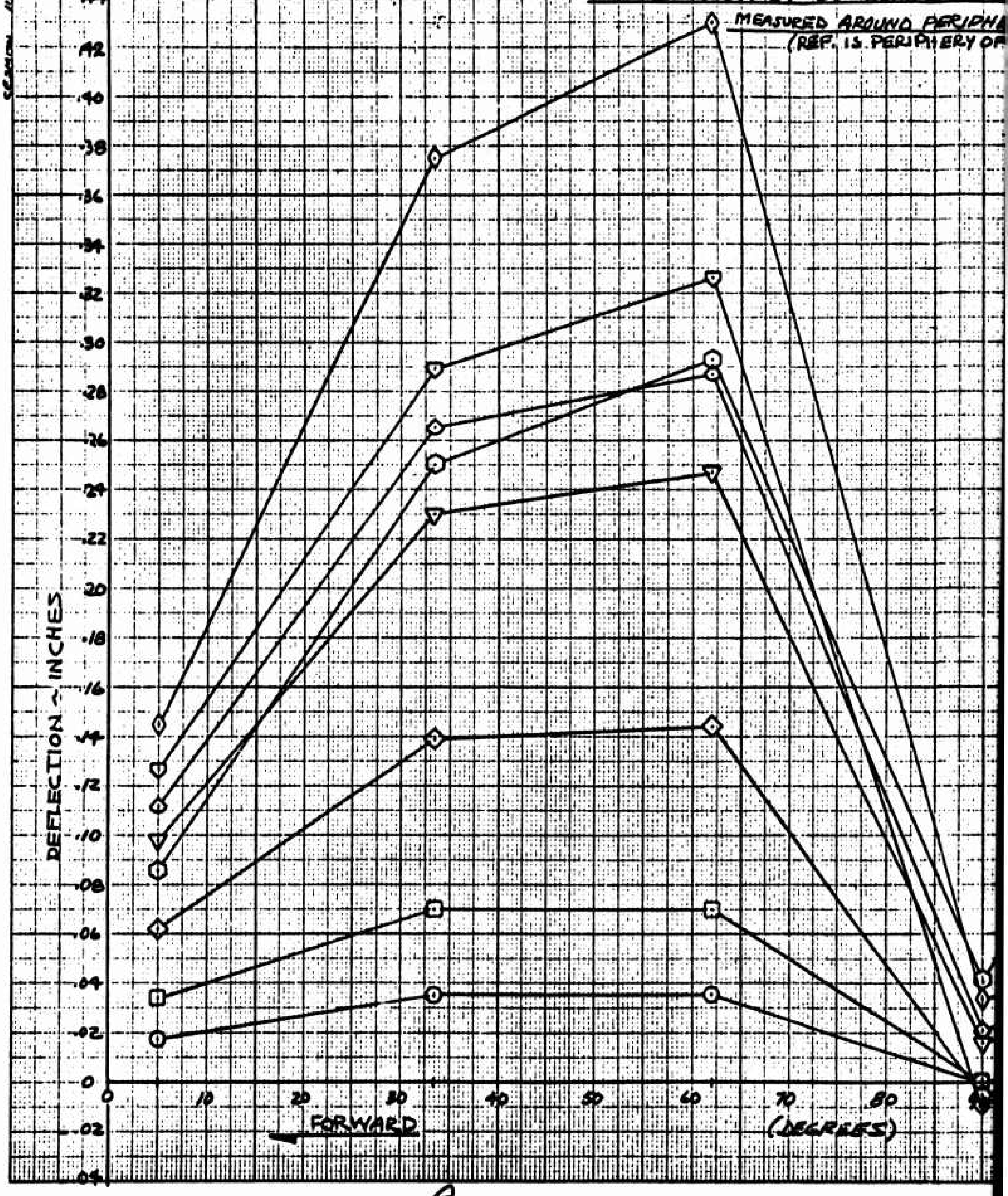
B

FIG. 119

DEFLECTION OF OUTBOARD DOO

MEASURED AROUND PERIPHE

(REF. IS PERIPHERY OF



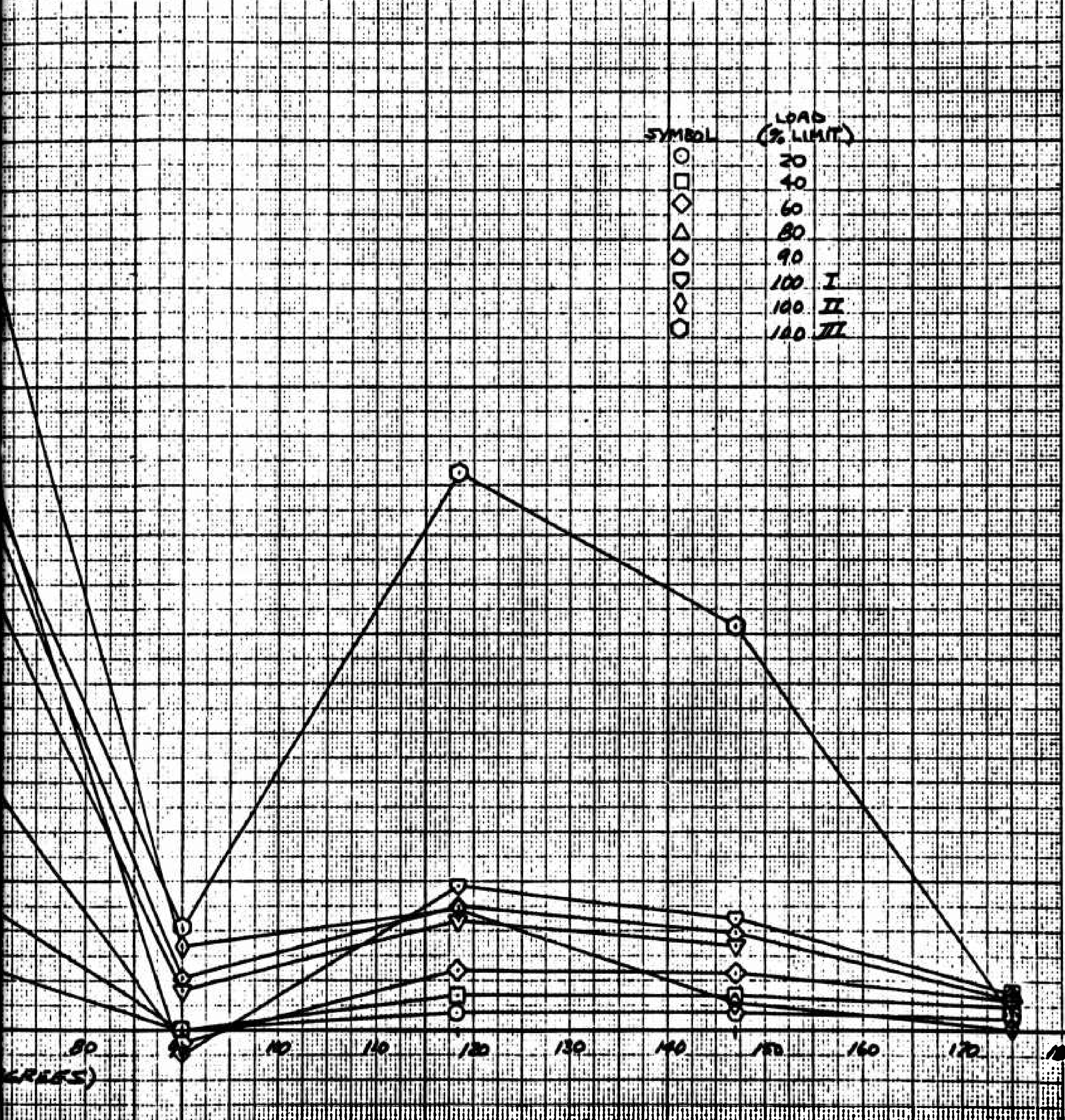
A

FIG. 119

OUTBOARD DOOR - TEST NO. 22 I

ED AROUND PERIPHERY OF DOOR

REF. IS PERIPHERY OF BELLMOUTH)



B

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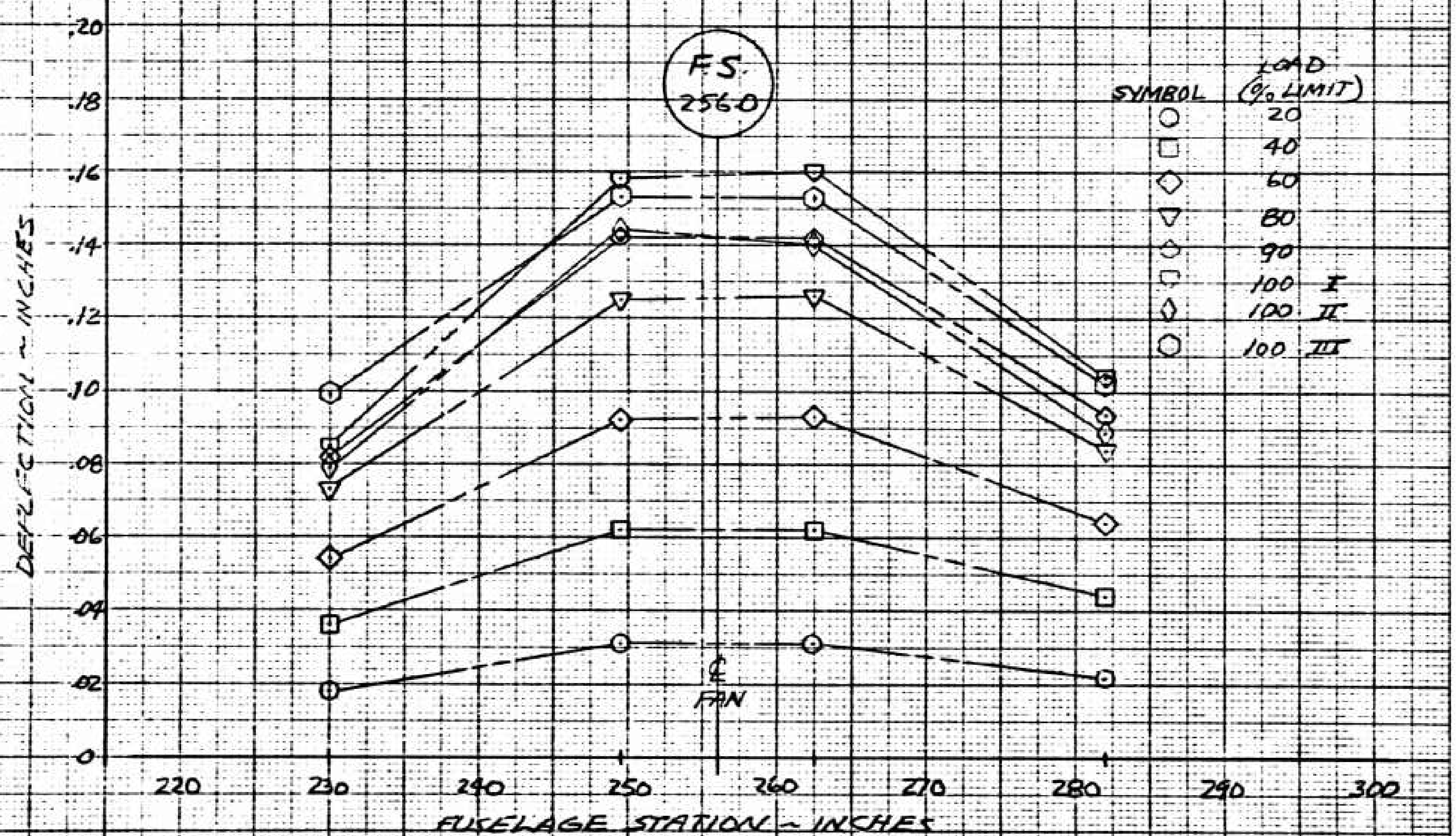
FIG. 120
DEFLECTION OF ACTUATOR AND OUTRIGGER HINGE LINES
I



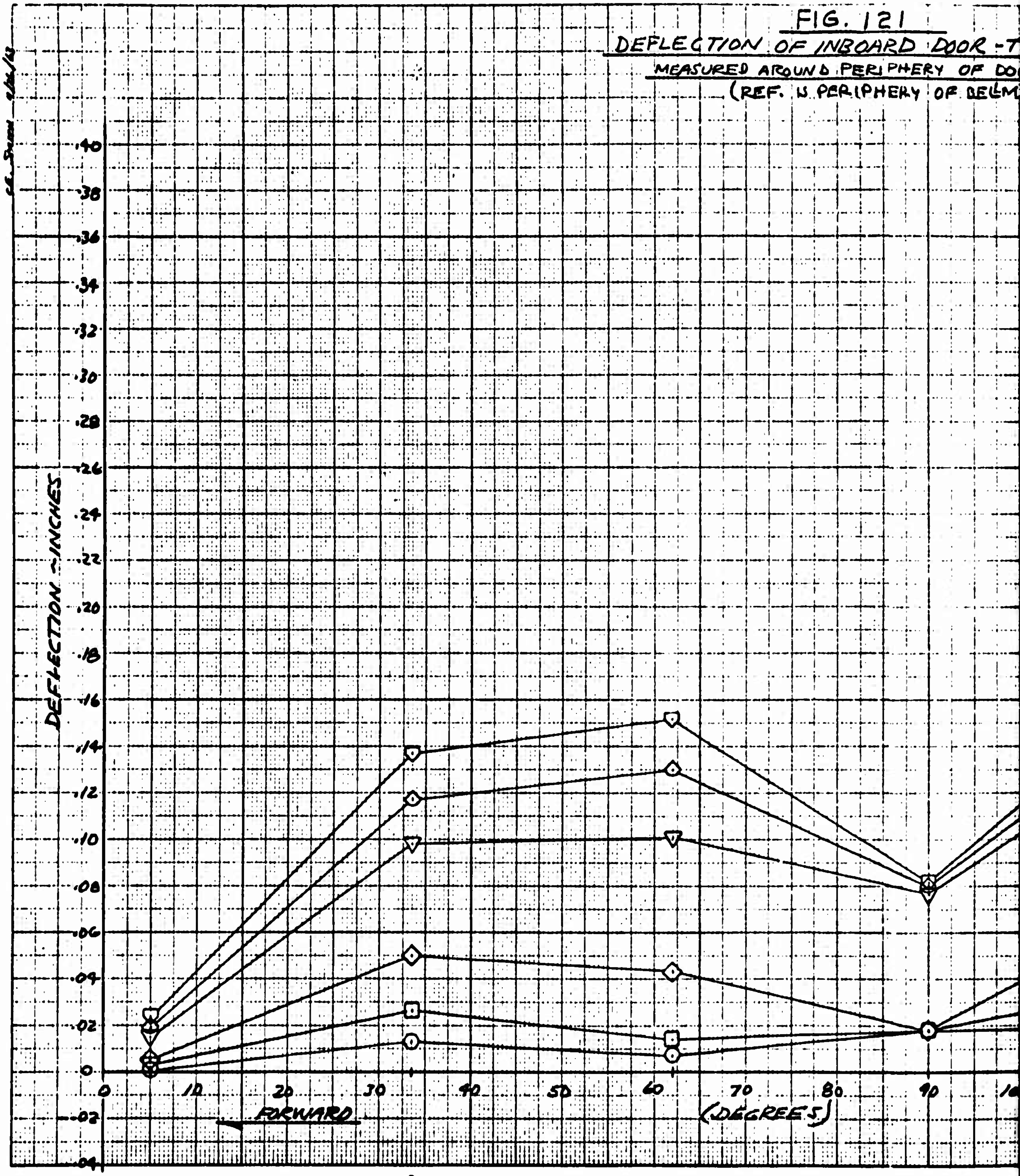


FIG. 121
DEFLECTION OF INBOARD DOOR -T
MEASURED AROUND PERIPHERY OF DO
(REF. ℄ PERIPHERY OF BELLM
DEFLECTION ~ INCHES
.40
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
-.04
0
10
20
30
40
50
60
70
80
90
FORWARD
(DEGREES)

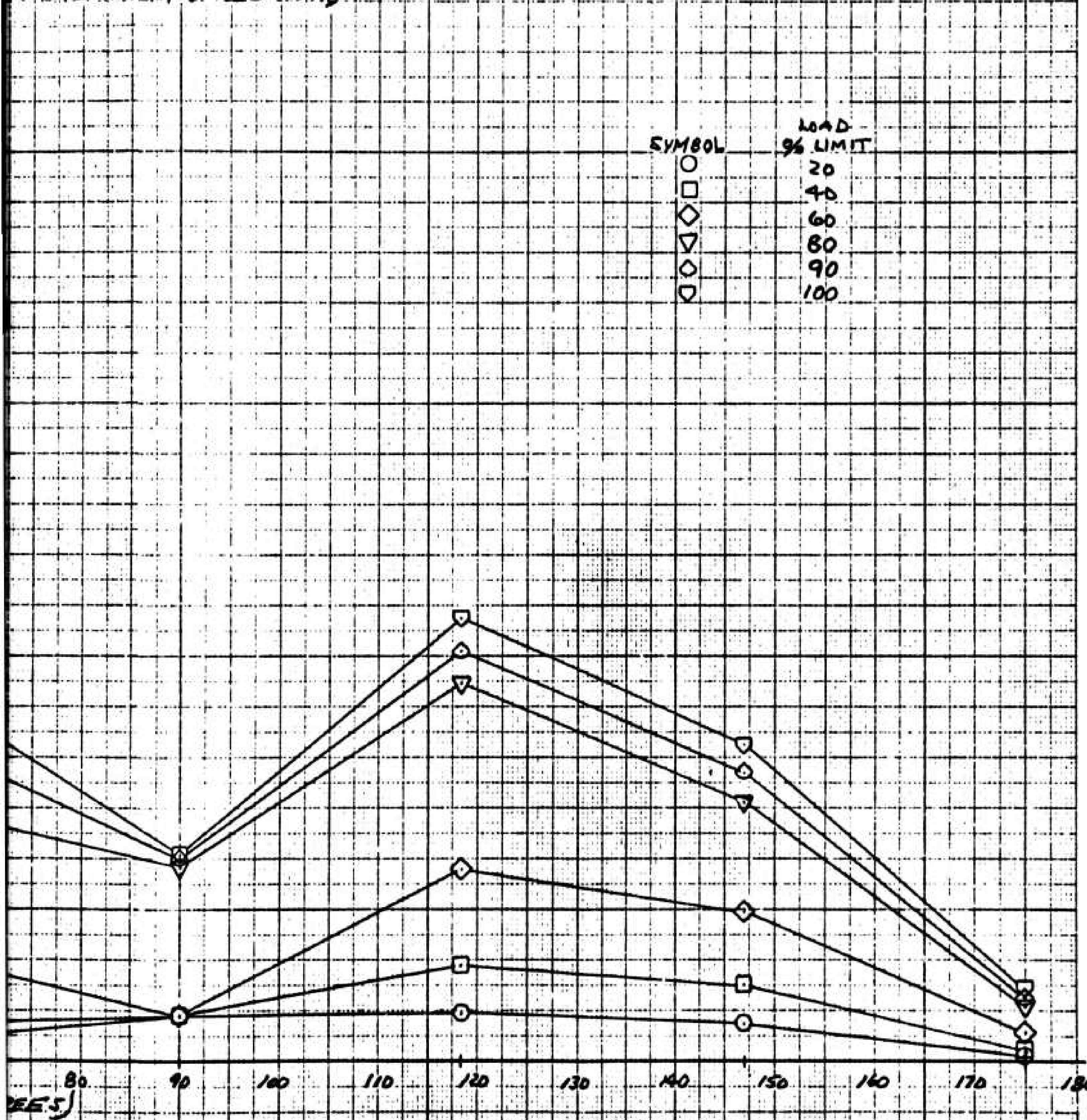
A

FIG. 121

OF INBOARD DOOR - TEST NO. 22 II

ROUND PERIPHERY OF DOOR

F. IS PERIPHERY OF BELLMOUTH)



B

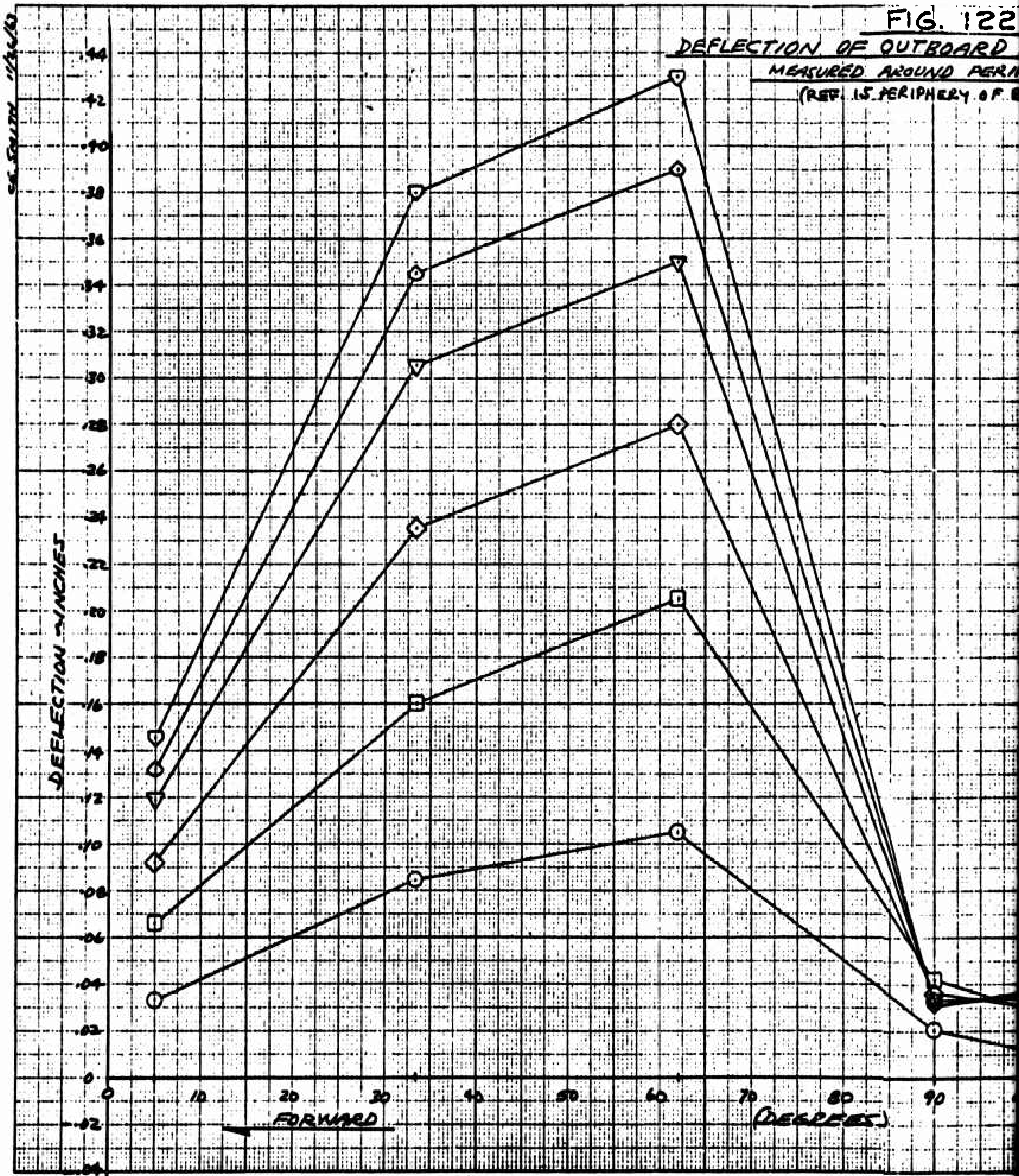


FIG. 122
DEFLECTION OF OUTBOARD
MEASURED AROUND PERI
(REF. 15 PERIPHERY OF
DEFLECTION ~ INCHES
.44
.42
.40
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
-.04
0
10
20
30
40
50
60
70
80
90
FORWARD
(DEGREES)

A

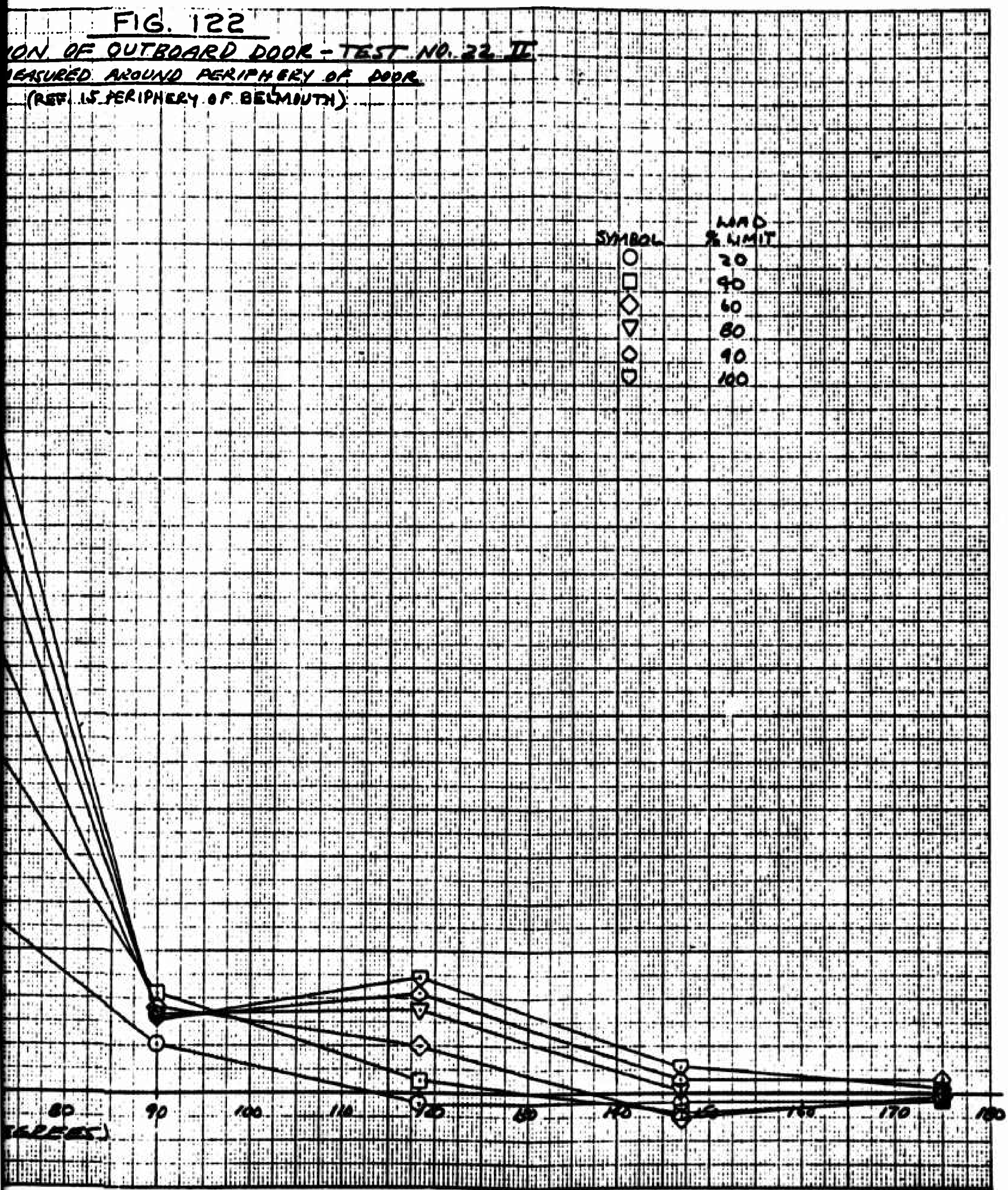


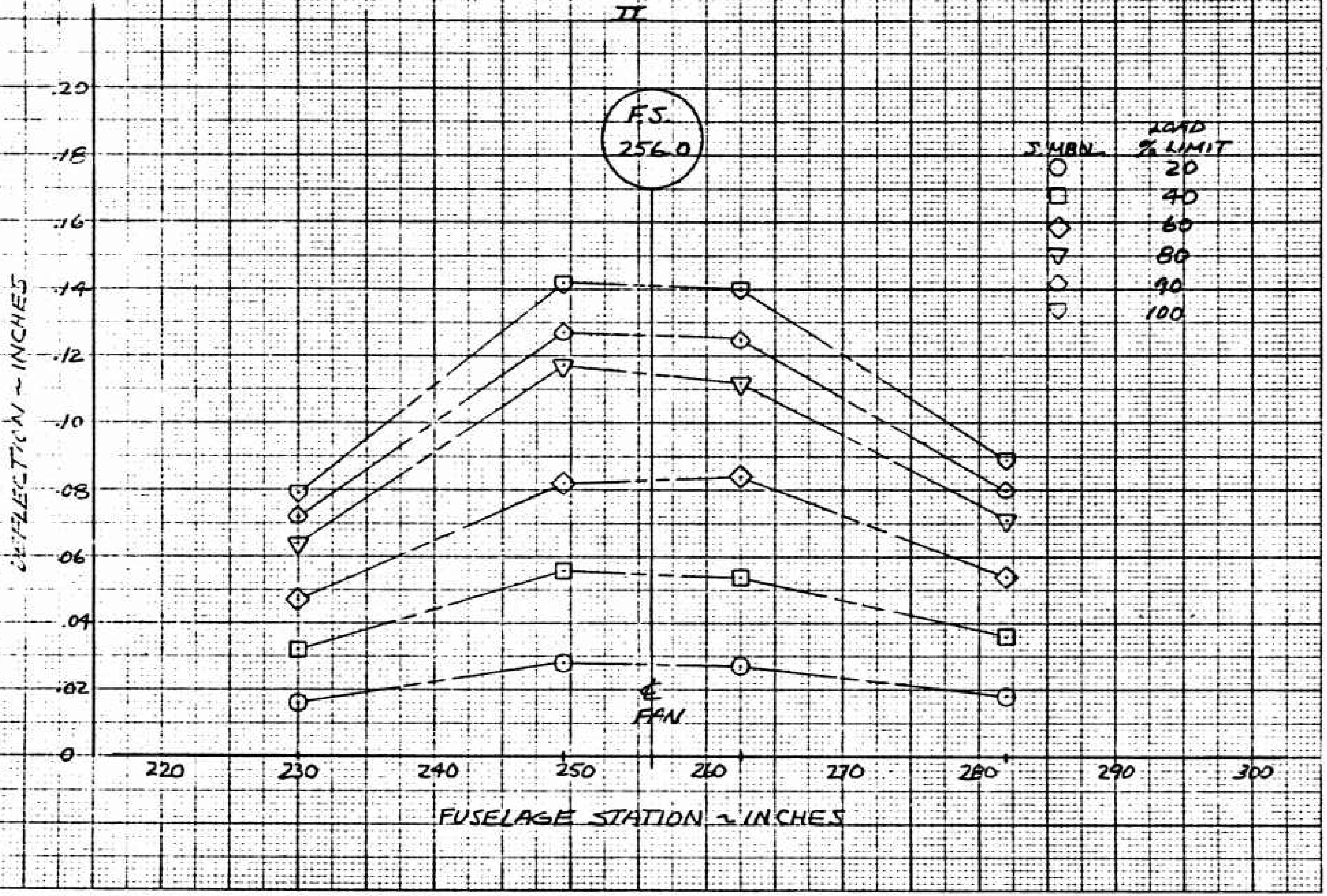
FIG. 122
ION OF OUTBOARD DOOR - TEST NO. 22 II
EASURED AROUND PERIPHERY OF DOOR
(REF. IS PERIPHERY OF BELLMOUTH)
SYMBOL
LOAD % LIMIT
20
40
60
80
90
100
80
90
100
110
120
130
140
150
160
170
180
EGREES)

B

FIG. 123

DEFLECTION OF ACTUATOR AND OUTRIGGER HINGE LINES

II



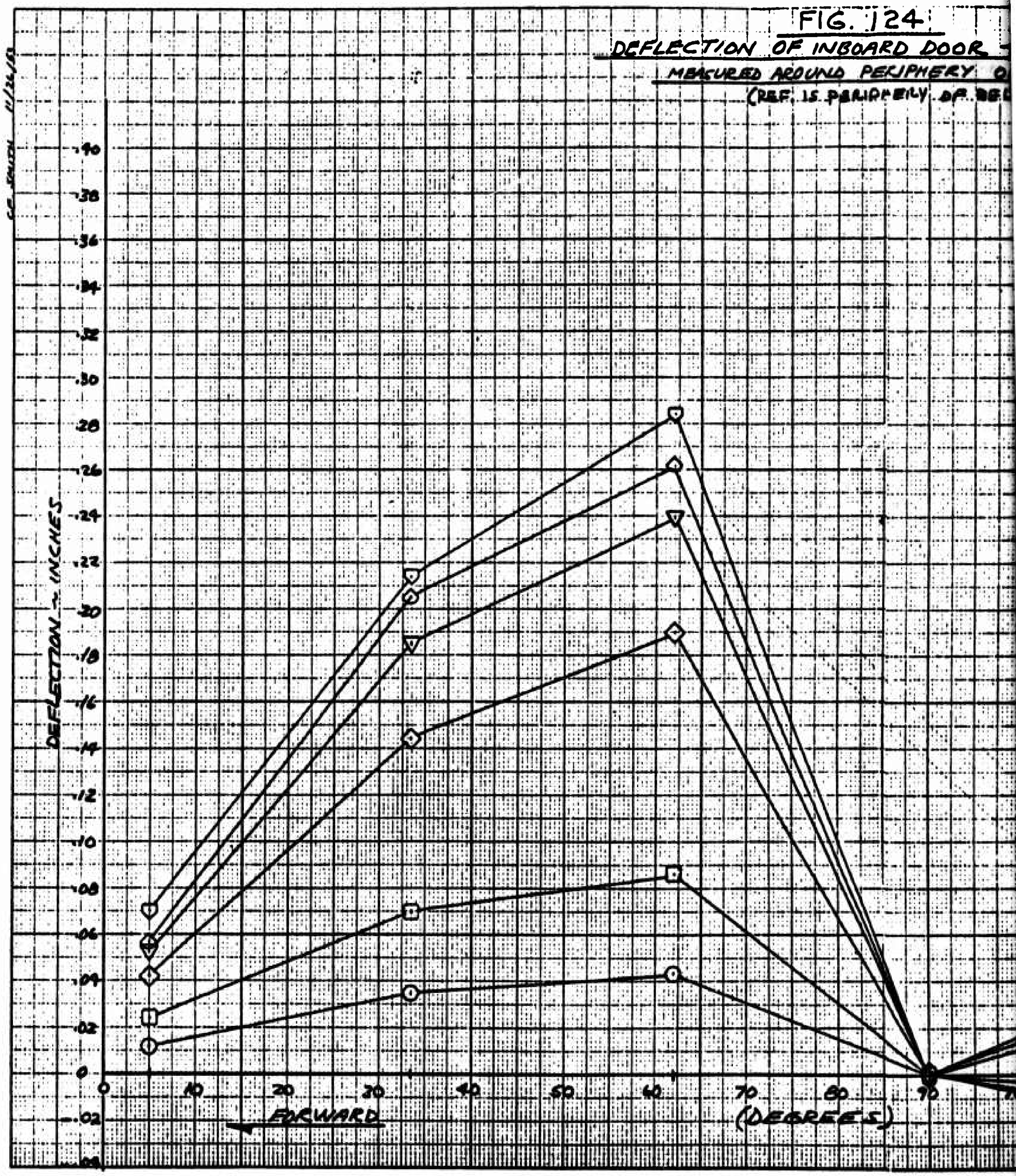


FIG. 124
DEFLECTION OF INBOARD DOOR
MEASURED AROUND PERIPHERY O
(REF. 15 PERIPHERY OF BE
DEFLECTION ~ INCHES
.40
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
0
10
20
30
40
50
60
70
80
90
FORWARD
(DEGREES)

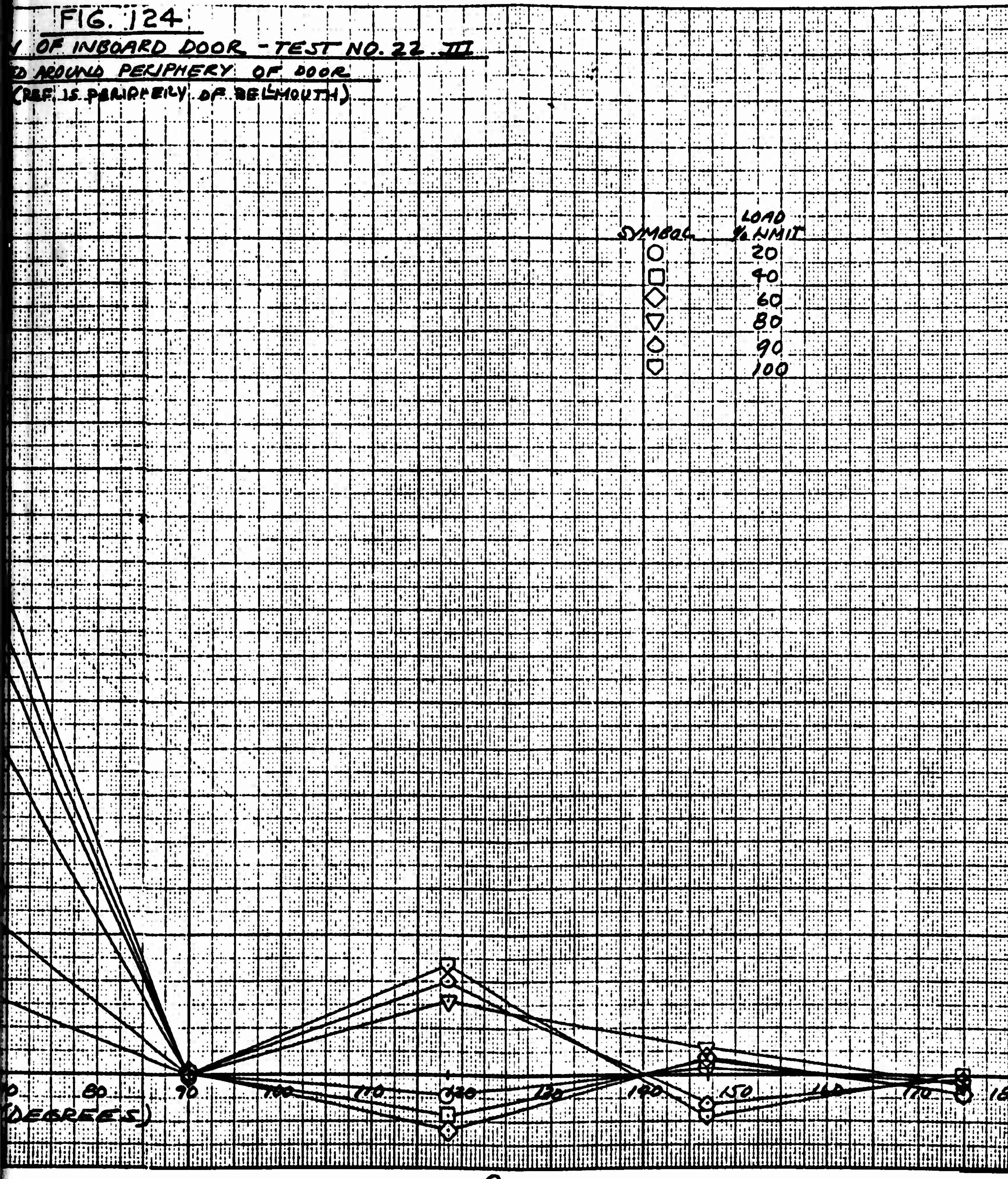
A

FIG. 124

N OF INBOARD DOOR - TEST NO. 22 III

ED AROUND PERIPHERY OF DOOR

(REF IS PERIPHERY OF BELLMOUTH)



B

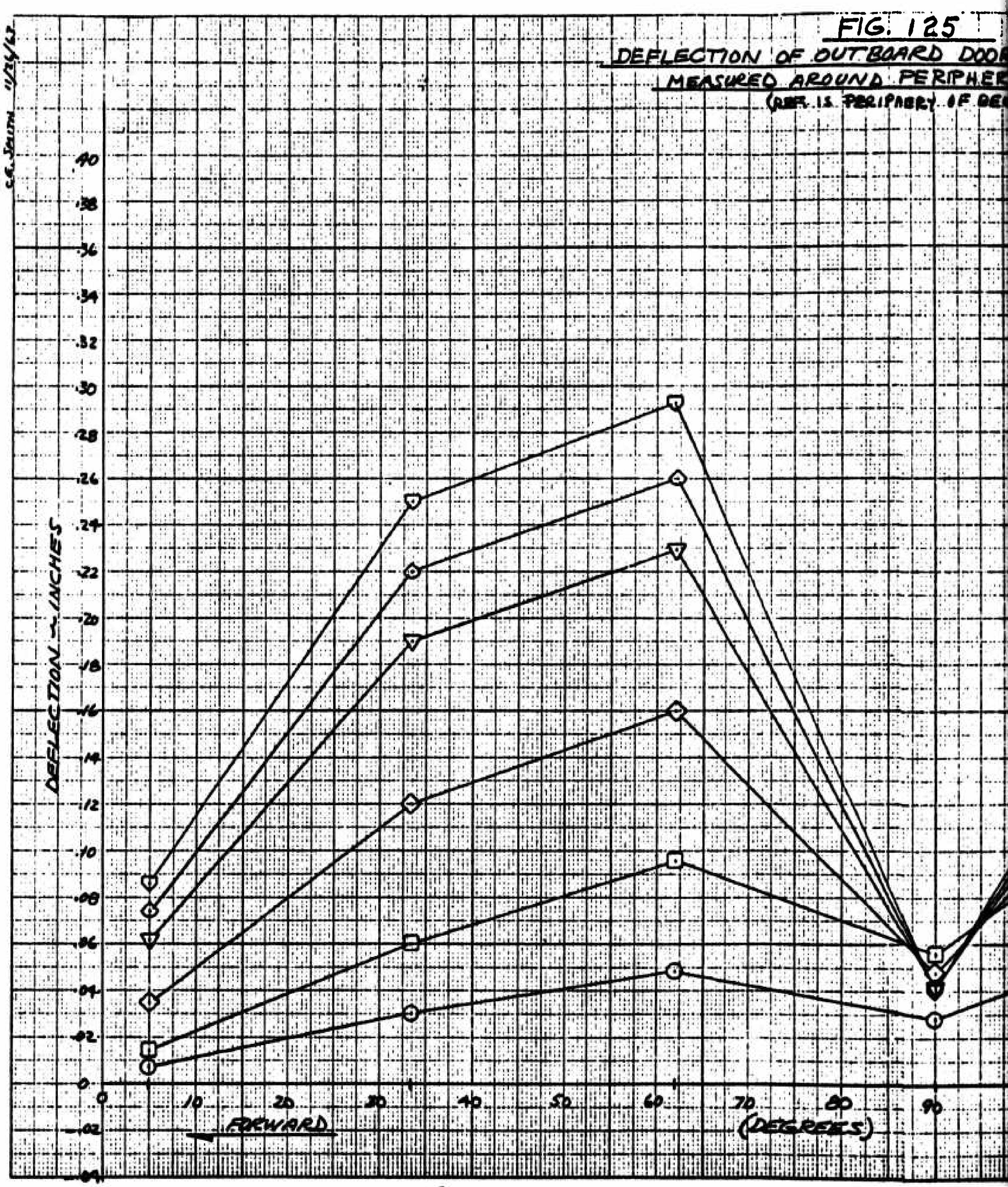


FIG. 125
DEFLECTION OF OUTBOARD DOO
MEASURED AROUND PERIPHER
(REF. IS PERIPHERY OF DE
C.E. SMITH 11/24/63
DEFLECTION ~ INCHES
.40
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
-.04
0
10
20
30
40
50
60
70
80
90
FORWARD
(DEGREES)

A

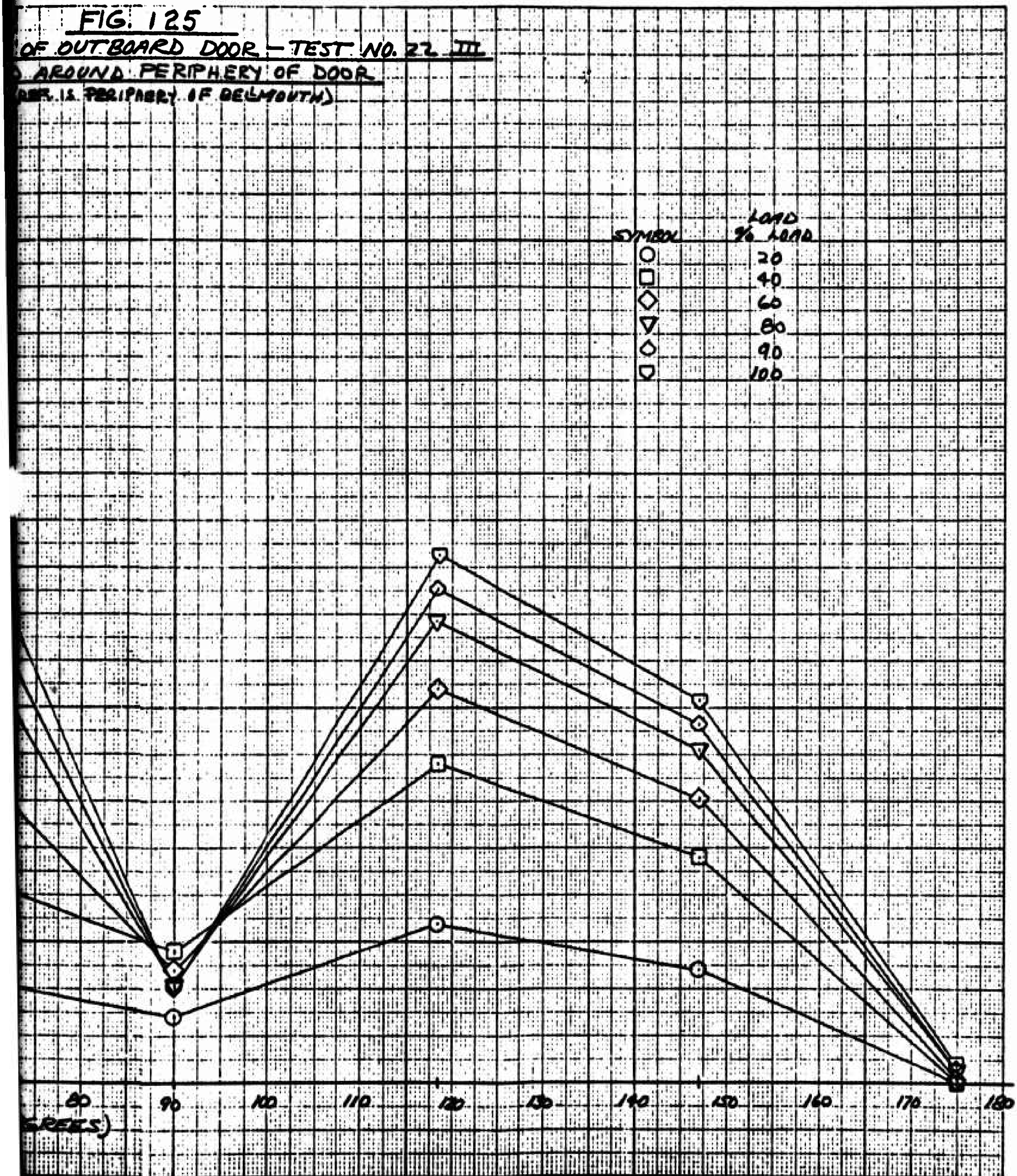


FIG. 125
OF OUTBOARD DOOR – TEST NO. 22 III
AROUND PERIPHERY OF DOOR
SYMBOL
LOAD % LOAD
20
40
60
80
90
100
80
90
100
110
120
130
140
150
160
170
180

FIG. 126

DEFLECTION OF ACTUATOR AND OUTRIGGER HINGE LINES

III

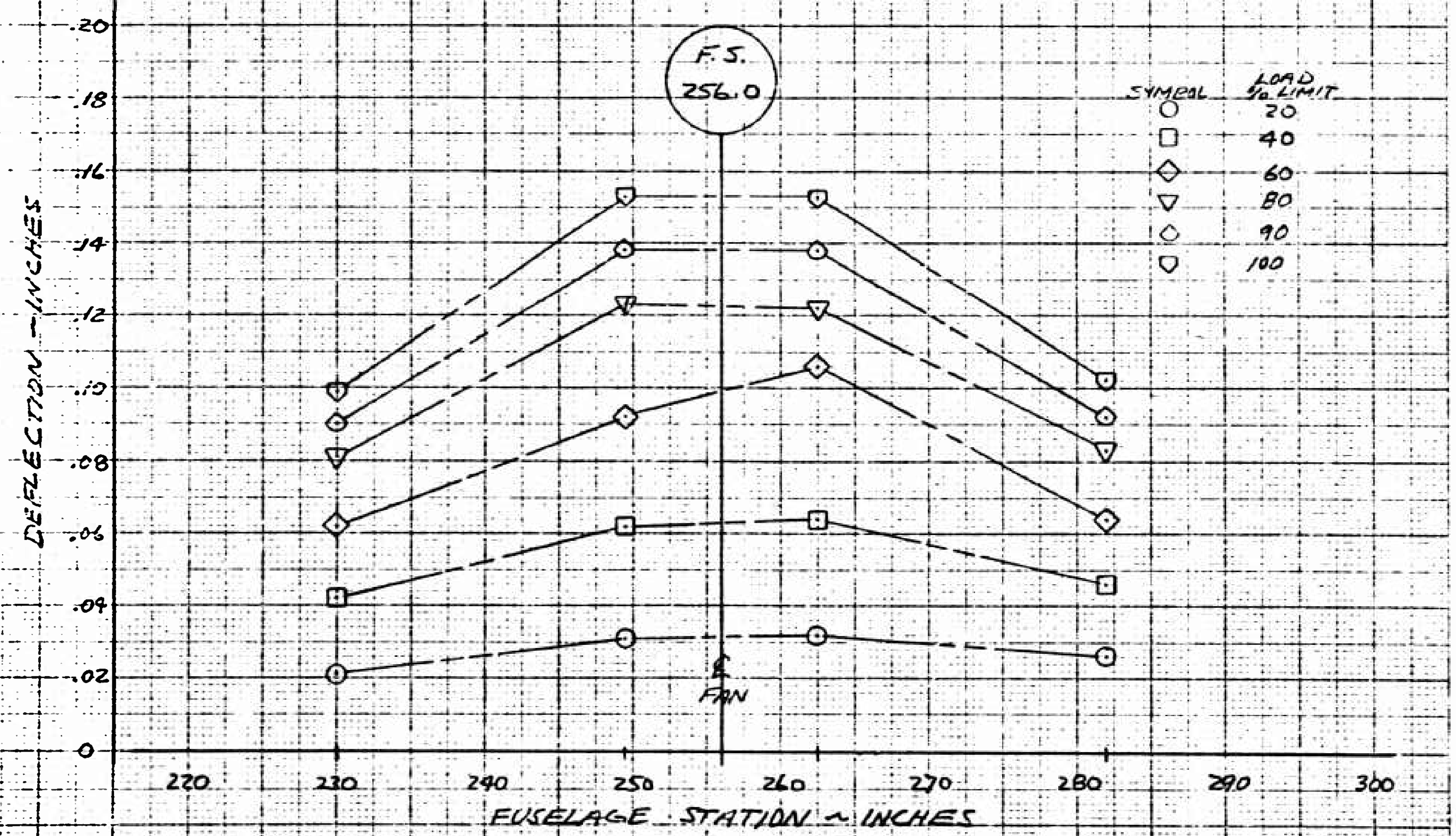
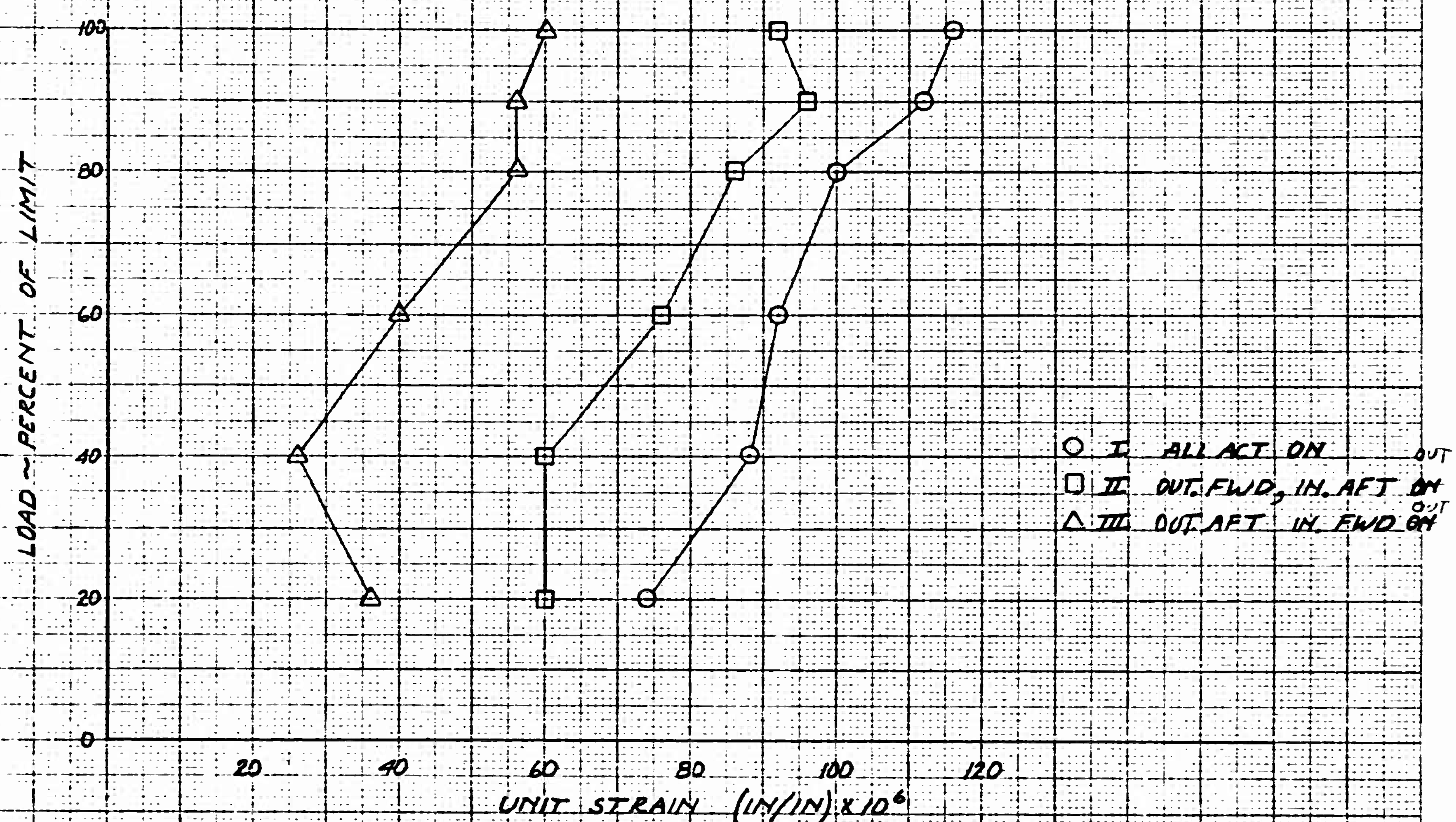


FIG 127
TEST Nº 22
WING FAN DOORS
FWD STRUT–SIDE BENDING



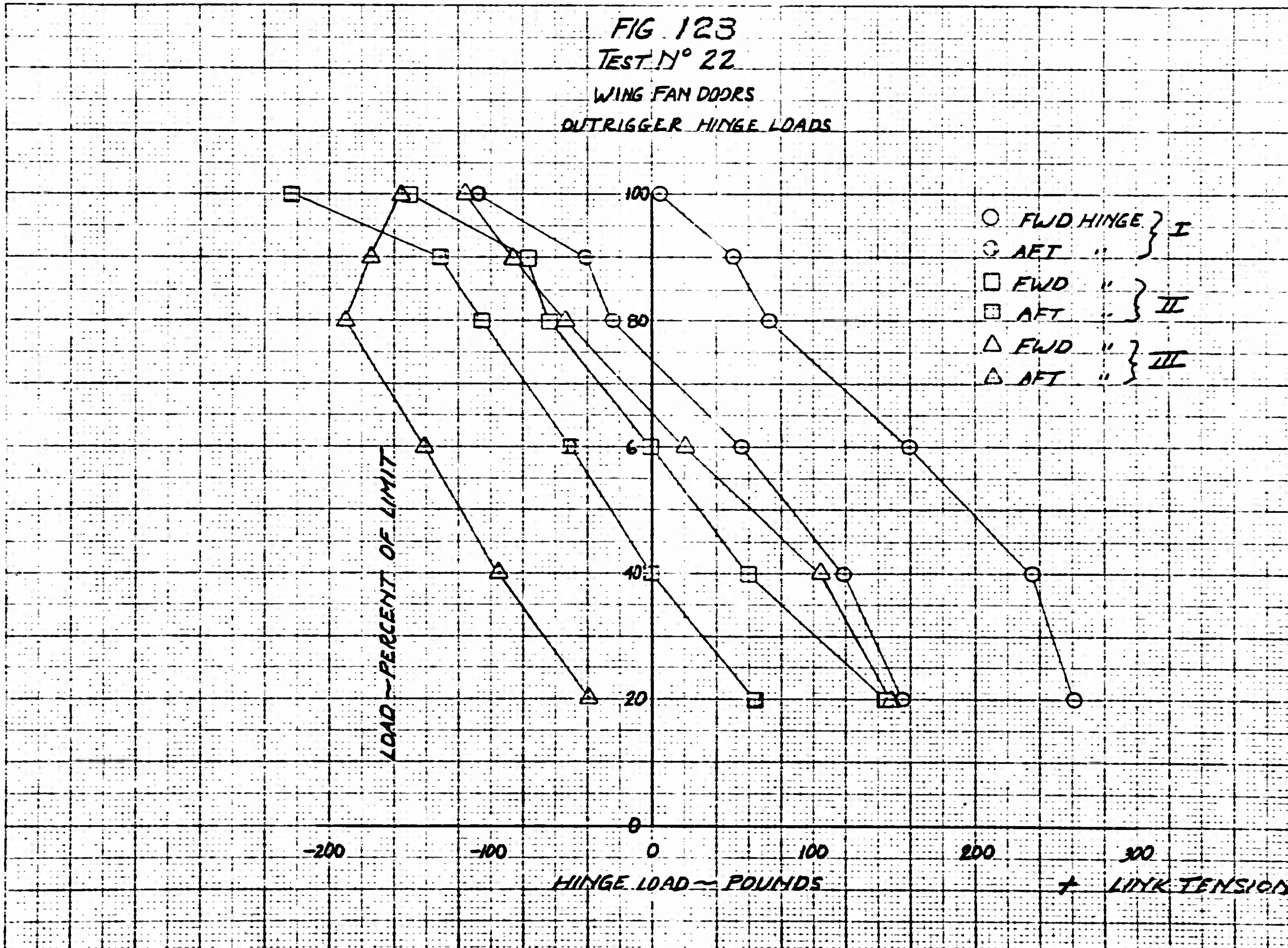


FIG 123
TEST N° 22
WING FAN DOORS
OUTRIGGER HINGE LOADS

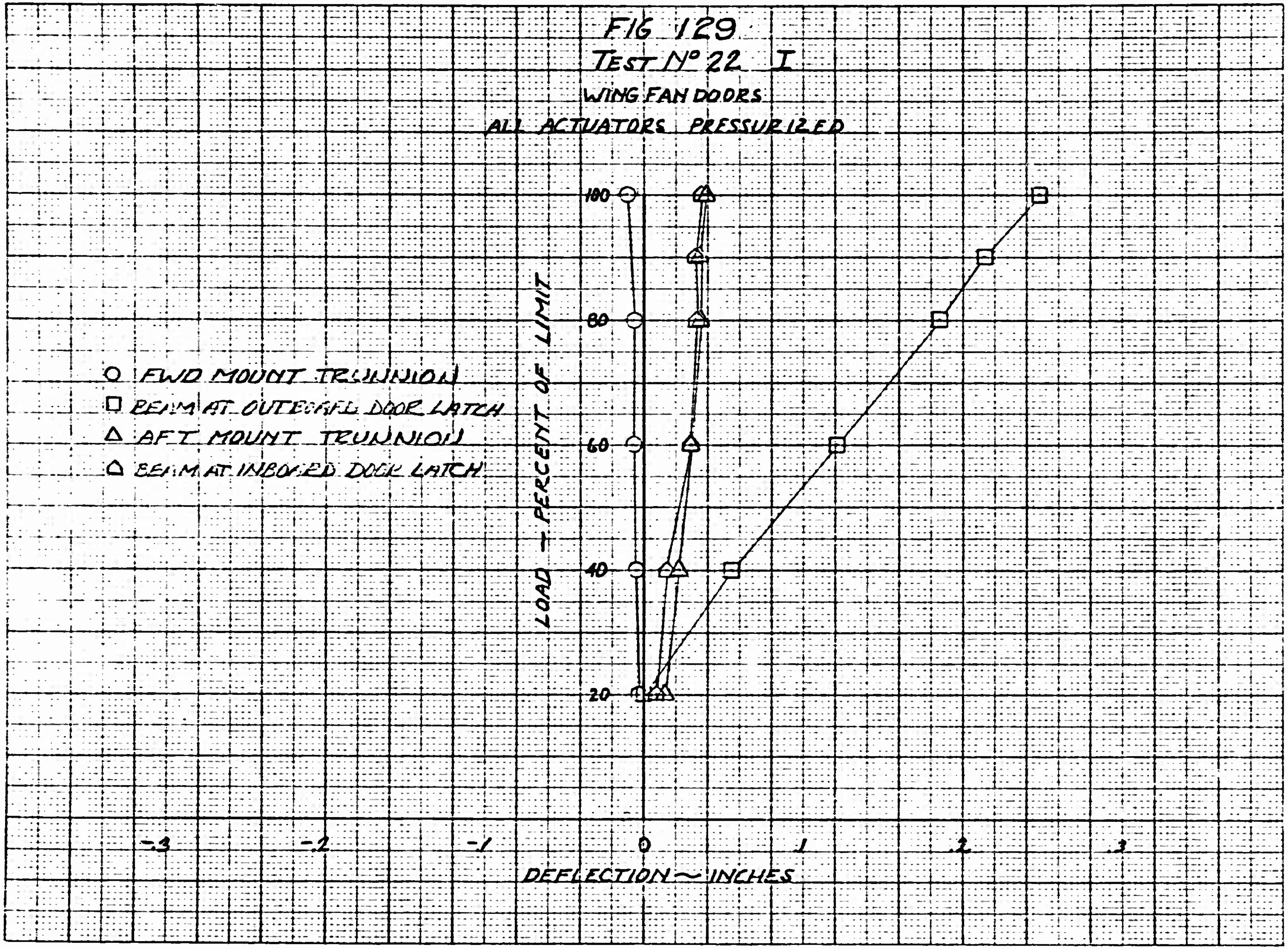


FIG 129
TEST Nº 22 I
WING FAN DOORS
ALL ACTUATORS PRESSURIZED
○ FWD MOUNT TRUNNION
□ BEAM AT OUTBOARD DOOR LATCH
△ AFT MOUNT TRUNNION
△ BEAM AT INBOARD DOOR LATCH
100
80
60
40
20
LOAD — PERCENT OF LIMIT
-.3
-.2
-.1
0
.1
.2
.3
DEFLECTION ~ INCHES

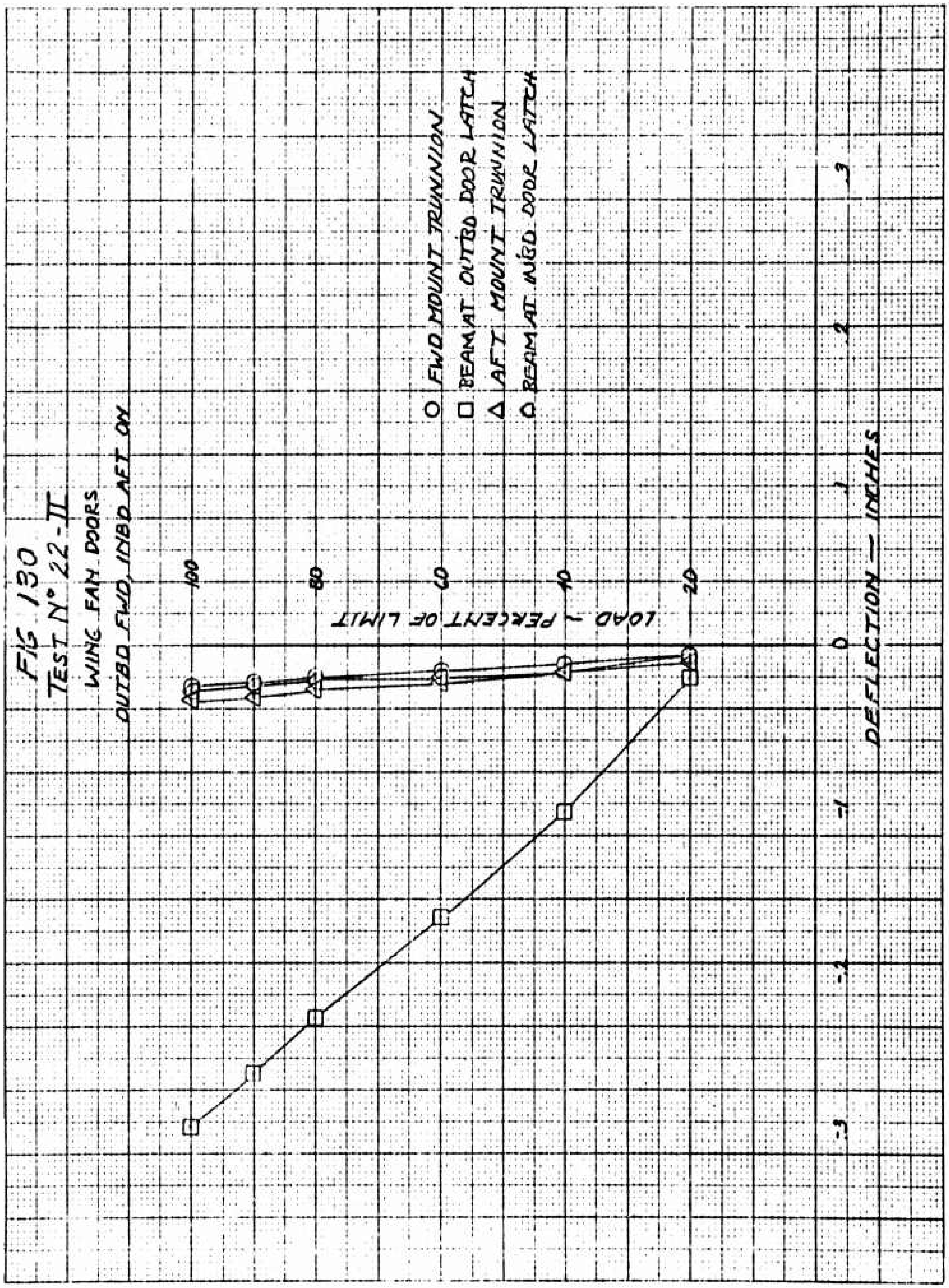


FIG 130
TEST N° 22-II
WING FAN DOORS
OUTBD FWD, INBD AFT ON
○ FWD MOUNT TRUNNION
□ BEAM AT OUTBD DOOR LATCH
△ AFT MOUNT TRUNNION
◇ BEAM AT INBD DOOR LATCH
LOAD — PERCENT OF LIMIT
100
80
60
40
20
0
DEFLECTION — INCHES
-3
-2
-1
0
1
2
3

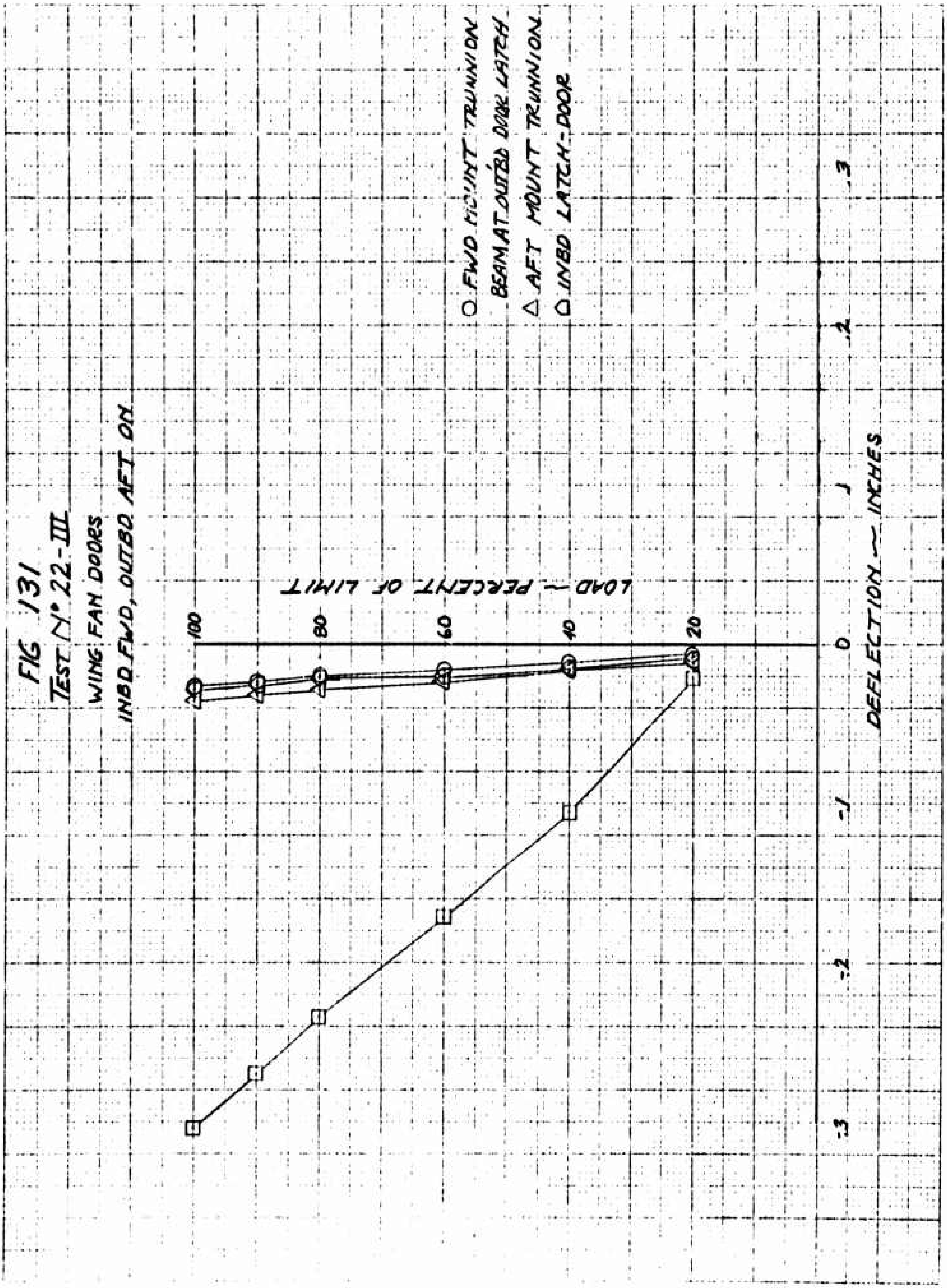


FIG 131
TEST Nº 22-III
WING FAN DOORS
INBD FWD, OUTBD AFT ON
LOAD ~ PERCENT OF LIMIT
100
80
60
40
20
○ FWD MOUNT TRUNNION
BEAM AT OUTBD DOOR LATCH
△ AFT MOUNT TRUNNION
◻ INBD LATCH-DOOR
-3
-2
-1
0
.1
.2
.3
DEFLECTION ~ INCHES

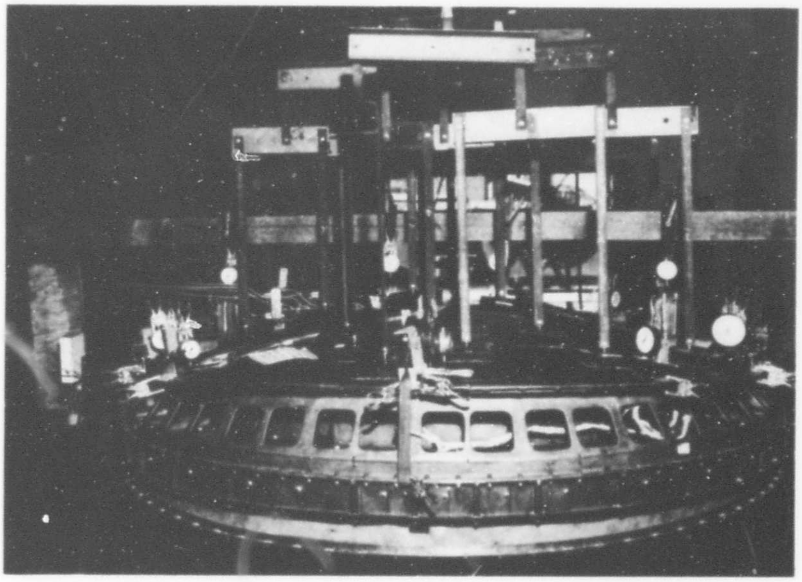


Figure 132 View of Right Fan Looking Inboard Showing General Whiffletree Layout and Deflection Measuring Dial Gages. Electrical Leads are Connected to Strain Gages that are not Shown. Doors Withstanding 90% Load.

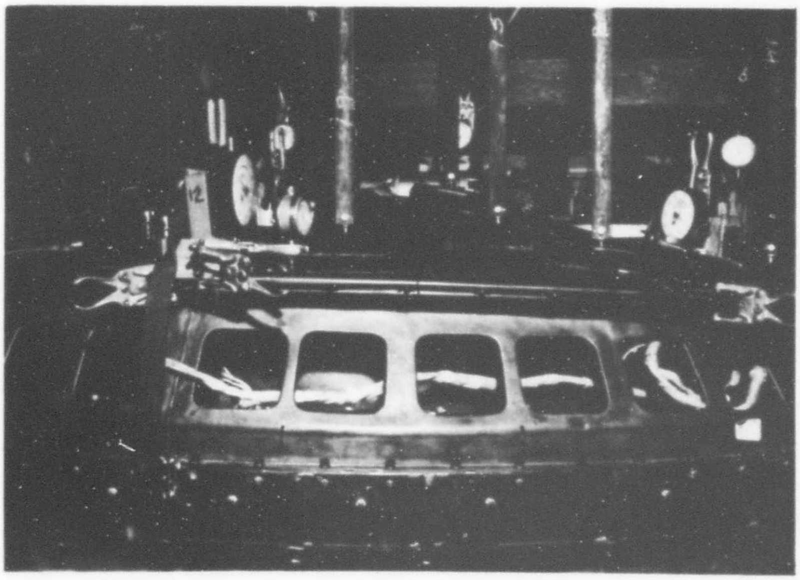


Figure 133 Closeup of View Above Showing Deflection of Fan Door Edges at 100% Load.

3.23 TEST NO. 23 - WING FAN DOORS AND ACTUATING HARDWARE

3.23.1 Test Condition

Low Speed Flight, Wing Fan Doors Closed

$$n_Z = 2.0, \; q = 45.9 \text{ psf}, \; \alpha = 18^\circ$$

3.23.2 Introduction

This test, like Test No. 22, represents a critical structural check of the wing fan door, door actuator arms, outrigger arms, support structure, G. E. fan hub and supporting struts. The test was conducted according to the test procedure outline with a few exceptions noted. Due to various conditions employed, a tabular presentation of data was employed. Photos of the interesting portions are also included.

3.23.3 Summary

This test is comprised of six sections, Conditions I through VI. The loading applied for each section along with the results are discussed below.

Condition I. A and I. B

Simulated loads were applied incrementally as called for with the fan doors closed and latched and with 3000 psi hydraulic pressure applied to the tension side of all four actuators. Deflection data and strain gage data were recorded at each load increment. Door deflection data for the points 1-20 and located as pictured appear in Table VIII for the 20, 40, 60, 80, 90, 100% loads. These are bracketed as I.

Strainsert bolt loads (total) for bolts 1-8 appear in Table IX. These are also for Condition I and are bracketed as I in the table.

Outrigger loads for the same Condition (I) appear in Table X and are so bracketed as for the above areas. Here the forward hinge and aft hinge loads are shown compositely, the forward inboard and outboard and the aft inboard and outboard. These loads should be added algebraically to obtain, e.g., forward hinge loads and aft hinge loads.

Condition I. C

Data appear in the same tables (and is so labeled) and represent:

a. 100% load, 4 actuators pressurized with the doors unlocked.

b. 100% load, 4 actuators pressurized with the doors locked.

Condition II

Step II. A omitted.

a. 100% load, OF - IA (outboard forward, inboard aft) out, fan doors unlocked.

b. 100% load, (OF - IA) out, doors locked.

Condition III

Step III. A omitted.

a. 100% load, (OA - IF) out, doors unlocked.

b. 100% load, (OA - IF) out, doors locked.

Condition IV

100% load with 3000 psi to 4 actuators, pressure gradually reduced, doors began to lift at 1200 psi. Stabilized 2" gap at 1000 psi, data taken at (a) gap initially and at (b) 2" gap, pressure increased, doors closed and relatched.

Condition V

100% load, 3000 psi pressure applied to (OF - IA), doors unlatched and pressure gradually reduced until gap at bellmouth appeared (2500 psi), 2" gap stabilized at 1900 psi. Data taken when (a) gap initially appeared and when (b) gap was 2". Pressure increased to close and lock doors.

Condition VI

100% load, 3000 psi pressure applied to (OA - IF), doors unlatched and pressure gradually reduced until gap appeared at bellmouth (2200 psi). 2" gap stabilized at 1900 psi. Pressure returned to 3000 psi to close doors. However, 3000 psi did not close the doors, 1" gap remained and recycling did not help to close the doors. The down lock actuators were energized and the door pulled down to its seated position.

Table XI shows the results of the fore and aft mount and outboard and inboard door latch deflections due to the aforementioned restraining methods, e.g., Conditions I through VI.

Figures 134 through 136 show deflections measured during Condition I. A and B. Figures 137 through 139 show deflections measured during Conditions I. C, II and III. Figures 140 through 146 show the method of load application and deflections encountered.

TABLE VIII

TEST NO. 23 - FAN DOOR DEFLECTIONS - INCHES

%	1	2	3	4	5	6	7	8	9	10	
20	.003	.008	.004	N. G.	.001	-.001	.001	.001	.001	.000	
40	.006	.016	.008	N. G.	.002	-.002	.002	.002	.002	.000	
60	.013	.039	.033	N. G.	.002	-.006	.001	.001	.001	-.002	
80	.019	.060	.059	-.006	.003	-.008	.002	.001	.002	-.001	I A & B
90	.023	.074	.076	-.008	.004	-.069	.003	.000	.002	-.001	
100	.029	.092	.097	-.010	.005	-.009	.003	.002	.002	-.002	
100	.027	.071	.057	-.040	N. G.	-.013	.002	.003	.001	-.003	I C (a)
100	.030	.094	.100	-.011	.006	-.012	.003	.001	.001	-.003	I C (b)
100	.014	.073	.089	-.025	.003	.027	.019	.088	-.003	-.014	II (a)
100	.014	.076	.093	-.024	.016	.027	.019	.088	-.003	-.014	II (b)
100	.042	.219	.286	.032	.077	-.004	-.008	.013	-.009	.030	III (a)
100	.042	.216	.278	.020	.076	-.004	-.008	.013	-.009	.030	III (b)

%	11	12	13	14	15	16	17	18	19	20	
20	.000	-.001	-.001	.005	.006	.003	.005	.008	.006	.001	
40	.000	-.002	-.002	.010	.042	.006	.010	.016	.012	.002	
60	-.001	-.007	-.005	.051	.042	.016	.020	.028	.023	.013	
80	-.001	-.010	-.007	.083	.070	.024	.026	.036	.031	.014	I A & B
90	-.001	-.012	-.008	.101	.088	.030	.029	.043	.037	.020	
100	-.001	-.014	-.009	.124	.108	.037	.033	.048	.041	.023	
100	-.001	-.015	-.009	.128	.112	.038	.031	.048	.042	.023	I C (a)
100	-.002	-.014	-.009	.128	.111	.038	.031	.048	.042	.023	I C (b)
100	-.005	-.006	.019	.293	.141	.060	.031	.041	.037	.023	II (a)
100	-.004	-.009	.009	.281	.136	.060	.031	.041	.036	.023	II (b)
100	.046	-.029	-.005	.130	.103	.025	.028	.043	.035	.023	III (a)
100	.046	-.029	-.005	.131	.104	.025	.028	.043	.034	.023	III (b)

N. G. = No Good

TABLE IX

TEST NO. 23 - STRAINSERT BOLT LOADS - POUNDS

%	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8		
0	220	230	220	220	230	210	200	230		
20	427	442	770	628	382	388	313	330		
40	437	448	755	628	371	399	310	330		
60	428	458	745	616	371	400	308	326	I A & B	
80	430	464	736	613	380	407	308	328		
90	432	472	723	610	385	416	308	326		
100	438	474	722	606	388	420	308	321		
100	438	482	731	598	385	422	308	321	I C	(a)
100	438	474	715	604	389	425	308	321		(b)
100	520	210	1066	204	428	205	324	215	II	(a)
100	515	210	1054	207	432	220	327	225		(b)
100	188	705	47	778	249	570	169	311	III	(a)
100	172	697	390	770	258	564	169	306		(b)
100	427	510	755	630	400	407	310	316	IV	(a)
100	431	295	384	299	392	320	231	250		(b)
100	177	735	384	797	266	592	171	319	V	(a)
100	166	539	362	566	264	520	185	296		(b)
100	456	202	826	204	380	210	124	215	VI	

TABLE X

TEST NO. 23 - OUTRIGGER LOADS AND FWD STRUT SIDE BENDING STRAIN

%	Pounds Outboard Fwd	Inboard Fwd	Outboard Aft	Inboard Aft	Fwd Strut Side Bending Strain		
0	---	---	---	--	$(in/in) \times 10^6$		
20	147	147	157	65	74		
40	168	144	172	79	58		
60	137	95	149	74	78	I A & B	
80	144	89	169	76	86		
90	147	83	166	76	88		
100	132	80	172	82	96		
100	129	78	157	79	96	I C	(a)
100	129	80	166	87	96		(b)
100	-147	121	157	-19	62	II	(a)
100	-141	130	166	- 8	80		(b)
100	-118	-115	34	65	76	III	(a)
100	-118	-124	29	60	78		(b)
100	126	78	151	76	88	IV	(a)
100	- 59	- 66	140	164	44		(b)
100	141	-121	11	63	62	V	(a)
100	109	-178	14	250	60		(b)
100	-218	72	254	44	32	VI	

TABLE XI

TEST NO. 23 - MOUNT AND LATCH DEFLECTIONS - INCHES

%	Fwd Mount	Aft Mount	Outboard Latch	Inboard Latch	
0	---	---	---	---	
20	.007	.002	.039	.003	
40	.004	.000	.022	.000	
60	-.001	-.002	.002	-.003	I A & B
80	.000	-.005	-.009	-.005	
90	.008	-.009	-.021	-.007	
100	.000	-.011	-.029	-.007	
100	.000	-.011	-.029	-.007	I C (a)
100	.000	-.011	-.029	-.007	(b)
100	.000	-.011	.055	-.006	II (a)
100	-.021	-.010	.052	-.001	(b)
100	.000	-.011	.059	-.003	III (a)
100	.000	-.011	-.061	.014	(b)
100	-.003	-.012	-.040	-.012	IV (a)
100	-.002	-.011	-.079	-.006	(b)
100	-.002	-.011	-.070	-.004	V (a)
100	-.001	-.009	-.076	-.003	(b)
100	-.006	-.012	-.081	-.007	VI

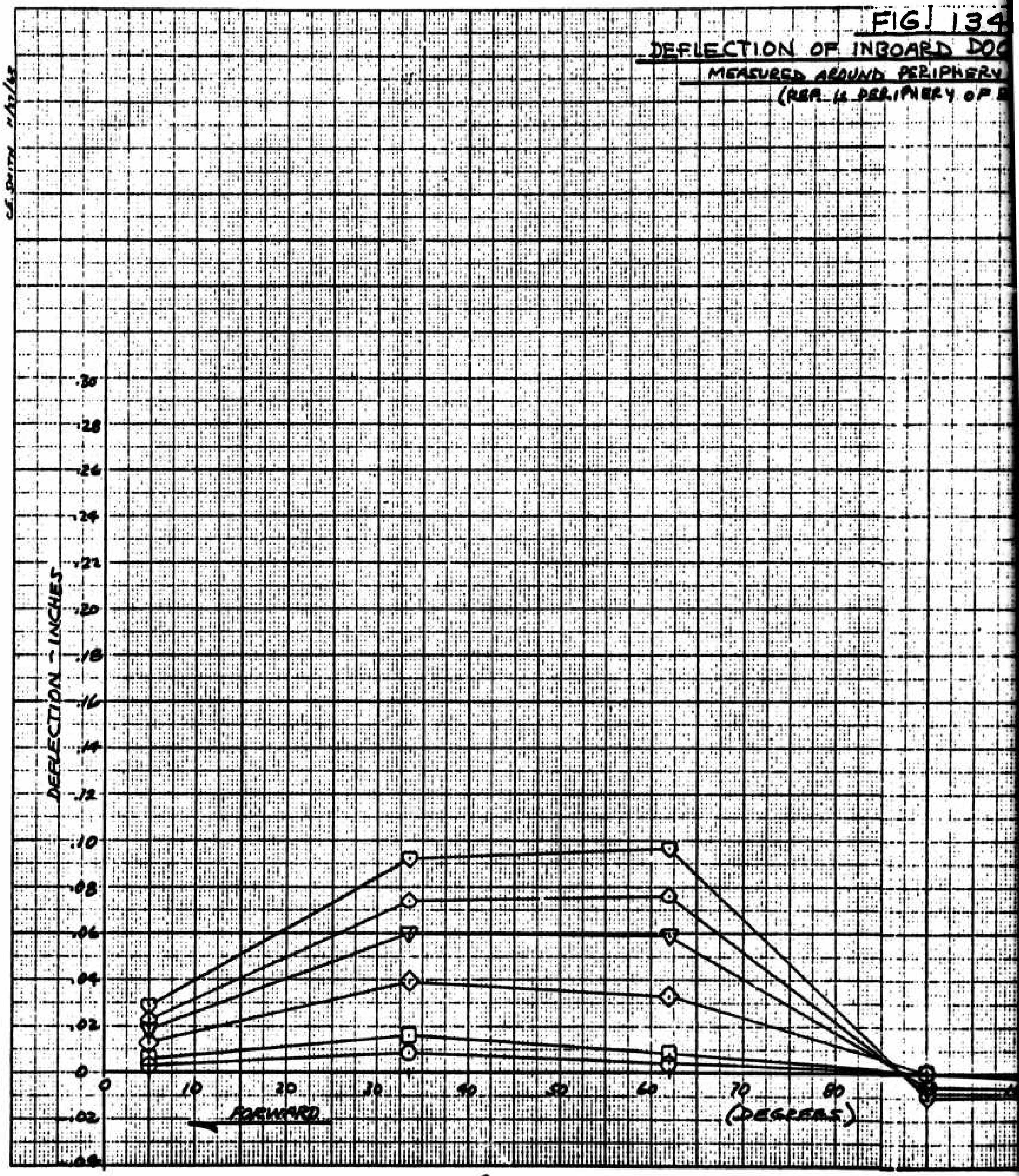


FIG. 134
DEFLECTION OF INBOARD DOO
MEASURED AROUND PERIPHERY
(REF. ℄ PERIPHERY OF
C.E. SMITH
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
.02
DEFLECTION ~ INCHES
0
10
20
30
40
50
60
70
80
FORWARD
(DEGREES)

A

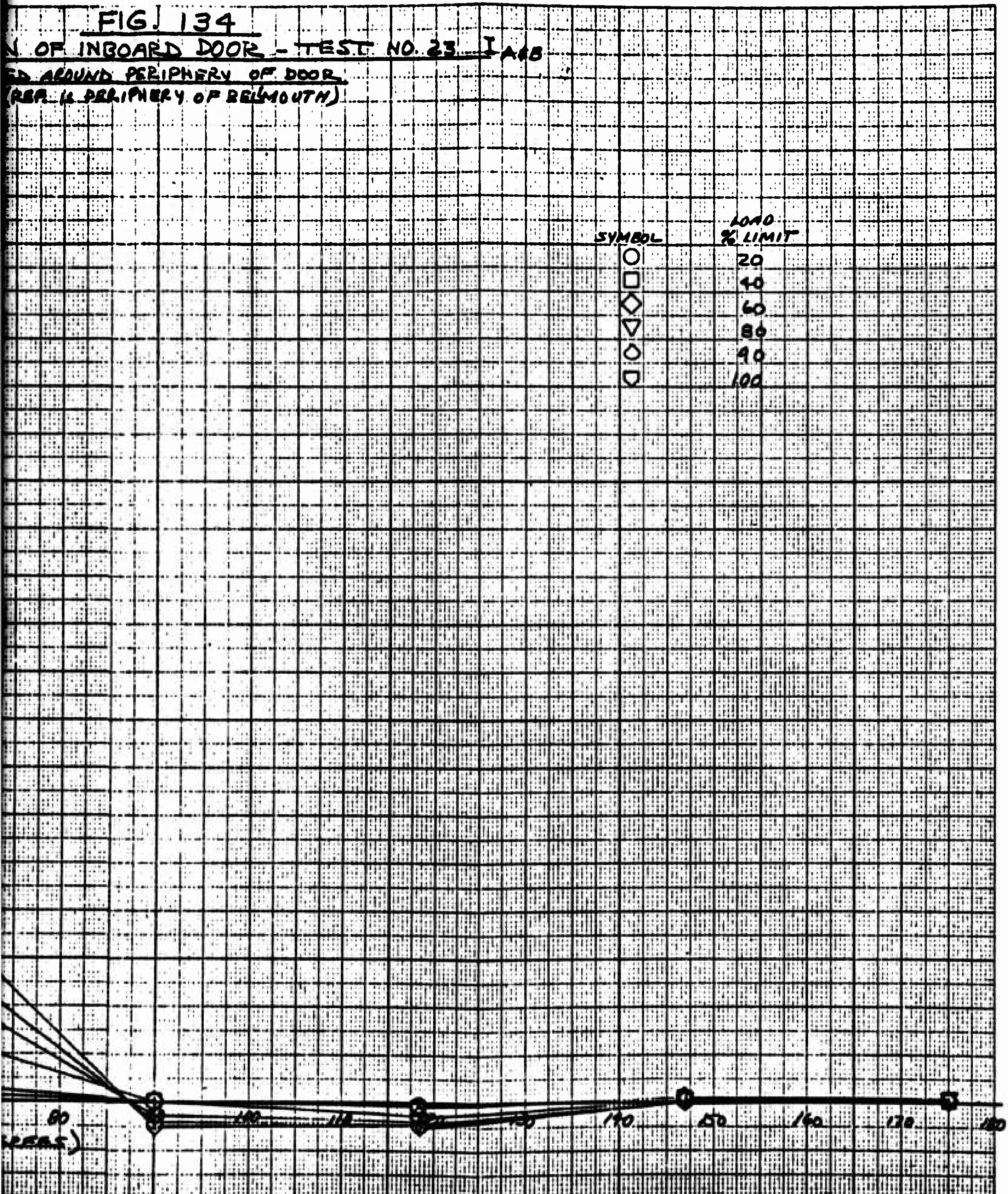


FIG. 134
N OF INBOARD DOOR - TEST NO. 23 I A&B
ED AROUND PERIPHERY OF DOOR
(REF. ¢ PERIPHERY OF BELLMOUTH)
SYMBOL
LOAD % LIMIT
20
40
60
80
90
100
80
100
110
120
130
140
150
160
170
180
REES)

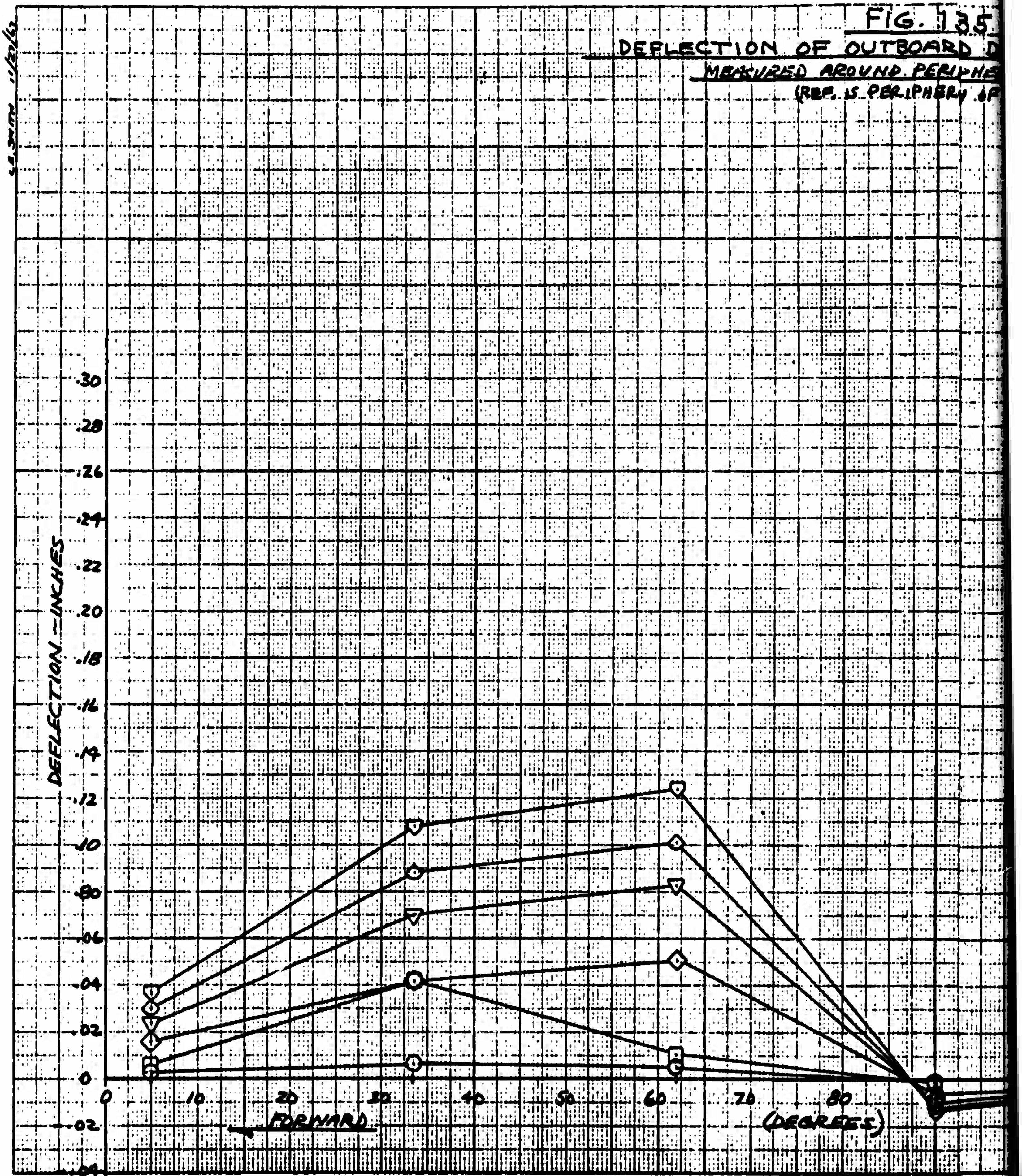
B

FIG. 135

DEFLECTION OF OUTBOARD D

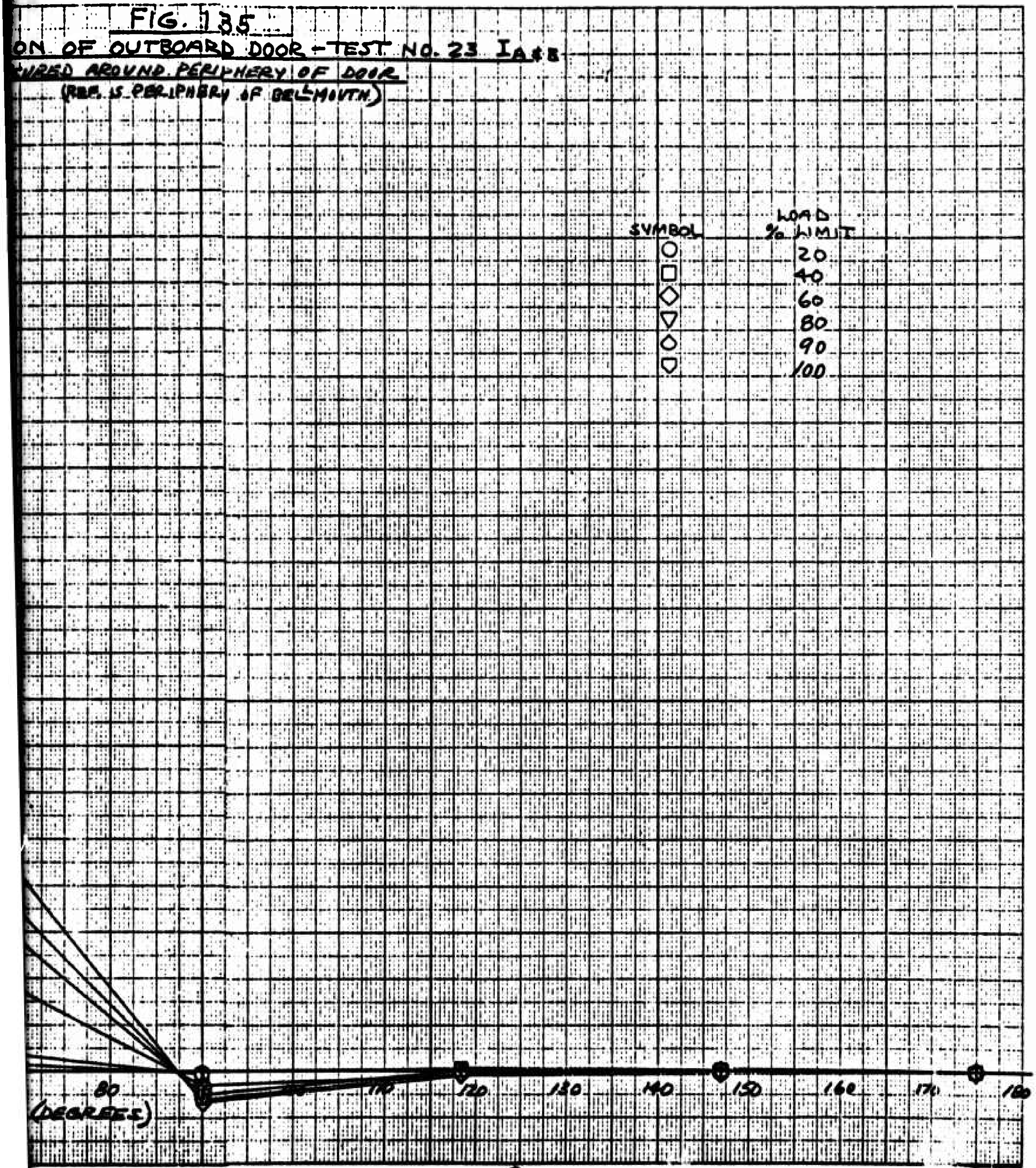
MEASURED AROUND PERIPHE

(REF. IS PERIPHERY OF



A

FIG. 135



ON OF OUTBOARD DOOR - TEST NO. 23 $I_{A\&B}$
URED AROUND PERIPHERY OF DOOR
(REF. IS PERIPHERY OF BELLMOUTH)
SYMBOL
LOAD % LIMIT
20
40
60
80
90
100
80
120
130
140
150
160
170
180
(DEGREES)

β

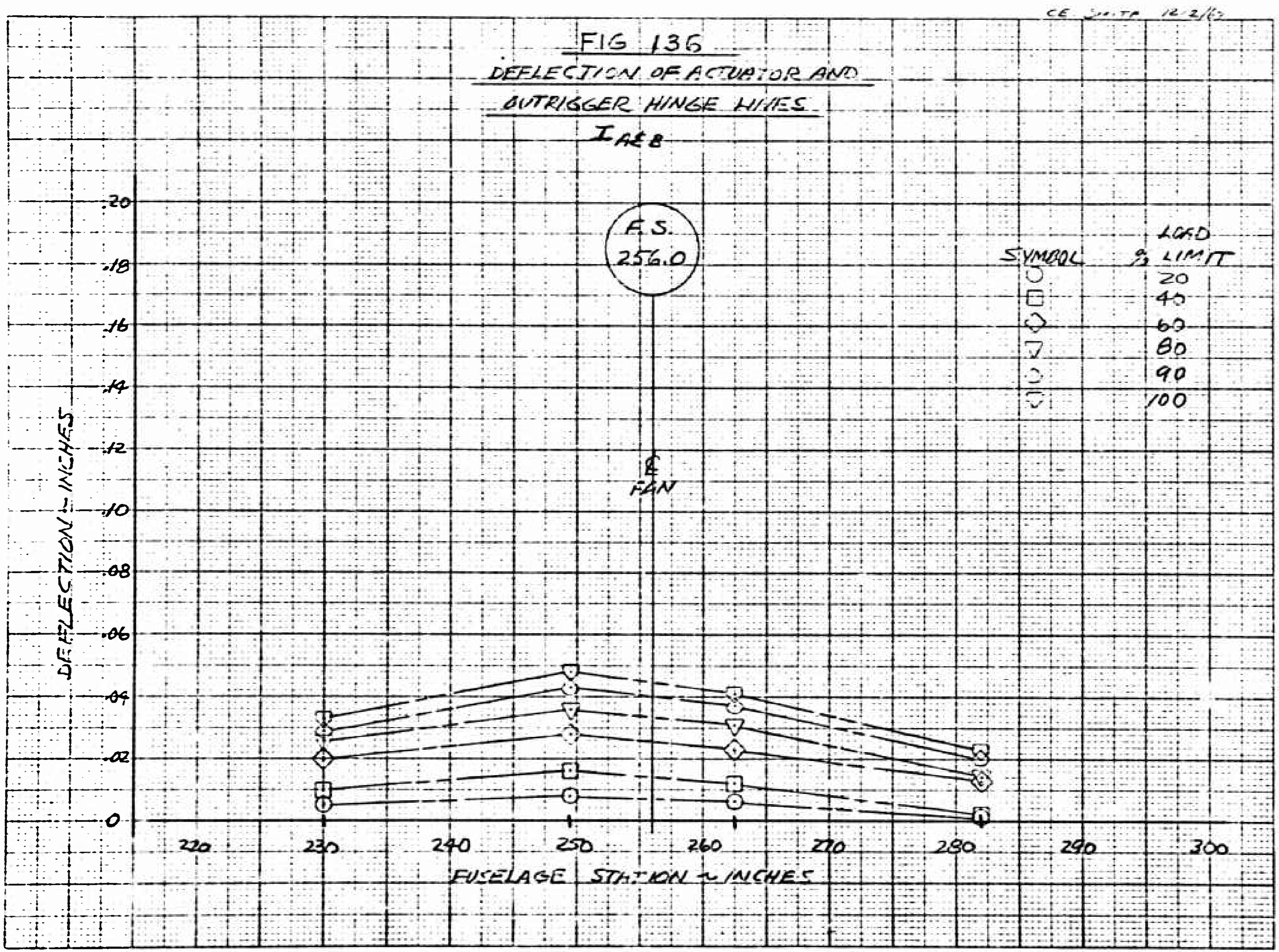


FIG 136
DEFLECTION OF ACTUATOR AND
OUTRIGGER HINGE LINES
F.S. 256.0
℄ FAN
SYMBOL
LOAD % LIMIT
20
40
60
80
90
100
DEFLECTION ~ INCHES
0
.02
.04
.06
.08
.10
.12
.14
.16
.18
.20
FUSELAGE STATION ~ INCHES
220
230
240
250
260
270
280
290
300

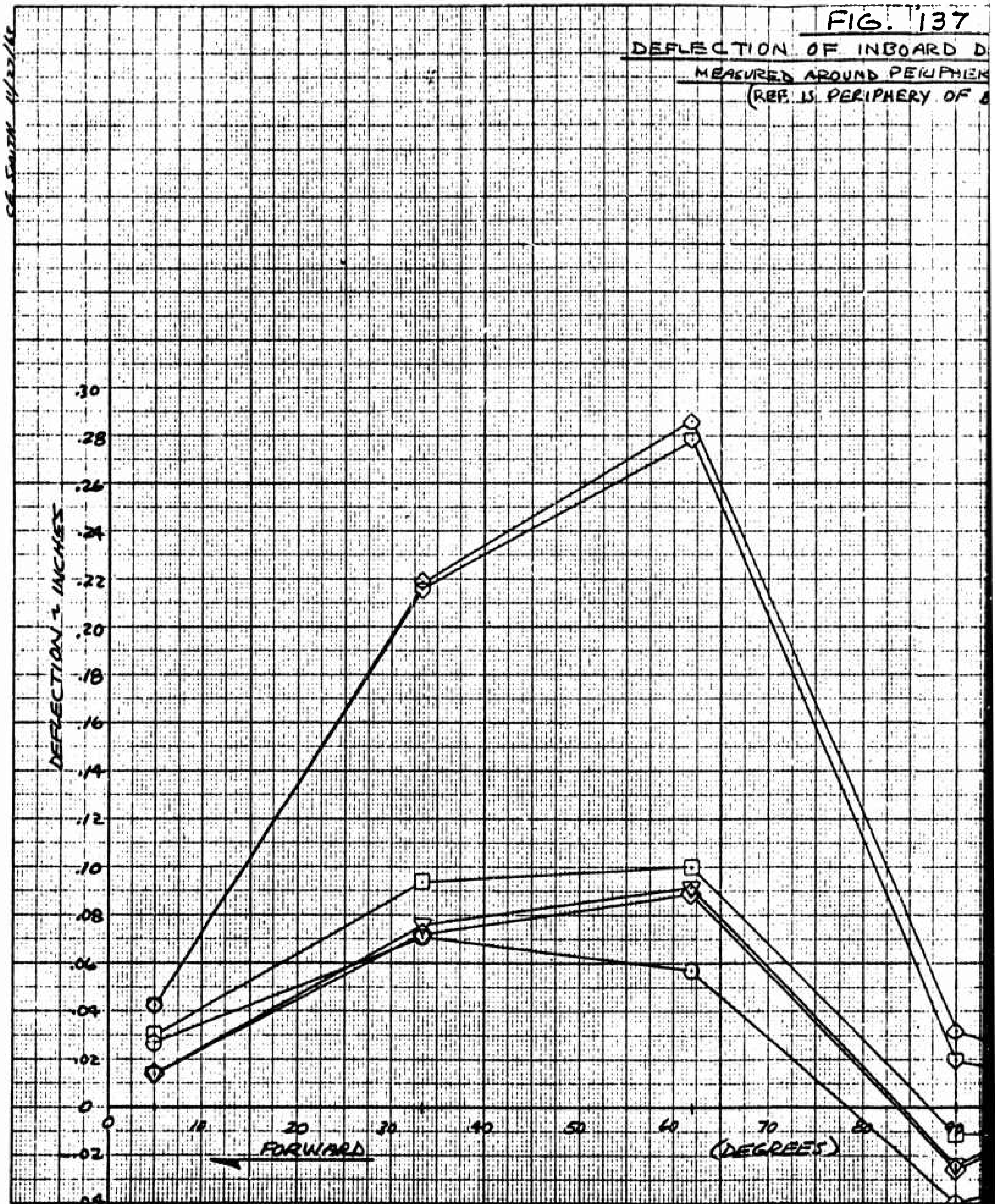


FIG. 137
DEFLECTION OF INBOARD D
MEASURED AROUND PERIPHER
(REF. IS PERIPHERY OF
C.E. SMITH 11/27/62
DEFLECTION ~ INCHES
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-.02
-.04
0
10
20
30
40
50
60
70
80
90
FORWARD
(DEGREES)

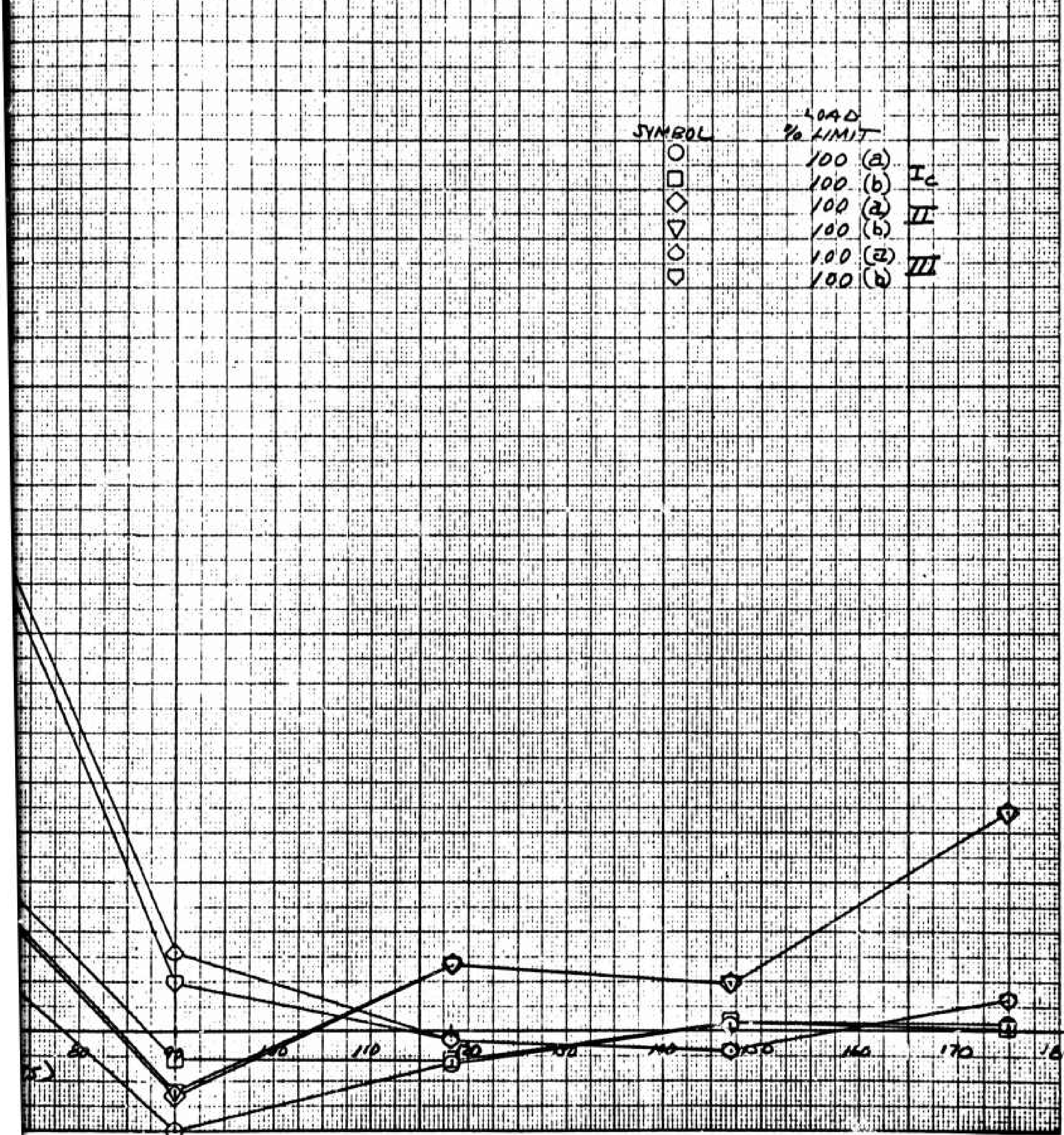
A

FIG. 137

OF INBOARD DOOR - TEST 23

AROUND PERIPHERY OF DOOR

IS PERIPHERY OF BELLMOUTH)



B

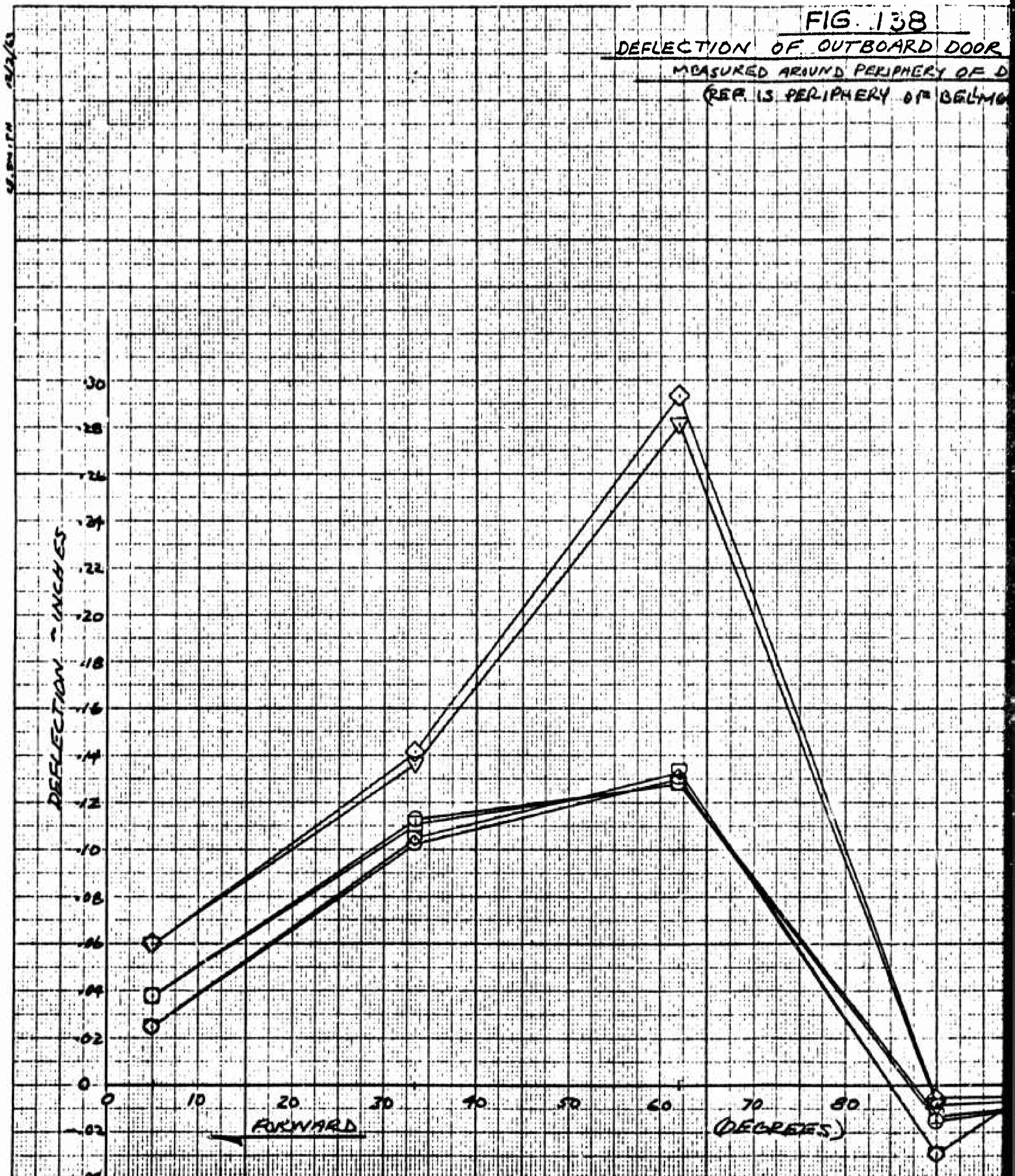


FIG. 138
DEFLECTION OF OUTBOARD DOOR
MEASURED AROUND PERIPHERY OF D
(REF. IS PERIPHERY OF BELLMO

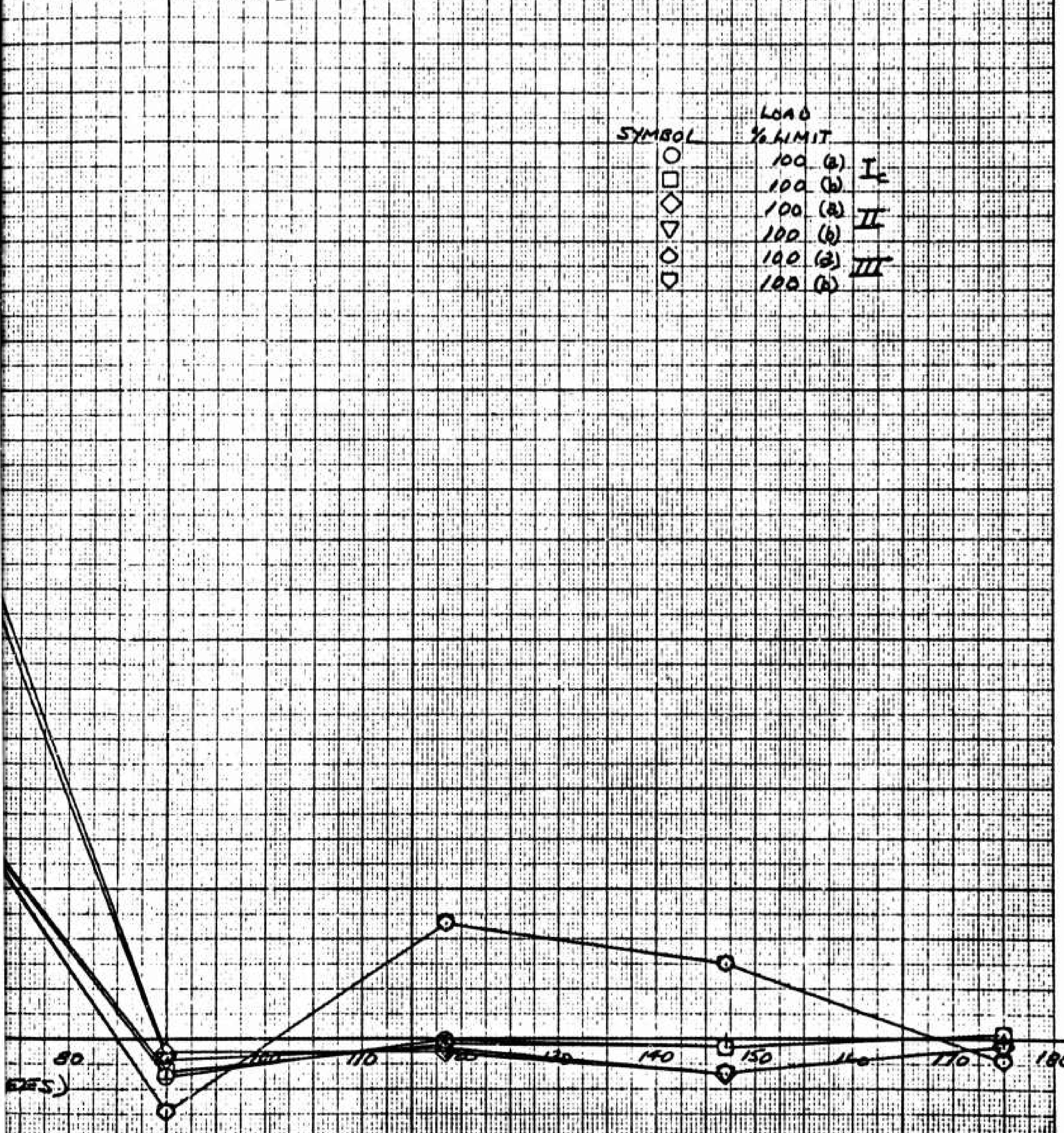
A

FIG. 138

F OUTBOARD DOOR - TEST NO. 23

AROUND PERIPHERY OF DOOR

PERIPHERY OF BELLMOUTH)



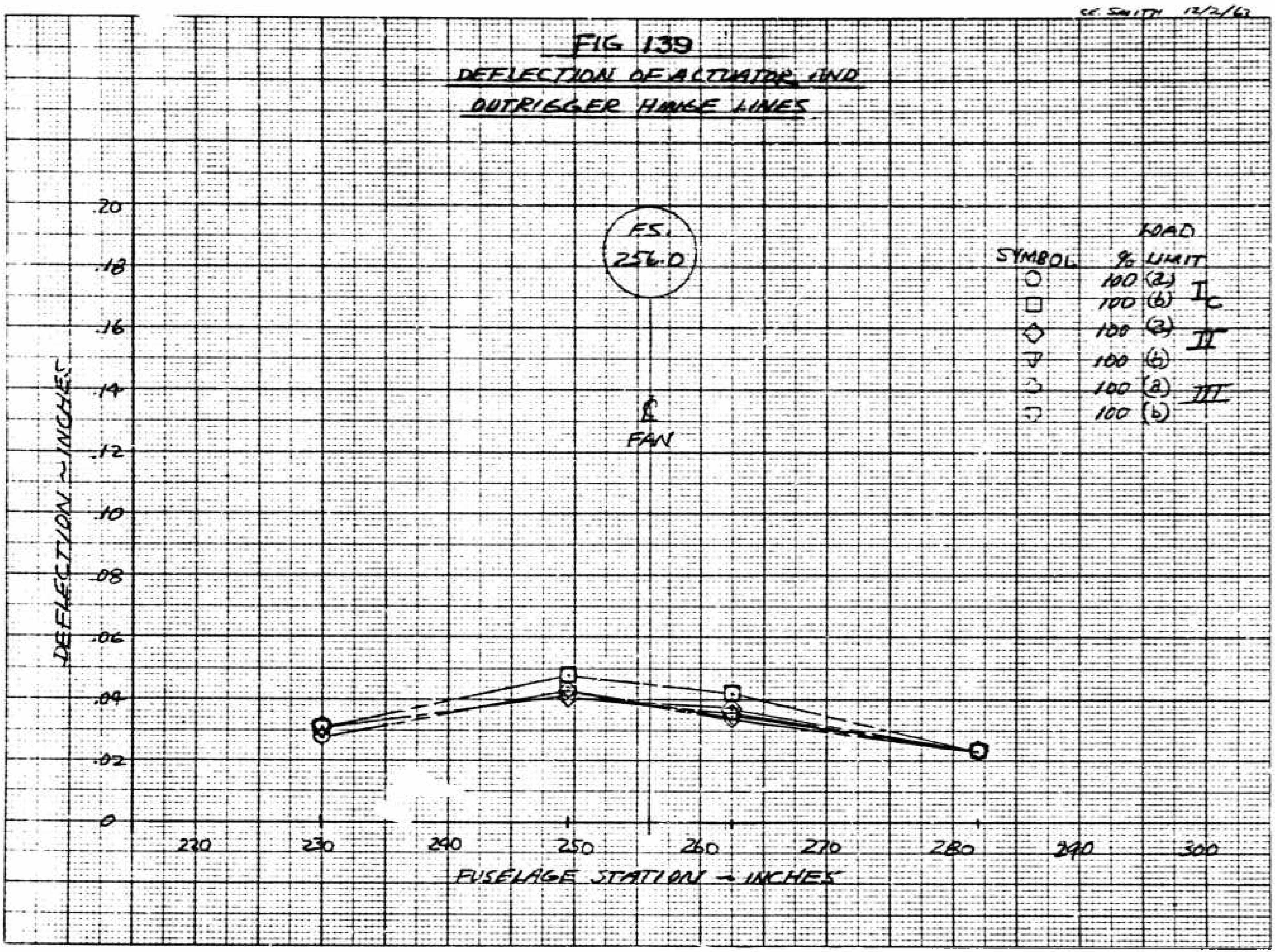


FIG 139
DEFLECTION OF ACTUATOR AND OUTRIGGER HINGE LINES

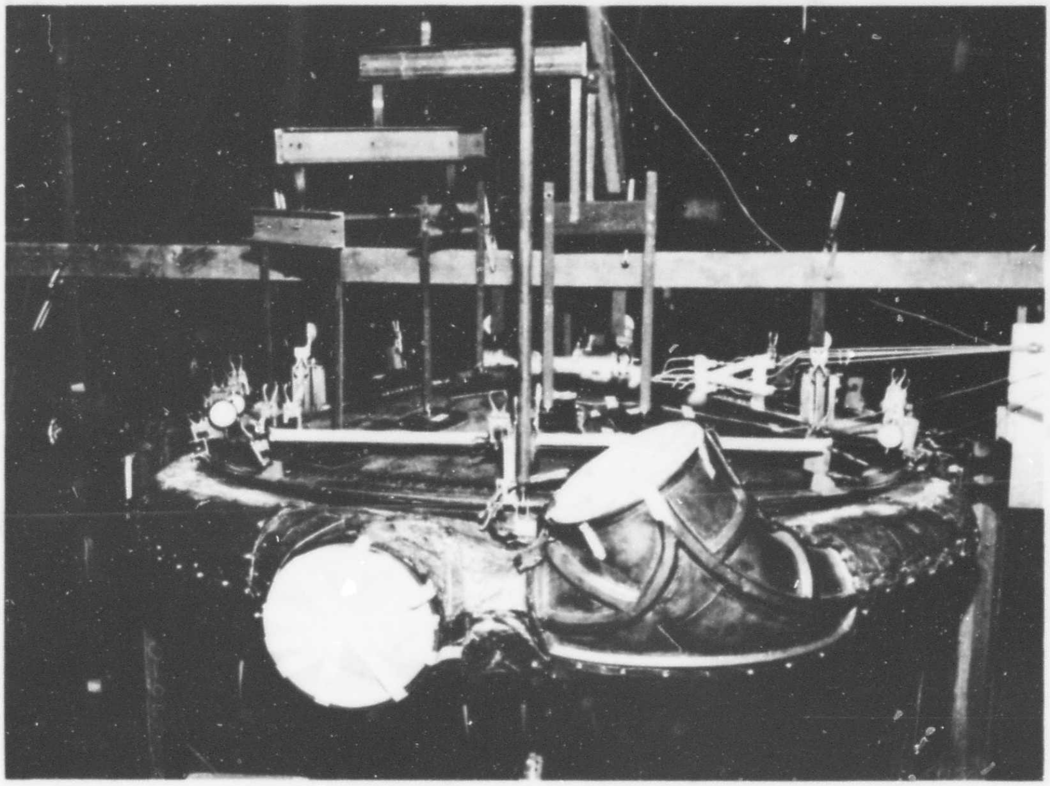


Figure 140 General Test #23 Setup Showing Whiffletree Arrangement and Deflection Dial Indicators

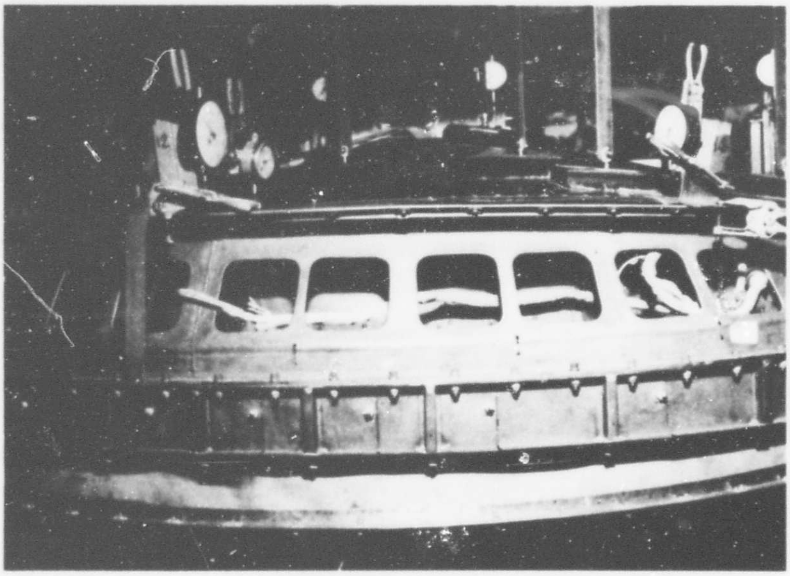


Figure 141 View of Right Front Corner Showing Door Gap. 100% Load (OF-1A) Out.

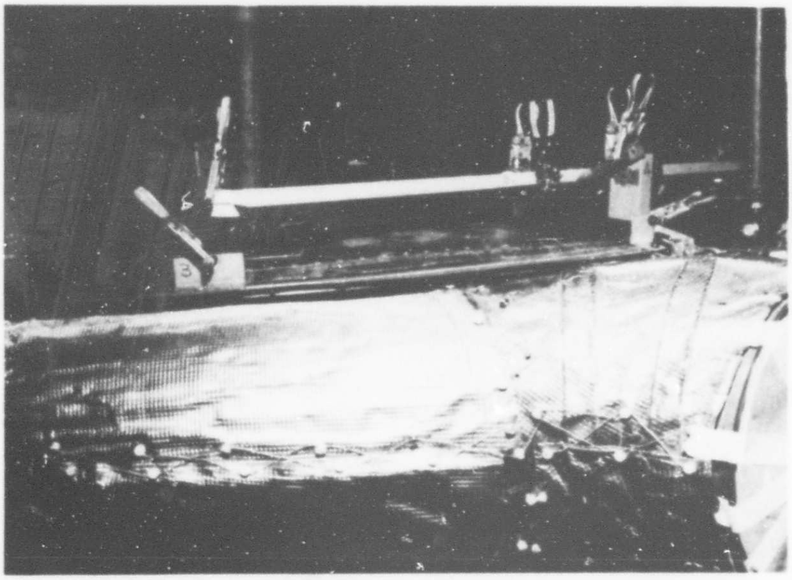


Figure 142 View of Left Front Fan Corner Showing Door Gap. 100% Load (IF-OA) Out.

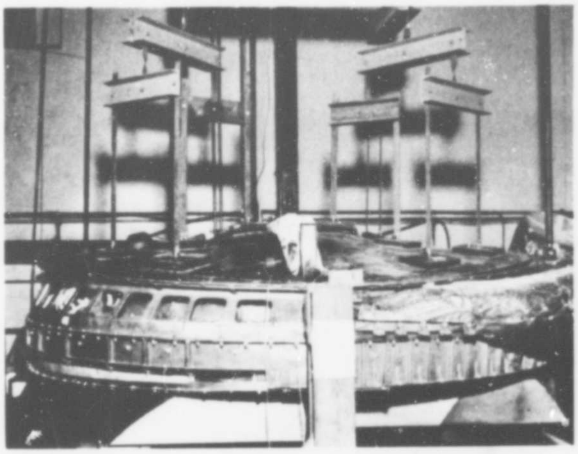


Figure 143
Door Gap Stabilized - Lowered Actuator Pressure (4 Actuators) vs Airload

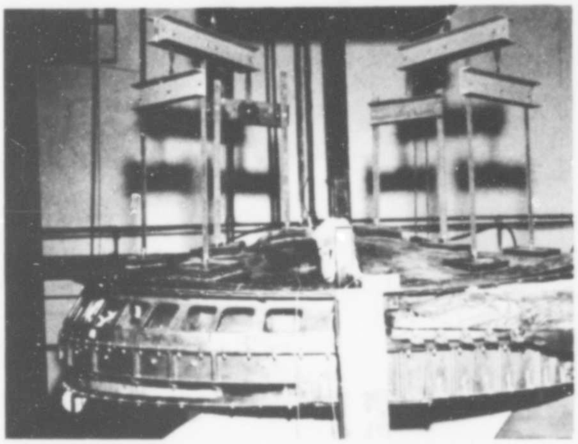


Figure 144
Door Gap Stabilized - Lowered Actuator Pressure on (Outboard Forward/ Inboard Aft) Actuator vs Airload

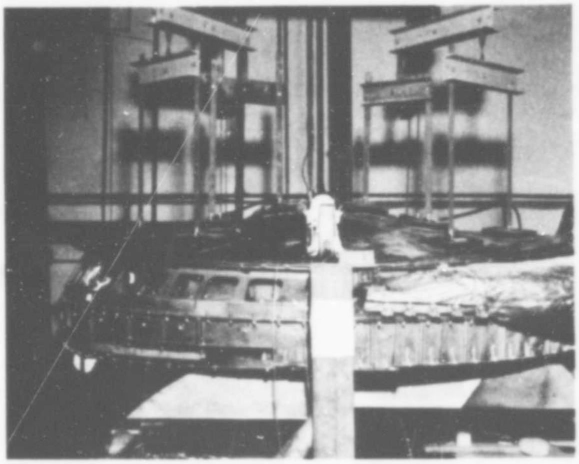


Figure 145
Door Gap Stabilized - Lowered Actuator Pressure on (Outboard Aft/Inboard Forward) Actuator vs Airload

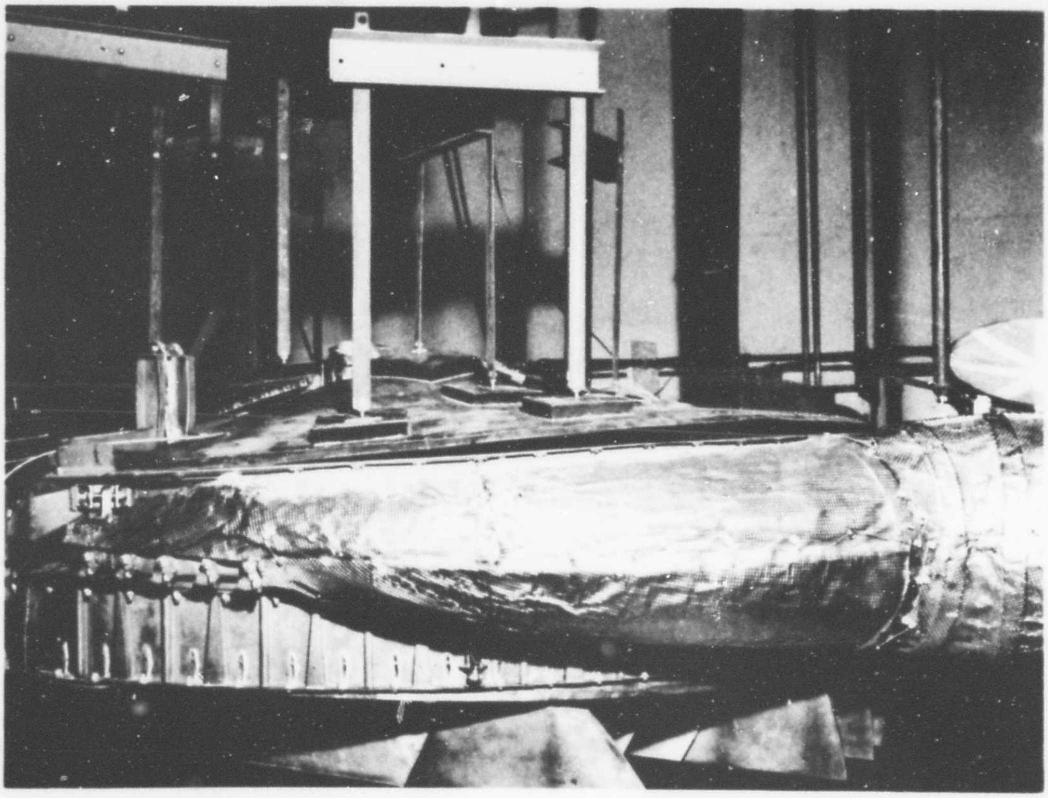


Figure 146 View of Door Gap After Actuator Pressure on (OA-IF) Actuators Returned to 3000 psi. Down lock on Doors Actuated and Pulled the Doors Closed and Locked.

3.24 TEST NO. 24 - WING FAN DOORS AND ACTUATING HARDWARE

3.24.1 Test Condition

Transition Flight Wing Fan Door Open - Left Slip

3.24.2 Introduction

This test condition represents a critical structural test for the wing fan doors and actuator arms, outrigger arms, support structure, G. E. fan hub and struts. The test was conducted and completed according to the test procedures outline.

3.24.3 Summary

The equivalent air load was applied to the door as called for in steps I, II, and III. In step I, the load was applied to the open door in increments of 25, 50, 75 and 100% with the four actuators pressurized at 3000 psi sustaining the door. While 100% limit load was applied the hydraulic pressure of the outboard aft and inboard forward actuator was gradually reduced to zero. Deflection and strains were again measured and recorded. This setup comprised step II. Actuators were then repressurized to 3000 psi. For step III, the hydraulic pressure of the opposite two actuators; outboard forward and inboard aft was reduced to zero. Strains and deflections were recorded while the 100% load was restrained by the two remaining pressurized actuators.

Figures 147 and 148 shows the net vertical and net side actuator hinge pin deflection versus the applied load. "Net" indicates the rotation about the support point was accounted for in computing deflections at the various distances from the rotation point.

Table XII contains data on the strainsert bolt loads. The variation in the bolts seemingly is ±150 pounds about the preload with the exception of Bolts 2 and 6. However, the above exception is for Case III outboard forward and inboard aft actuators inactive.

Figures 149 and 150 contain the forward and aft outrigger hinge pin shear loads along with their respective deflections.

In Figure 151 side bending of the forward strain gaged strut is expressed as unit strain versus the applied load. Since it was believed that "E" of some other value than 30 x 10^6 might be used to calculate the unit stress, the plot was made versus unit strain.

In Figure 152 inboard door deflections are plotted versus angular distances around the periphery of the door at constant load.

Table XII contains the total (induced plus preload) loads of the eight strainsert bolts at the various listed actuator pressures. These loads were measured with the fan doors fully closed and latched with the similar hydraulic actuators holding the doors against the latches. Bolt 3 was labeled inoperative.

Figure 153 shows the wing fan in the test jig prior to loading of the opened doors, and Figure 154 shows the method of load application.

TABLE XII

TEST NO. 24 - STRAINSERT BOLT LOADS - POUNDS

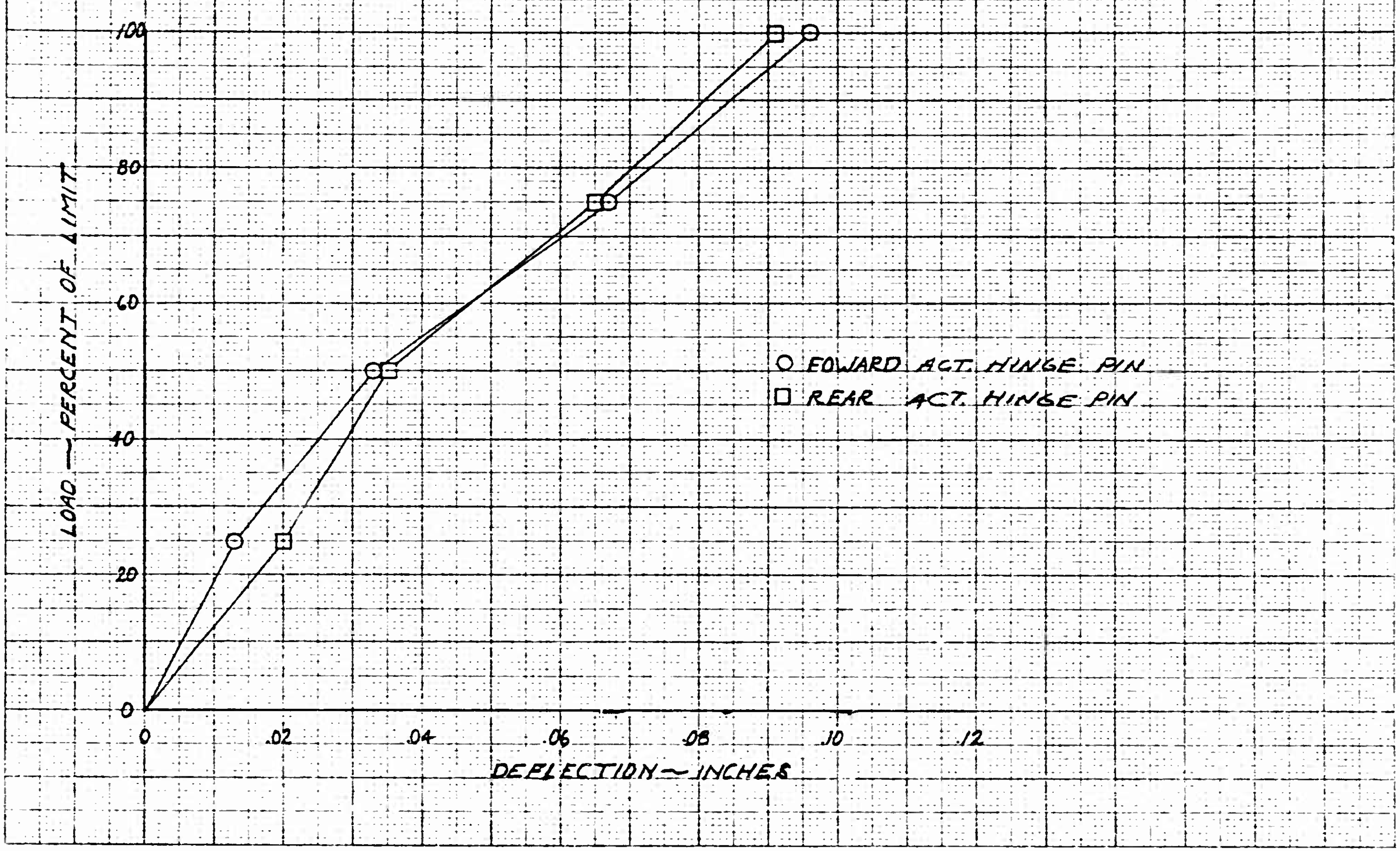
%	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	
Preload	220	230	220	220	230	210	200	230	
25	236	246	INOPERATIVE	217	215	210	223	220	I
50	220	261		214	190	210	233	190	
75	220	265		180	130	245	266	160	
100	170	372		160	100	350	298	140	
100	231	277		75	160	275	347	70	II
100	105	540		175	65	502	275	190	III

FIG 147

TEST N° 24

WING FAN DOORS

ACT. HINGE PIN - VERTICAL DEFLECTION



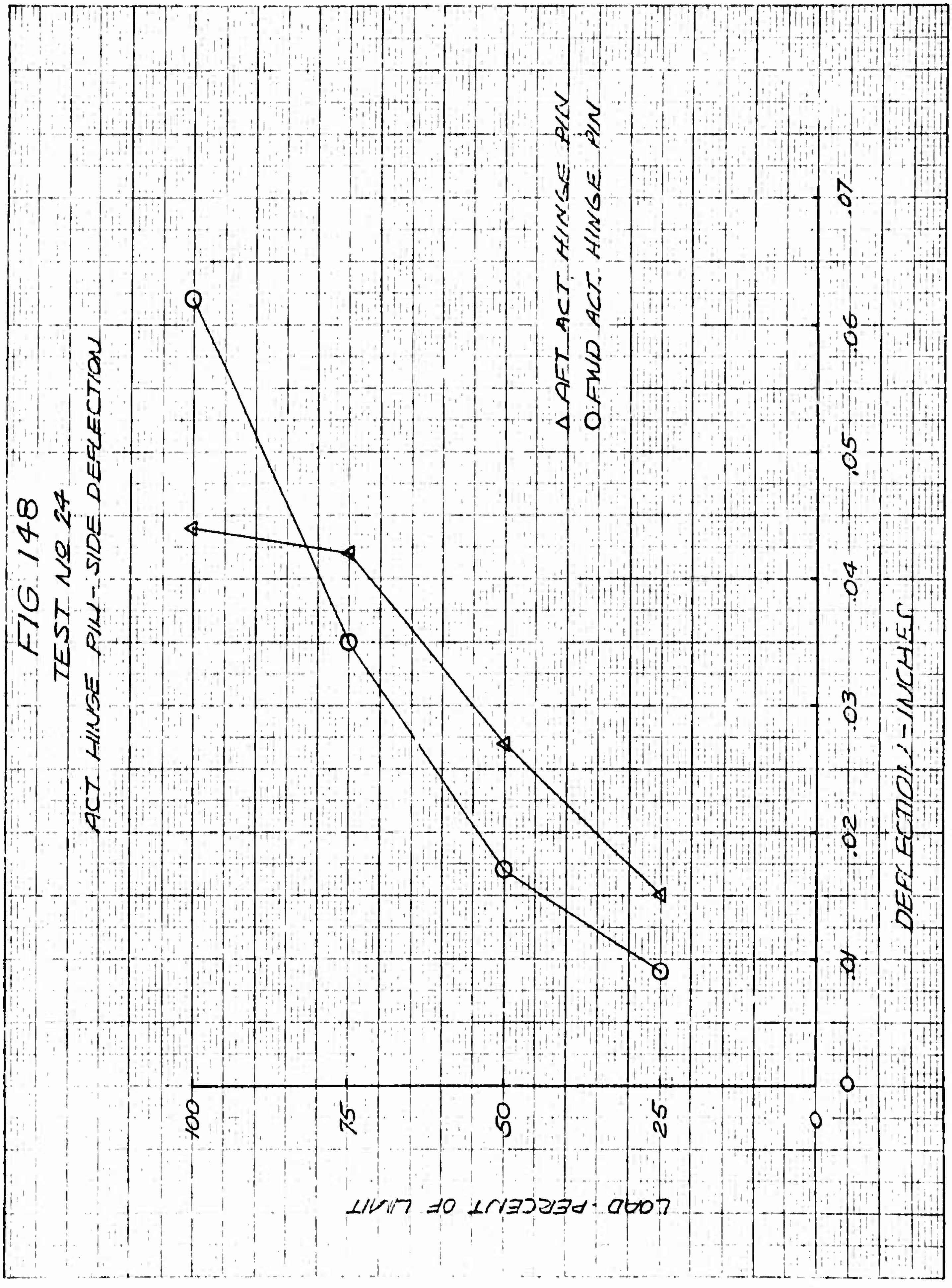
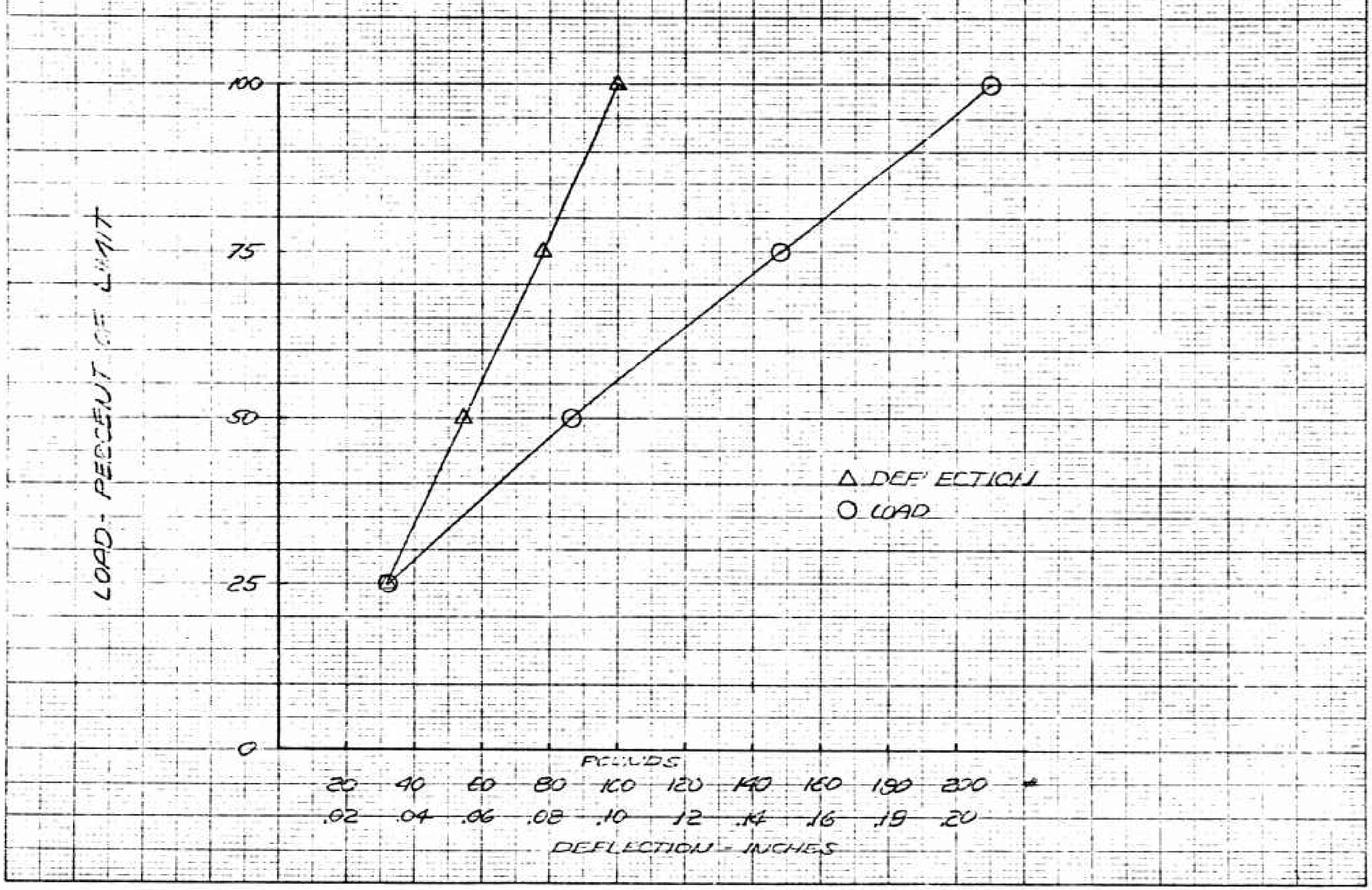


FIG 148
TEST NO 24
ACT HINGE PIN - SIDE DEFLECTION

FIG 149

TEST No 2A

FWD OUTRIGGER PIN



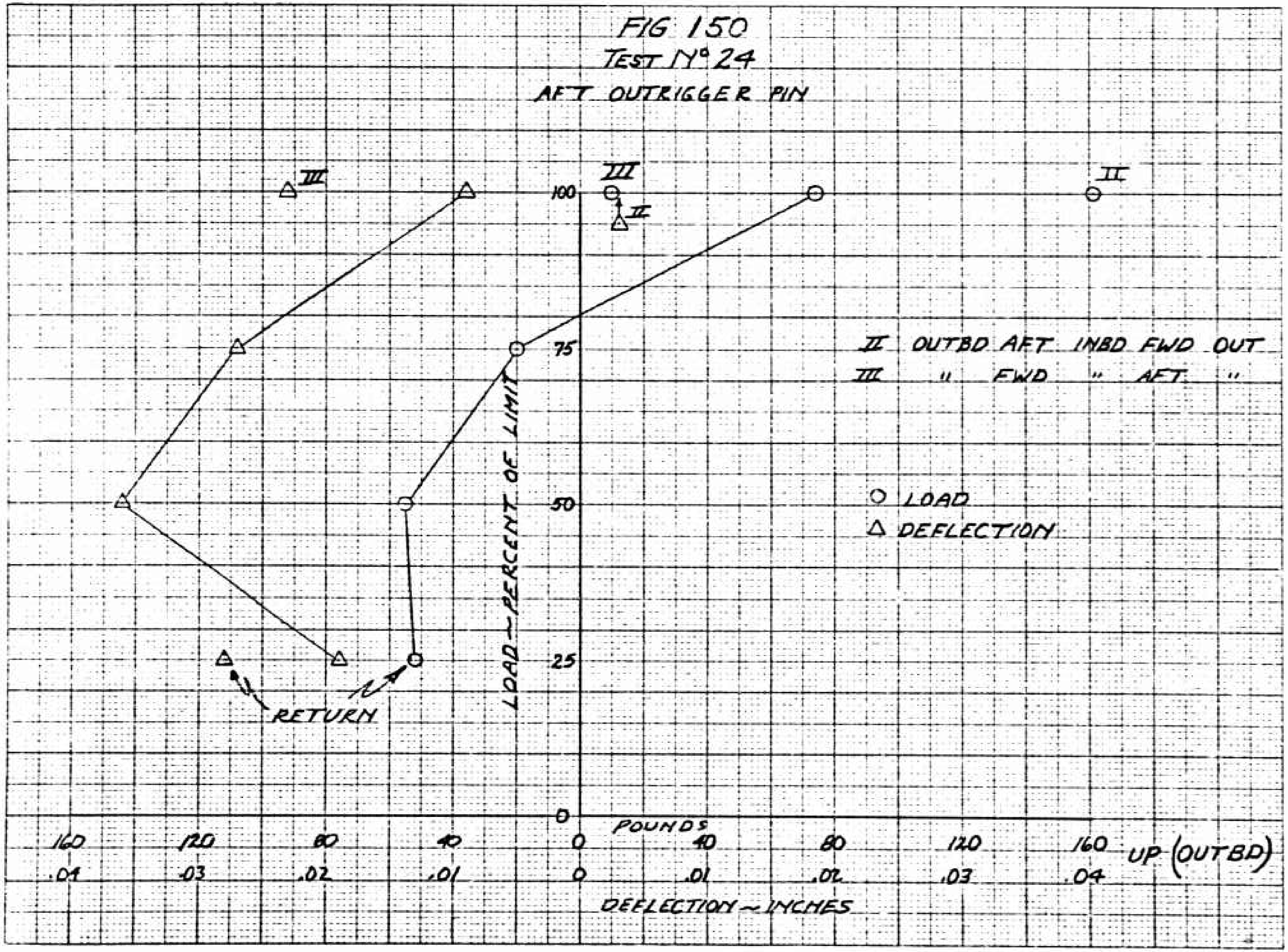


FIG 150
TEST Nº 24
AFT OUTRIGGER PIN
II OUTBD AFT INBD FWD OUT
III " FWD " AFT "
○ LOAD
△ DEFLECTION
LOAD ~ PERCENT OF LIMIT
100
75
50
25
0
POUNDS
160 120 80 40 0 40 80 120 160
.04 .03 .02 .01 0 .01 .02 .03 .04
UP (OUTBD)
DEFLECTION ~ INCHES
RETURN
II
III

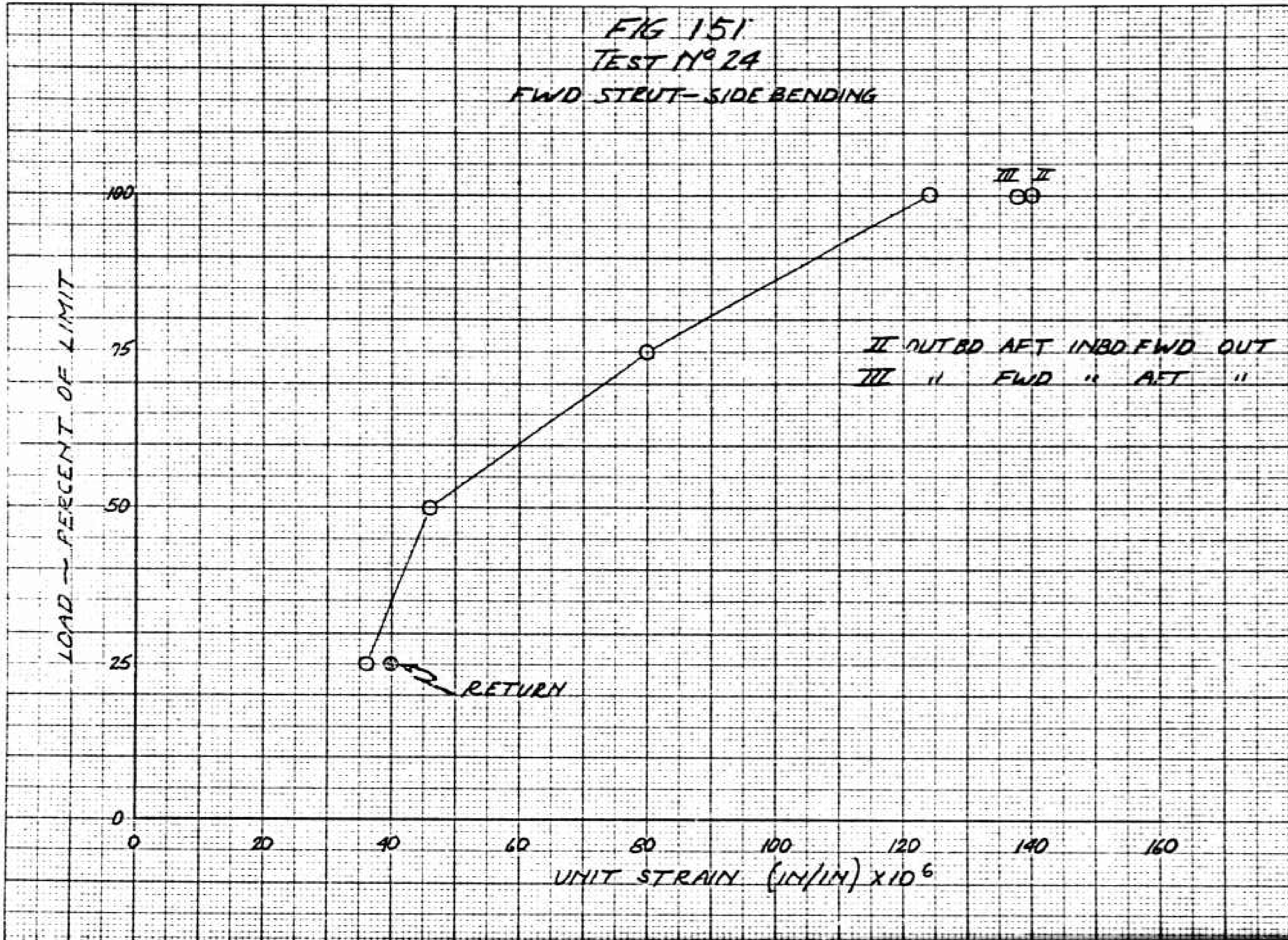


FIG 151
TEST Nº 24
FWD STRUT—SIDE BENDING
III II
II OUTBD AFT INBD FWD OUT
III " FWD " AFT "
RETURN
LOAD — PERCENT OF LIMIT
100
75
50
25
0
0
20
40
60
80
100
120
140
160
UNIT STRAIN (IN/IN) X10⁶

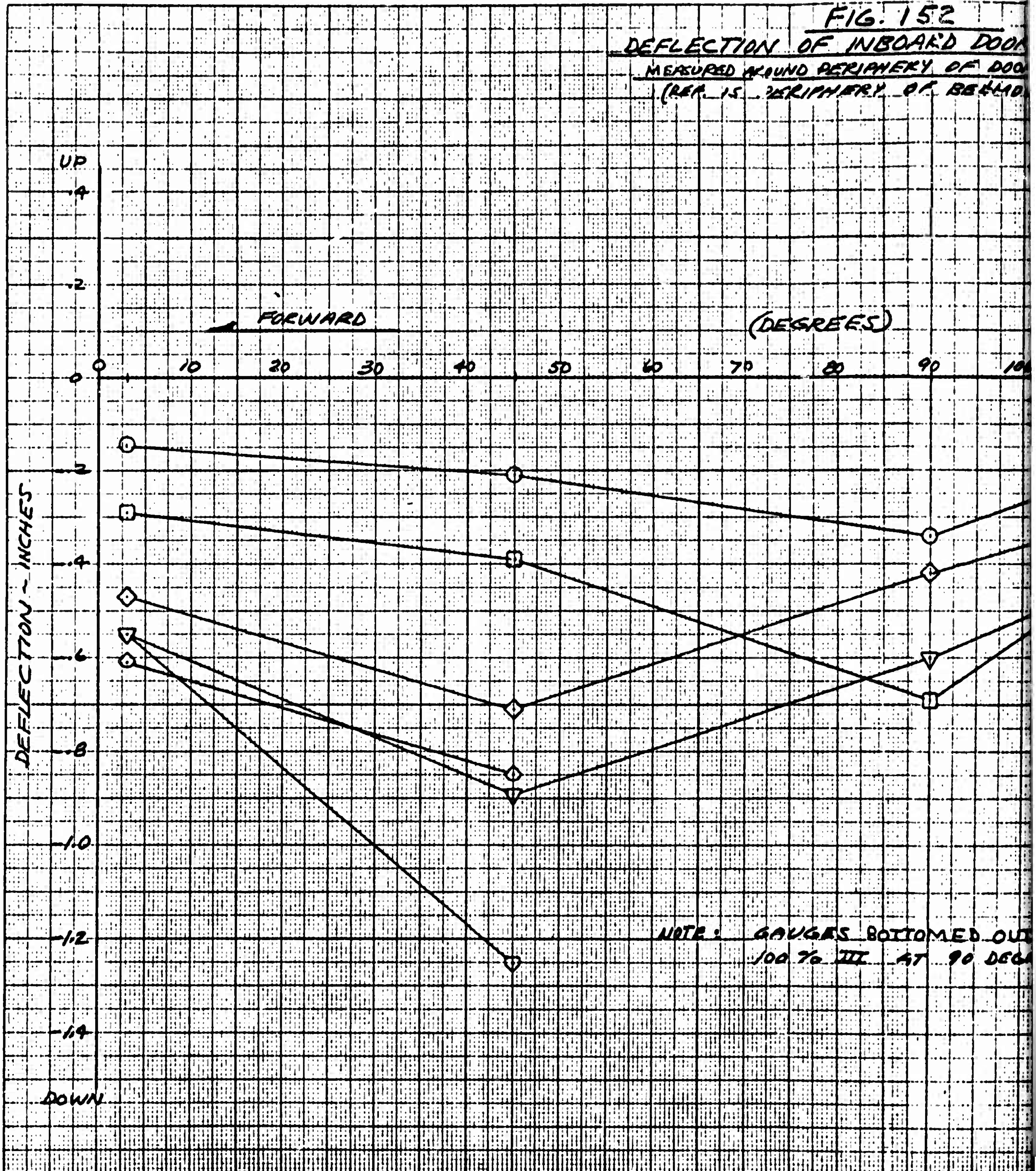


FIG. 152
DEFLECTION OF INBOARD DOO
MEASURED AROUND PERIPHERY OF DOO
(REF. IS PERIPHERY OF BE
UP
.4
.2
0
.2
.4
.6
.8
1.0
1.2
1.4
DOWN
DEFLECTION ~ INCHES
FORWARD
(DEGREES)
0
10
20
30
40
50
60
70
80
90
NOTE: GAUGES BOTTOMED OU
100 % III AT 90 DEG

A

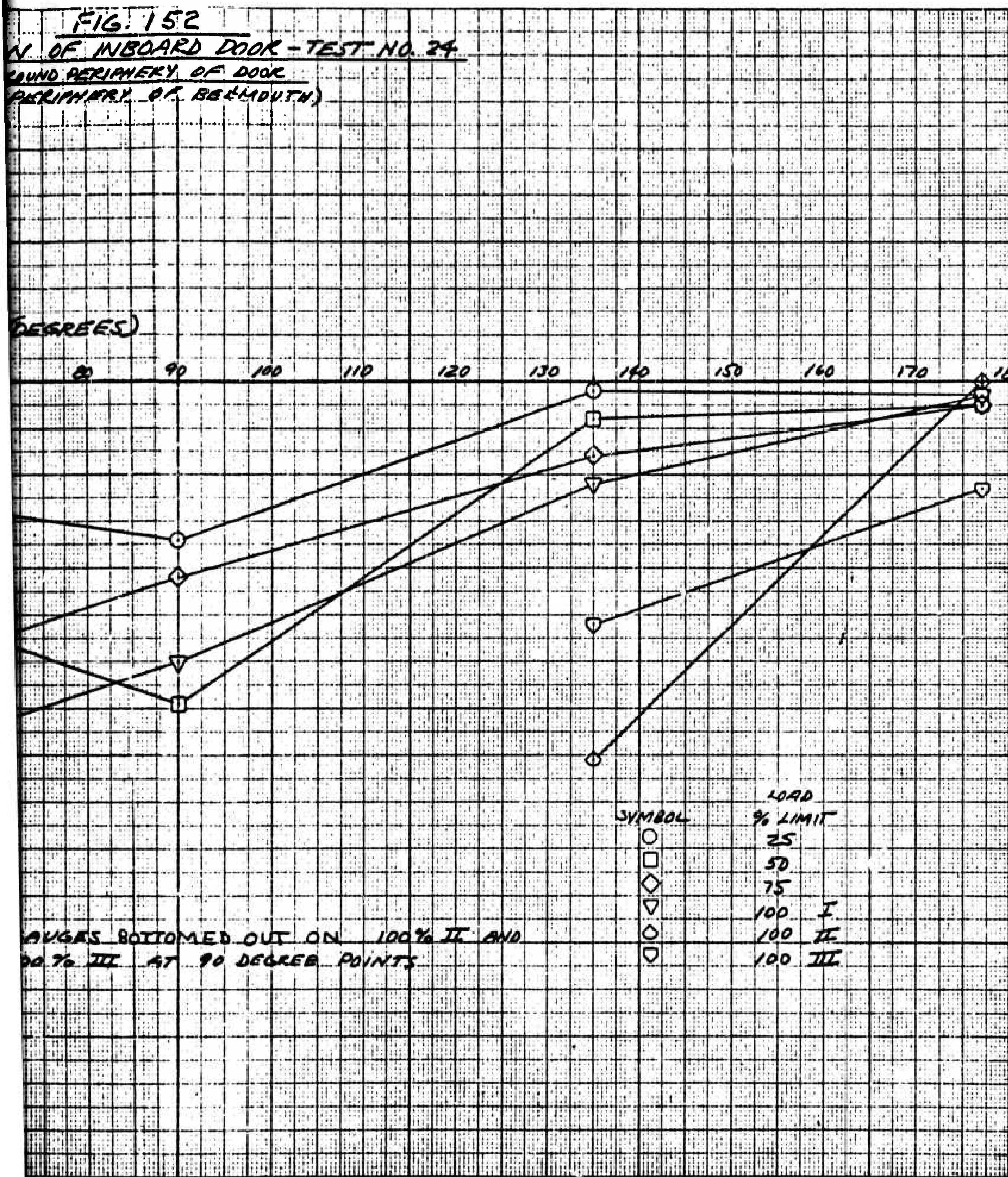


FIG. 152
N OF INBOARD DOOR - TEST NO. 24
ROUND PERIPHERY OF DOOR
PERIPHERY OF BELLMOUTH)
DEGREES)
80
90
100
110
120
130
140
150
160
170
180
LOAD
SYMBOL
% LIMIT
25
50
75
100 I
100 II
100 III
AUGES BOTTOMED OUT ON 100% II AND
00% III AT 90 DEGREE POINTS

B

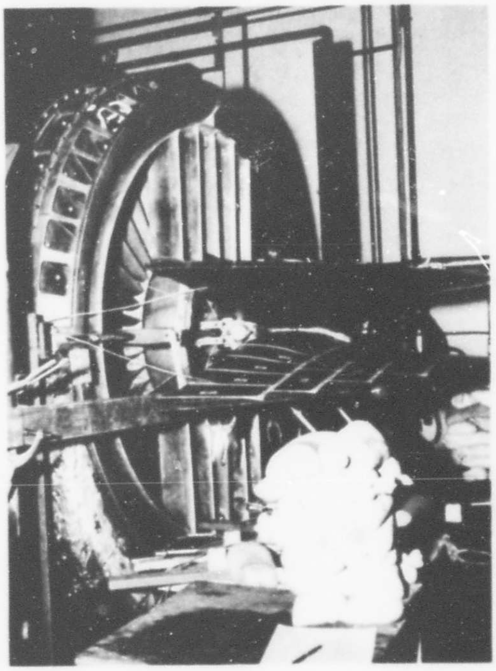


Figure 153
View Looking Aft
With Inboard Side
Down. Struts and
Hinge in Foreground
Make Up the Forward
Outrigger.

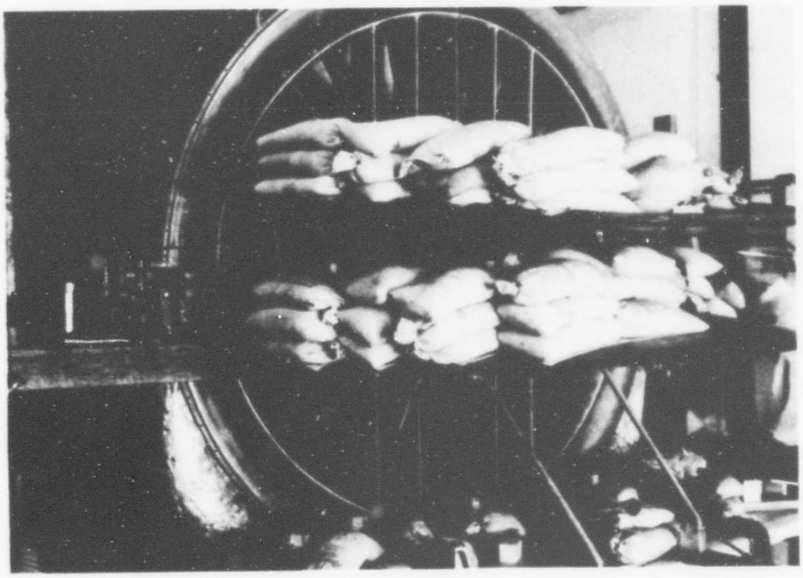


Figure 154 View of Loaded Fan Doors. Distribution of Load Varied for Right and Left Slip Due to Shift in Center of Pressure. Part III of Test at 100% Load.

3.25 TEST NO. 25 - WING FAN DOORS

3.25.1 Test Condition

Transition Flight, Extreme Forward Center of Pressure on Open Doors due to Right Slip

3.25.2 Introduction

This test is nearly identical to Test 24. The right slip maneuver was also looked at since only the right fan assembly was instrumented. This provided the effect of both right and left slip as regards door loads and deflections. The right slip condition did, however, provide a more forward center of pressure on the right door, and it was mainly due to this redistributed loading that the test was initiated.

3.25.3 Summary

Figures 155 and 156 presents the vertical and net side deflections respectively of the actuator hinge pin versus the applied load. It will be noted the return to the 25% load point deflection falls on the higher side; however, no explanation could be found.

Figures 157 and 158 contain plots of the total strainsert bolt load versus limit load applied to the open fan doors.

The side bending of the forward strut is shown in Figure 159 and is expressed as unit strain versus the applied load.

The forward and aft outrigger pin side deflections are plotted in Figures 160 and 161, respectively. The pin shear loads also appear on the same plots. Again all deflections are net deflections.

Figure 162 shows the method of load application.

FIG 155

TEST Nº 25

ACT HINGE PIN — VERTICAL DEFLECTION

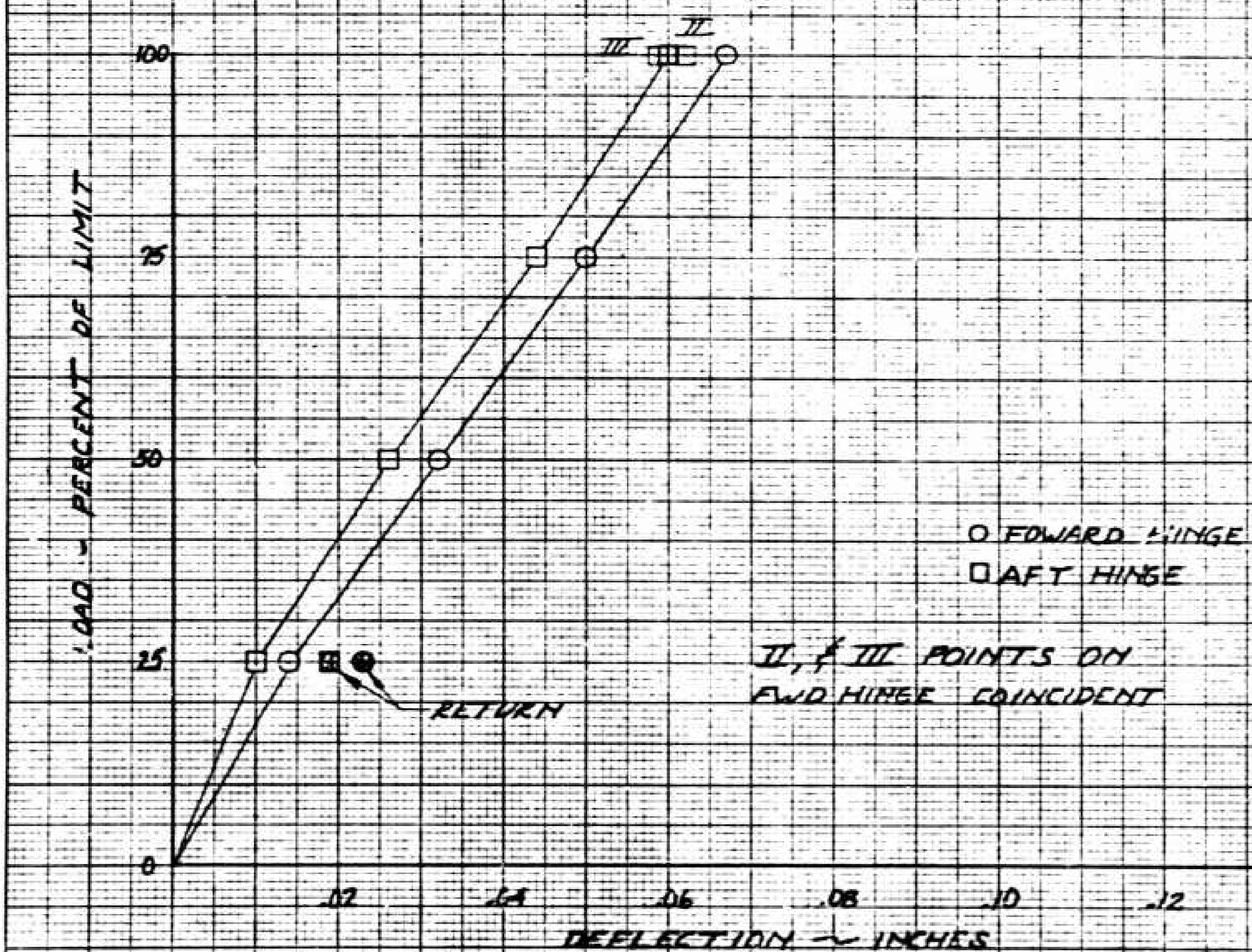
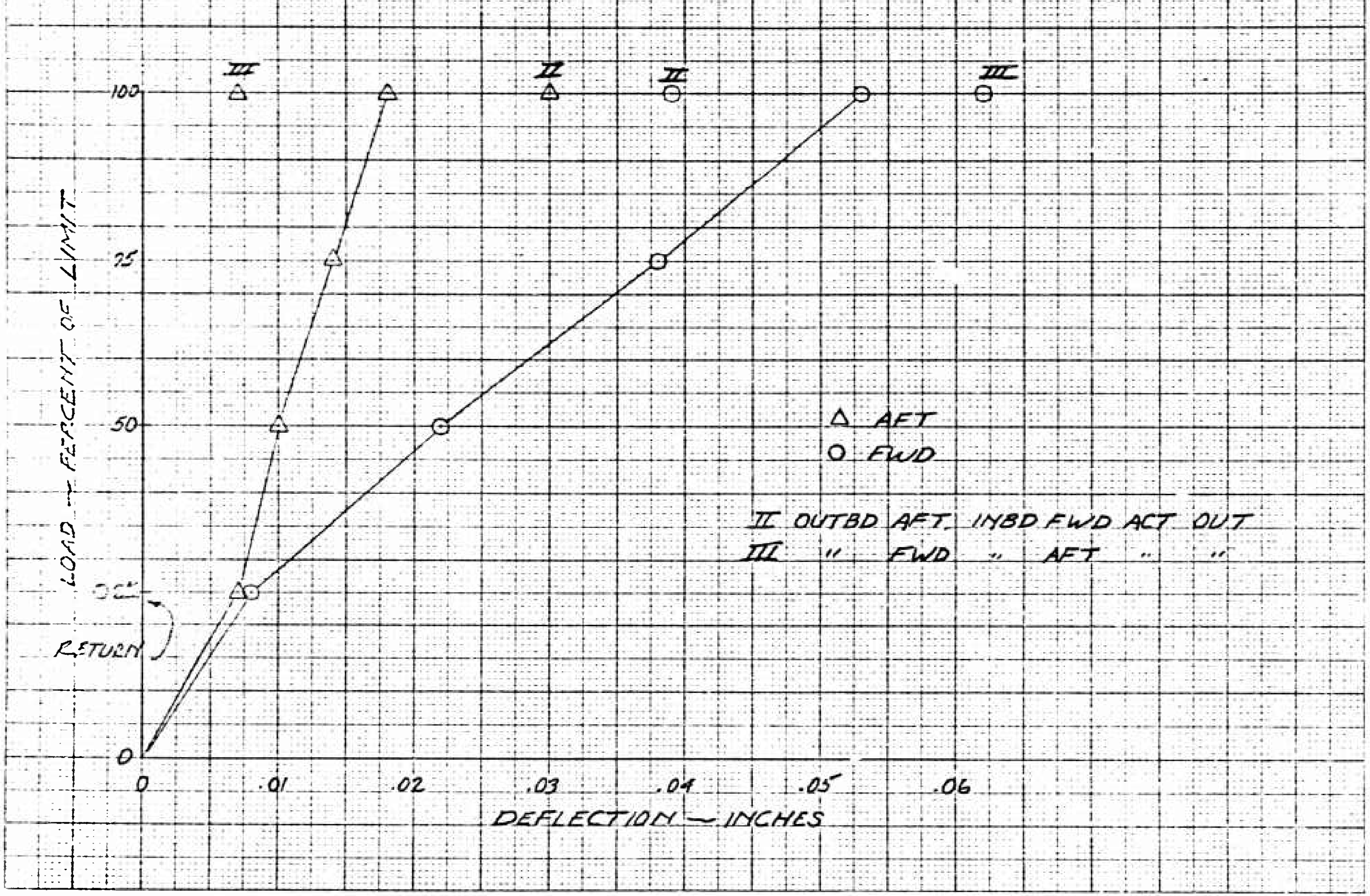


FIG 156
TEST N° 25
ACT. HINGE PIN ~ SIDE DEFLECTION



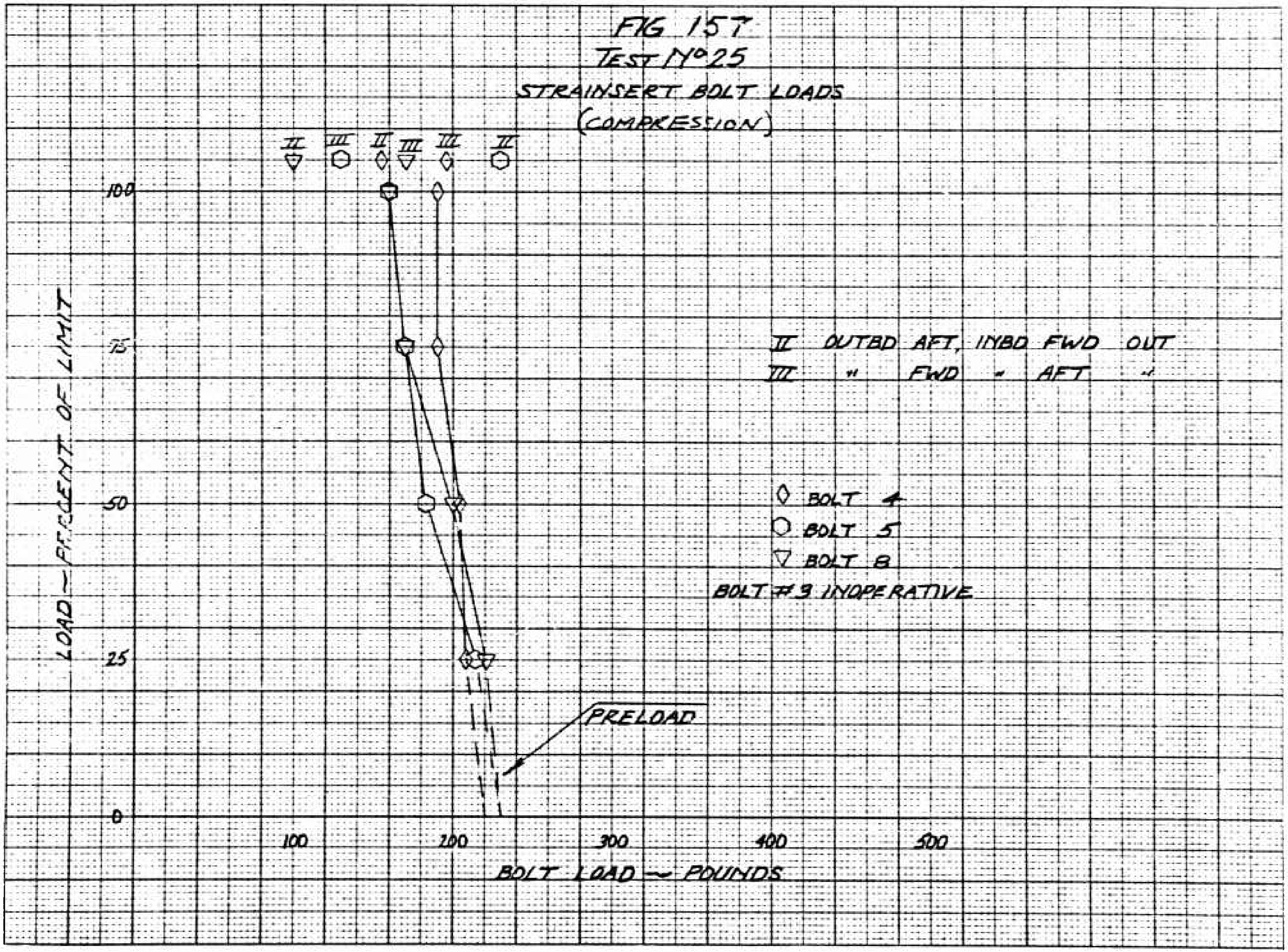


FIG 157
TEST Nº 25
STRAINSERT BOLT LOADS
(COMPRESSION)
II III II III III II
II OUTBD AFT, INBD FWD OUT
III " FWD " AFT "
BOLT 4
BOLT 5
BOLT 8
BOLT #3 INOPERATIVE
PRELOAD
100
75
50
25
0
LOAD ~ PERCENT OF LIMIT
100
200
300
400
500
BOLT LOAD ~ POUNDS

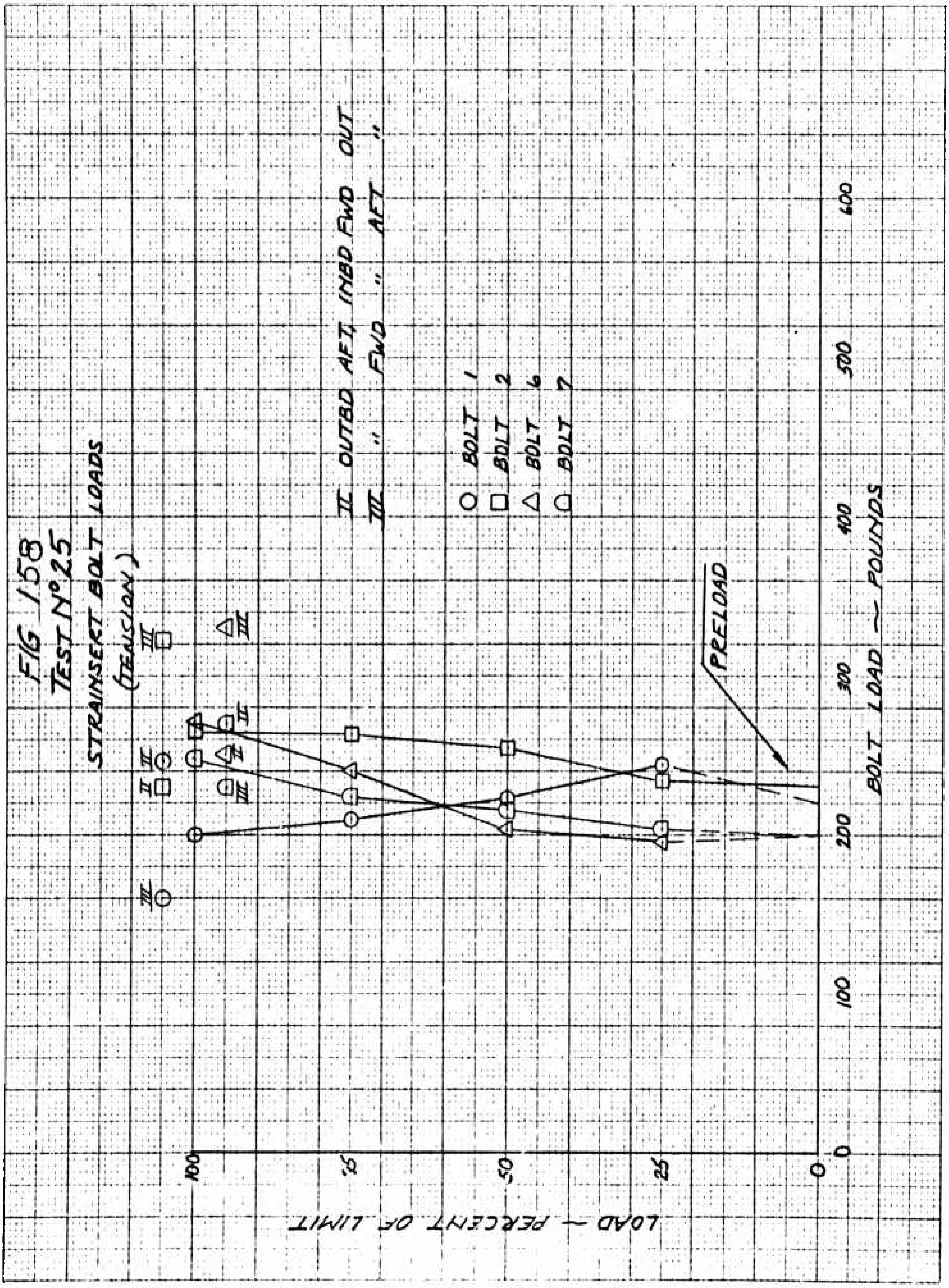


FIG 158
TEST No 25
STRAINSERT BOLT LOADS
(TENSION)
II OUTBD AFT, INBD FWD OUT
III " FWD " AFT "
BOLT 1
BOLT 2
BOLT 6
BOLT 7
PRELOAD
BOLT LOAD ~ POUNDS
LOAD ~ PERCENT OF LIMIT
0
100
200
300
400
500
600
25
50
75
100

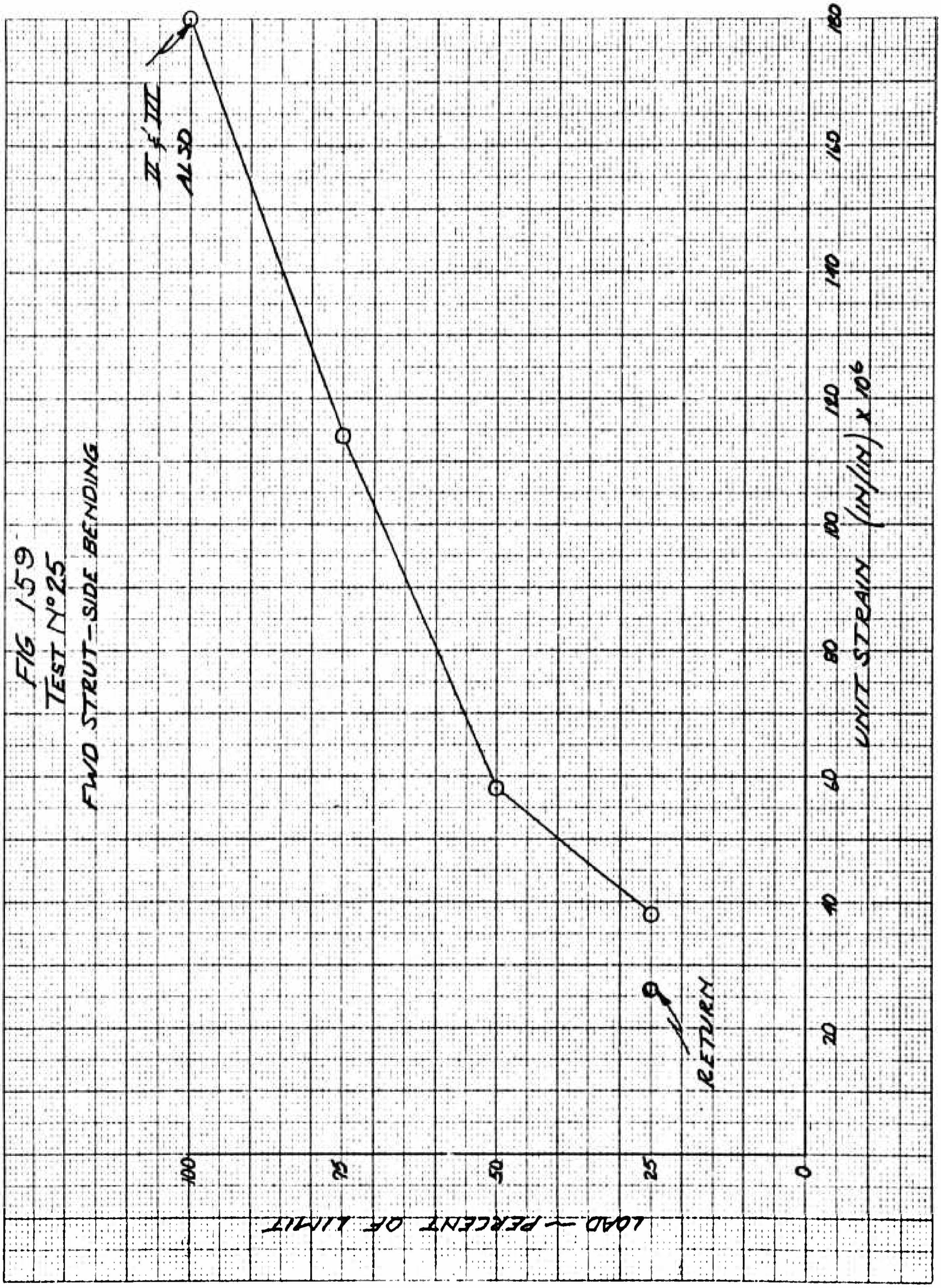


FIG 159
TEST Nº25
FWD STRUT-SIDE BENDING
II & III ALSO
RETURN
UNIT STRAIN (IN/IN) x 10^6
0
20
40
60
80
100
120
140
160
180
LOAD — PERCENT OF LIMIT
0
25
50
75
100

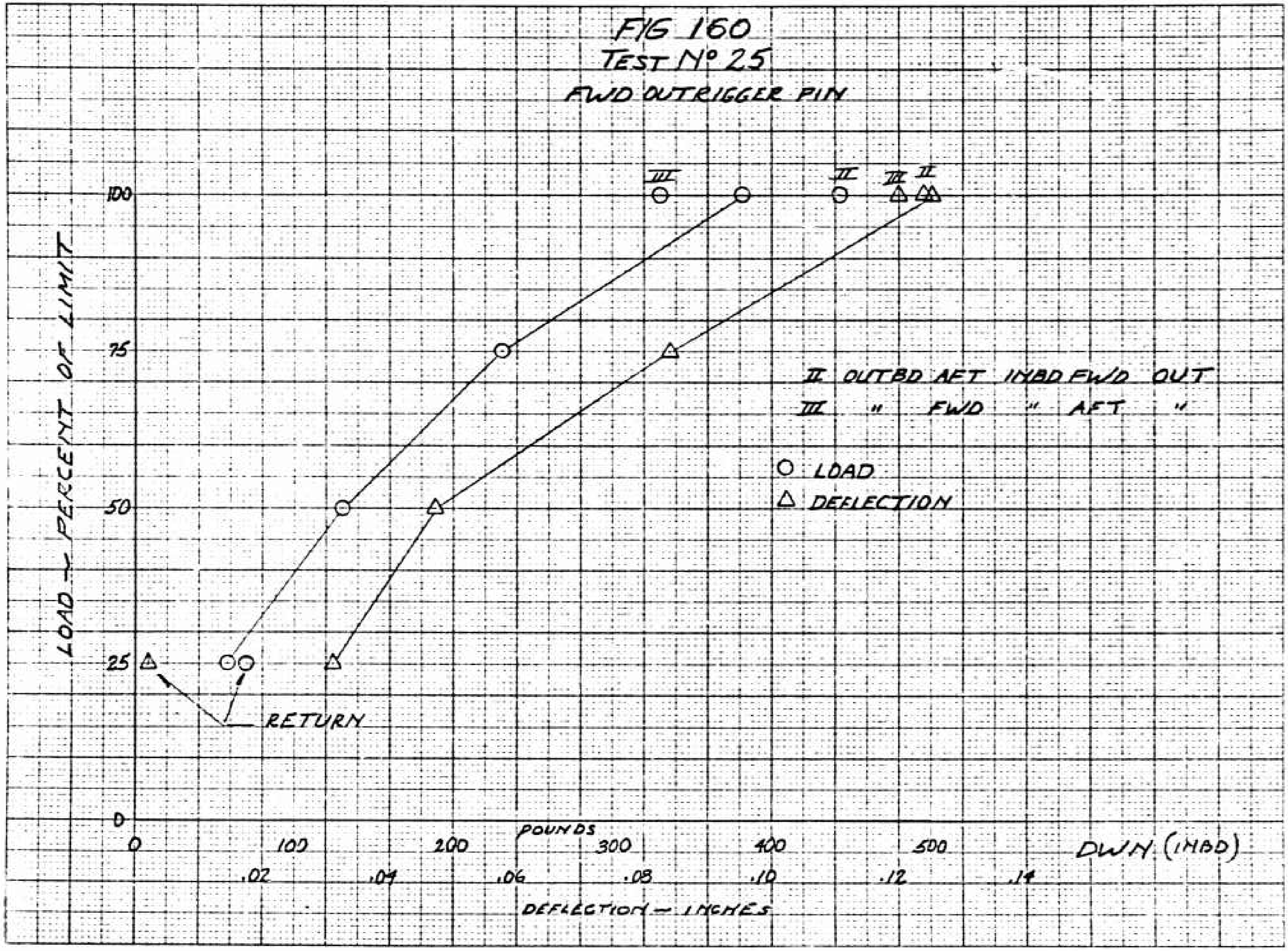


FIG 160
TEST Nº 25
FWD OUTRIGGER PIN
III
II
III II
100
75
50
25
0
II OUTBD AFT INBD FWD OUT
III " FWD " AFT "
○ LOAD
△ DEFLECTION
RETURN
LOAD — PERCENT OF LIMIT
0
100
200
300
400
500
POUNDS
.02
.04
.06
.08
.10
.12
.14
DWN (INBD)
DEFLECTION — INCHES

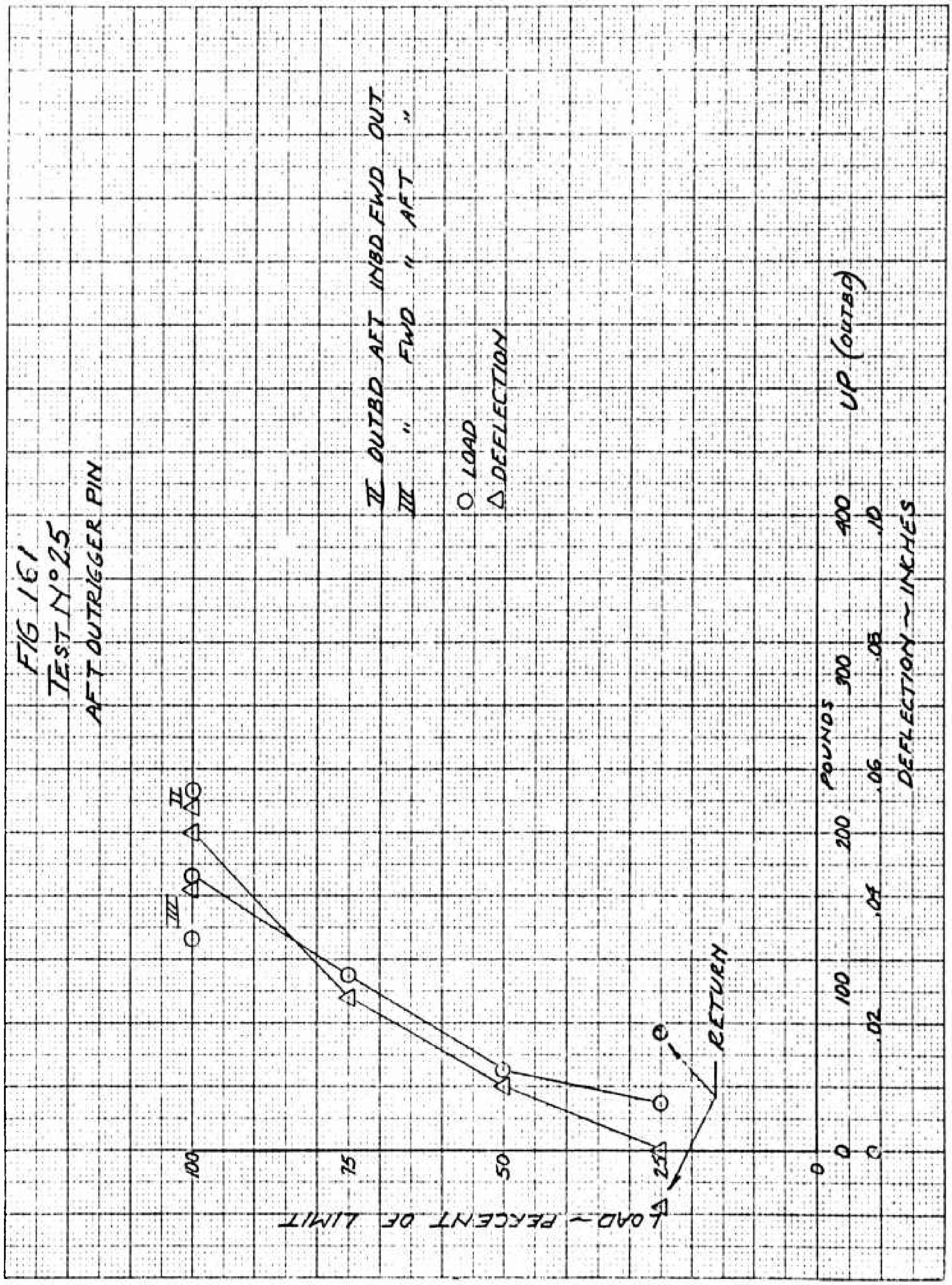
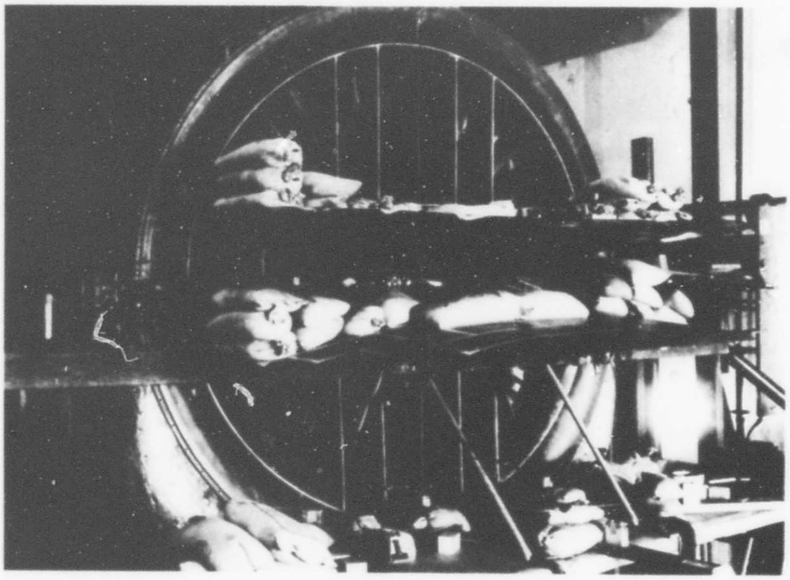


FIG 161
TEST N°25
AFT OUTRIGGER PIN
II OUTBD AFT INBD FWD OUT
III " FWD " AFT "
○ LOAD
△ DEFLECTION
UP (OUTBD)
II
III
RETURN
LOAD ~ PERCENT OF LIMIT
0
25
50
75
100
POUNDS
0
100
200
300
400
0
.02
.04
.06
.08
.10
DEFLECTION ~ INCHES



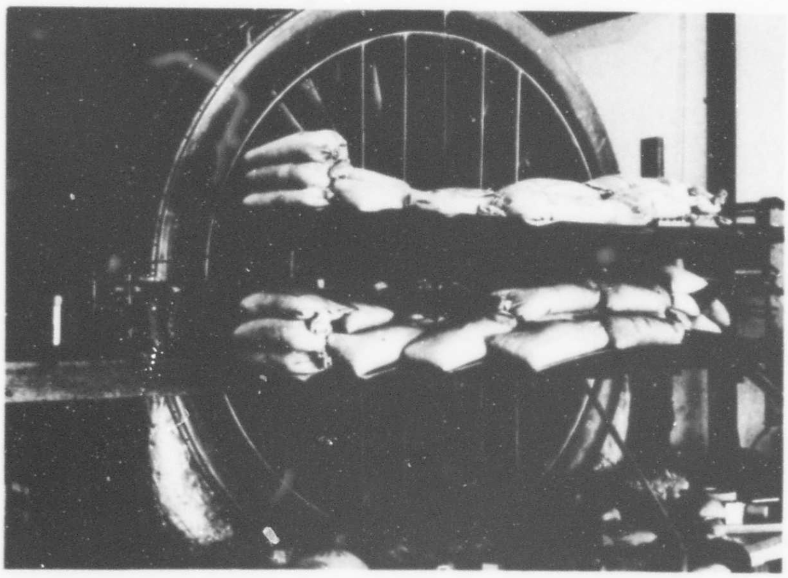


Figure 162 The Above two Photos Show the Variation of Load Distribution on the Fan Doors. Placement of Shot Bags Could Represent Right and Left Slip.

REFERENCES

1. Report Number 126, Structural Proof Test Program

2. Report Number 130, Structural Analysis, Wing Basic Components, dated October 1963

3. Report Number 144, Fuselage Structural Analysis, Volume II, dated February 1964

4. Ryan Internal Report MR 63-9
Elevated Temperature and Notch Strength Properties of 18 NiCoMo (250) MarAge Steel.