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STATIC LOAD-DEFLECTION RELATIONS
FOR
20 x 4.4 AND 32 x 8.8 AIRCRAFT TIRES
ON
AN ELFACA MODEL C RUNWAY LIGHT COVER

by

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To

Equipment Laboratory
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Department of the Air Force

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NBS

U. S. DEPARTMENT OF COMMERCE

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1. INTRODUCTION

The results of previous tests [1]* indicated that the proprietary runway light covers, commonly known as Elfaca, were potentially hazardous to aircraft with small tires. Subsequently, these light covers were modified to eliminate this objection and incorporate certain other desired changes. This report is concerned with the results of static load tests of two sizes of aircraft tires on a modified Elfaca light cover.

2. TEST SAMPLES AND FIXTURES

Two new aircraft tires, sizes 20 x 4.4, 10 ply rating and 32 x 8.8, 22 ply rating were used for these tests. An Elfaca flush light cover, USA model C, was mounted in concrete to simulate an actual installation. Following the details in a report by the manufacturer [2], the light cover was set in a concrete slab with outside dimensions of 16 inches wide, 108 inches long and 13 inches deep. Compressive loads were applied to the tires and light cover through yoke type loading fixtures and steel shafts through the wheels with a testing machine of 10,000,000 lb capacity. For the tests of the 20 x 4.4 aircraft tire, an auxiliary load measuring capsule of 50,000 lb capacity was placed in series with the reaction head and the loading fixture to indicate loads with increased sensitivity. Deflection measurements were made with dial gages. The test set up for the 32 x 8.8 tire on the light cover is shown in figure 1.

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* References are listed at the end of the text.

3. TEST PROCEDURES

The mounted light cover was placed on the lower platen of a compression testing machine and a tire loading fixture was attached to the head so that the tire could be loaded in various positions relative to the light cover. Each tire was loaded twice on a flat steel plate to provide a basis for comparing the load-deflection relations of the tires on the light cover. The test positions of each tire on the grating are given in table 1. Eight tests were made with the 20 x 4.4 tire and five tests were made with the 32 x 8.8 tire. The 20 x 4.4 tire was loaded at four evenly spaced points along the axis of the grating to study the effects of the varying distances between the bars.

Continuously increasing compressive loads were applied and values of load and deflection were determined simultaneously. The vertical deflections of the axis of the wheel relative to the top of the concrete slab or flat plate were measured for all tests.

The position of no load and zero deflection was taken to be that position where there was sufficient contact between the tire and loading surface to prevent easy rotation of the wheel by hand. The air pressure in the tires with no load was measured before each test to be 155 lb/in.^{2} in the 20 x 4.4 tire and 280 lb/in.^{2} in the 32 x 8.8 tire.

4. RESULTS

4.1 Size 20 x 4.4 Tire

The load versus deflection relations for the eight tests of the 20 x 4.4 tire are shown in figure 2. The deflections for opposite sides of the tire were averaged for each load. Figures 3 and 4 are photographs of the tire sustaining the maximum loads applied during tests 7 and 8, 9,500 lb. The tests were stopped when it appeared that the wheel flange was bearing directly on double thicknesses of the casing and tube.

The load-deflection data for tests 4, 5, 6 and 7 were plotted against the positions of the tire along the axis of the light cover in figure 5. For comparison, the deflections due to 2,000, 6,000 and 9,000 lb loads applied to the tire on a flat plate, test 2, are shown in figure 5 as dashed lines.

4.2 Size 32 x 8.8 Tire

The 32 x 8.8 tire is shown in figures 6, 7, 8 and 9 sustaining the maximum loads applied during tests 1, 2, 3 and 4, respectively, of this tire. The load versus deflection relations for the five tests of this tire are shown in figure 10. The deflection values are the average of measurements made on opposite sides of the tire. The tests were stopped with 85,000 lb loads applied to the tire on the flat plate and with 80,000 lb loads applied to the tire in the other test positions to avoid possible damage to the tire which might influence the results of subsequent tests.

The lamp cover plate appeared to be displaced about 1/4 inch below the top of the concrete slab with 80,000 lb applied through the tire during test 4. The cover plate appeared to return to its original position upon removal of the load.

Visual examination of the light cover and tires after these tests did not reveal any damage.

5. DISCUSSION

The load-deflection relations for the tests of the 20 x 4.4 and 32 x 8.8 tires loaded on a model C Elfaca light cover indicate that under normal operating loads and conditions, the tires would probably roll over the light cover without significant damage to either.

There are several factors that cannot be evaluated satisfactorily from the static load tests reported here. Some of these factors, some of which were listed in a previous report [1], are

(a) The effects of the differences in the coefficients of friction between the pavement and the light cover on the braking characteristics of the various sizes of tires operating at different pressures.

(b) The possibility of reduced fatigue life for critical parts due to the additional force excitations resulting from operations over this light cover.

(c) The excitation of resonant vibrations in the aircraft structure due to the periodic spacings of the light covers on the runway.

(d) The damaging effects of the relatively thin bars on the treads of skidding tires.

(e) The increase in the forces on the landing gear when traversing a protrusion and, for small tires, the increase in the drag load on the wheel when it is required to climb out of the grating.

For the Director,

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Washington, D. C.

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REFERENCES

1. Irwin, L. K., "Results of Static Loading Tests of Elfaca Gratings by Aircraft Tires", National Bureau of Standards Report No. 4086, Lab. No. 6.4/2-85-2, May 1955.

2. Anonymous, "Elfaca Flush Airfield Lighting", Structural Concrete Products Corp., 10 East 40th Street, New York 16, N. Y., September 18, 1956.

Table 1. Test Positions of 20 x 4.4 and 32 x 8.8 Tires on the Elfaca Model C Runway Light Cover.

Test No.	No. of bars supporting tire: Initially	No. of bars supporting tire: At max. load	Average bar spacing under ℄ of wheel: Center to center	Average bar spacing under ℄ of wheel: Clear space	Distance from widest end of grating to ℄ of wheel	Figure No. of set-up
			in.	in.	in.	
			20 x 4.4 Tire			
1	(a)	-	-	-	-	-
2	(a)	-	-	-	-	-
3	1	3	1.85	1.45	10	-
4	2	2	1.85	1.45	10	-
5	2	4(c)	1.70	1.35	18 1/8	-
6	2	4(c)	1.55	1.25	26 1/4	-
7	2	4	1.40	1.12	34 3/8	3
8	(b)	-	1.40	1.12	34 3/8	4
			32 x 8.8 Tire			
1	(a)	-	-	-	-	6
2	2	6	1.40	1.12	34 3/8	1,7
3	(b)	-	1.40	1.12	34 3/8	8
4	(d)	-	-	-	79 7/8	9
5	(a)	-	-	-	-	-

(a) Tire supported on flat plate
(b) Tire axis at 45° to long dimension of grating
(c) Only partial support from outside bars
(d) Tire supported on lamp cover plate

A 32 x 8.8 Tire Positioned for Loading on a Model C El-
faca Light Cover. Distance from Wide End = 34 3/8 in.

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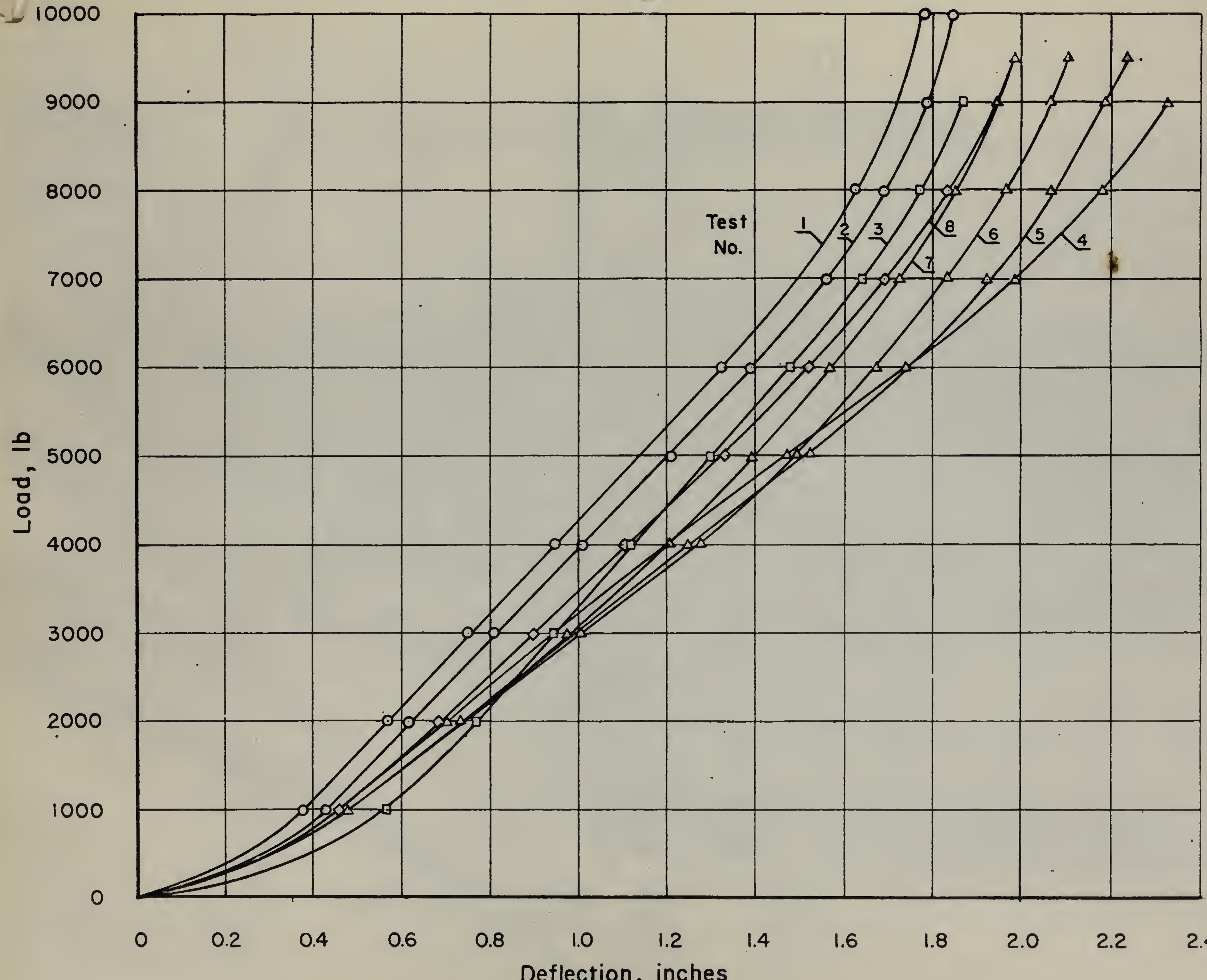
Figure 1



Load vs. Deflection Relations for 20 X 4.4 Tire on Model C Elfaca Light Cover

6.4/295-4 Figure 2

A 20 x 4.4 Tire Initially Centered on Two Bars of
a Model C Elfaca Light Cover. Load = 9,500 lb.

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Figure 3

A 20 x 4.4 Tire at 45° to the Bars of a Model
C Elfaca Light Cover. Load = 9,500 lb.
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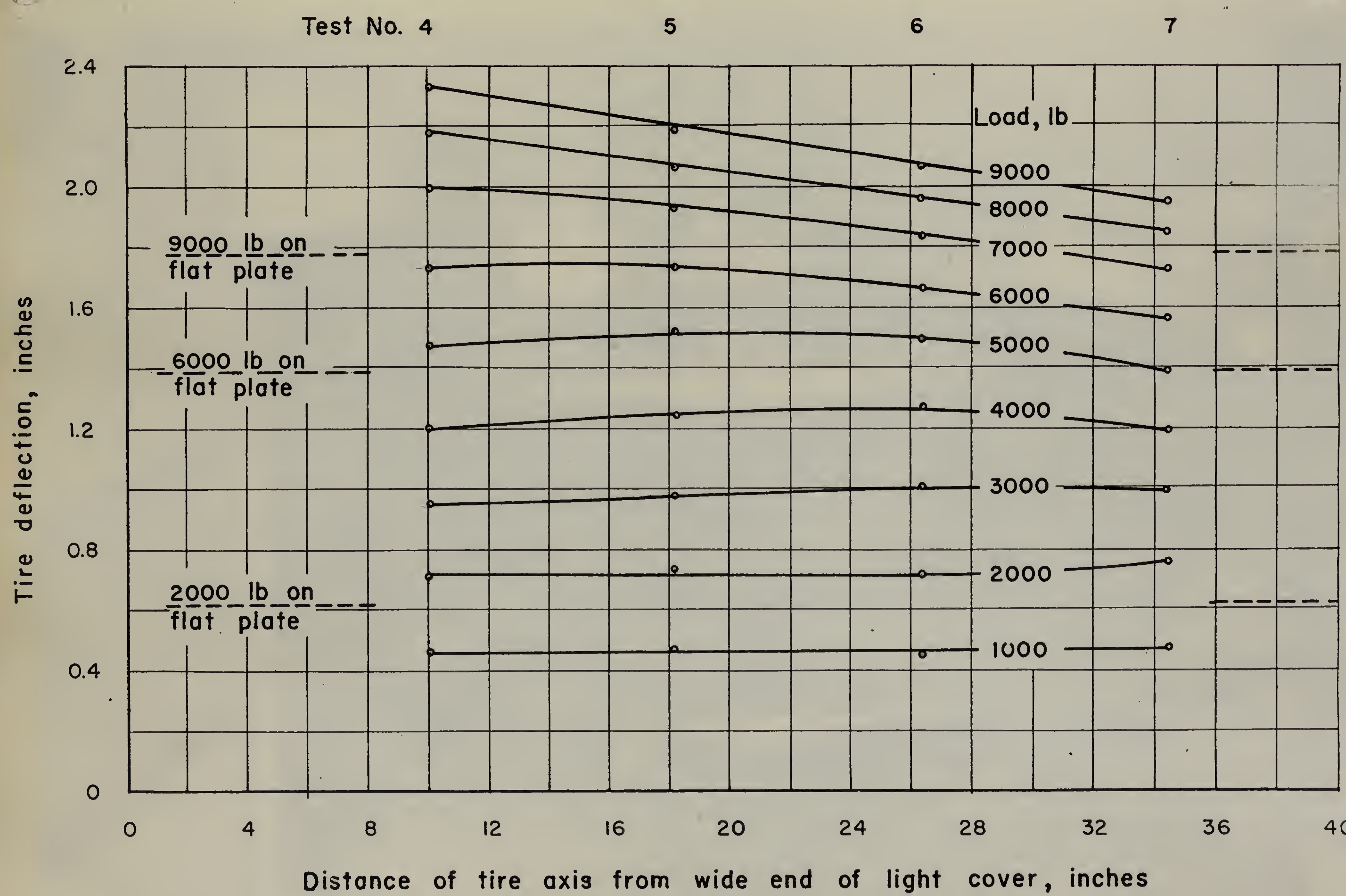
Figure 4



Deflection vs. Position of a 20X4.4 Tire on the Light Cover
With Various Loads

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Figure 5

A 32 x 8.8 Tire on a Flat Plate. Load = 85,000 lb.
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Figure 6

A 32 x 8.8 Tire Centered on the Bars of a Model C Elfaca Light Cover. Load = 80,000 lb.

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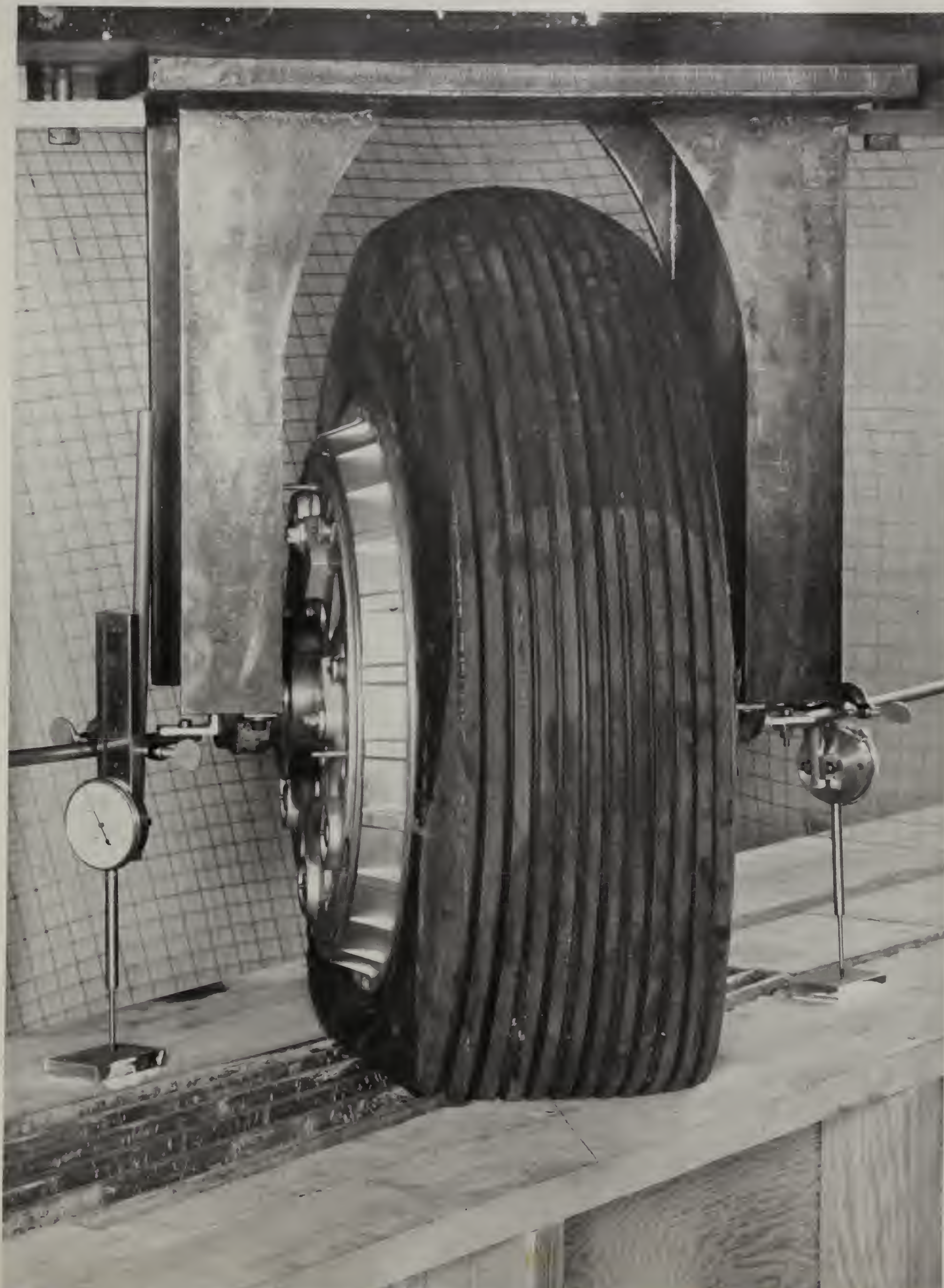
Figure 7



A 32 x 8.8 Tire at 45° to the Bars of a Model C Elfaca Light Cover. Load = 80,000 lb.

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Figure 8

A 32 x 8.8 Tire Centered on the Lamp Cover Plate of a Model C Elfaca Light Cover. Load = 80,000 lb.

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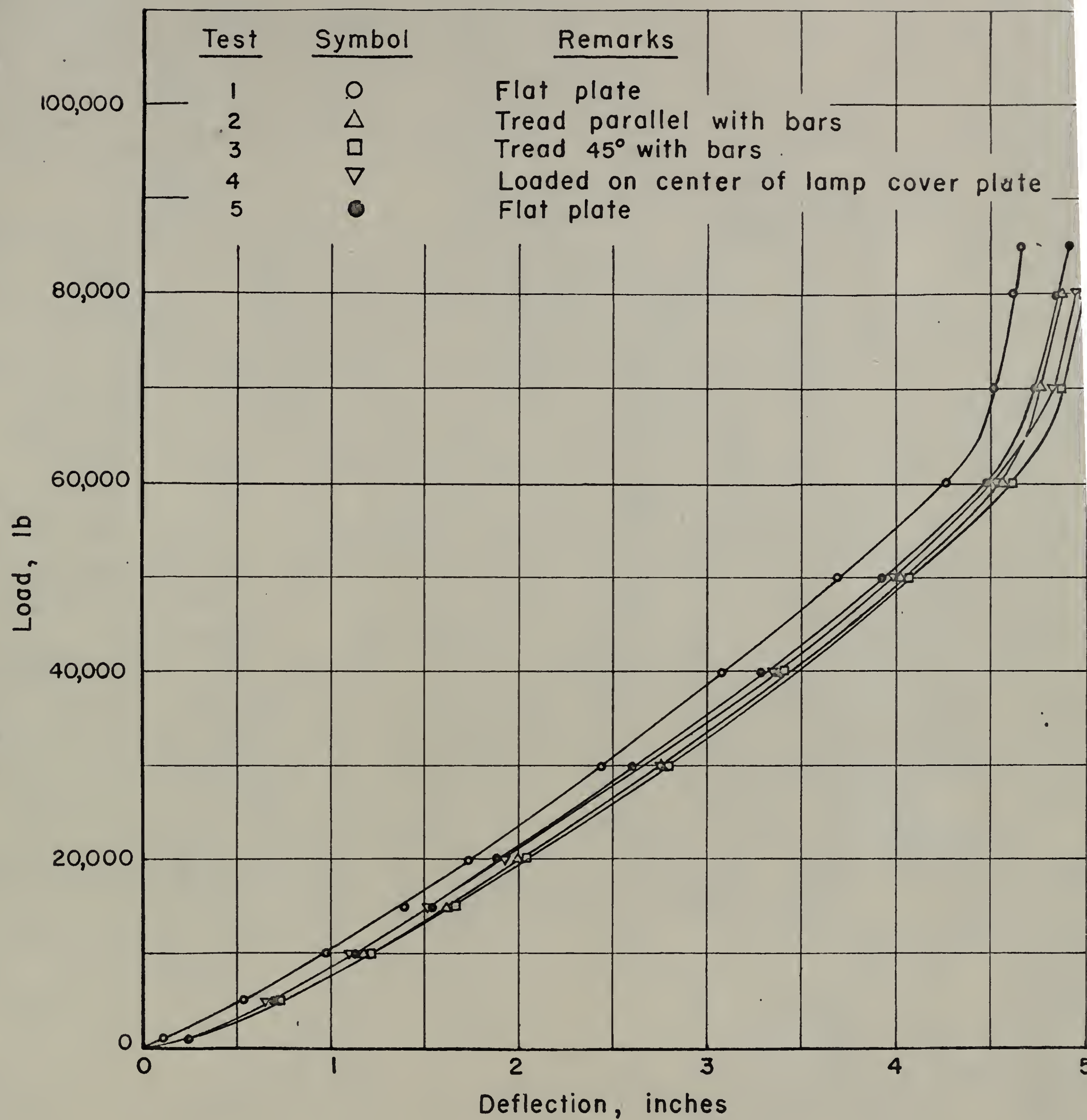
Figure 9



Load vs. Deflection Relations for 32 X 8.8 Tire on Model C Elfaca Light Cover