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Tests on cold formed steel studs American Iron and Steel Institute

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TESTS ON COLD FORMED STEEL STUDS
AMERICAN IRON AND STEEL INSTITUTE

Second Progress Report, April, 1940

I. PURPOSE OF THE INVESTIGATION

The purpose of the investigation is to provide technical information for the development of standard specifications for steel stud wall construction, suitable for inclusion in building codes.

II. SCOPE OF THE PROGRAM

The scope of the program now under way is as outlined by the Committee and reported in a letter from B. L. Wood dated January 22, 1940.

III. SCOPE OF THIS PROGRESS REPORT

The scope of this progress report number 2 covers results of tests on single type B studs with pin (free) ends. The methods of testing are described and the data obtained are herein presented. No particular conclusions have been drawn from these preliminary tests, since the data re for only one type of stud and for only one end condition.

IV. GRAPHICAL REPRESENTATIONS

Graphical representations of the results (Figs. 4 - 8 inclusive) represent the load deflection relation for each stud, for lengths of 4,6,8,10, and 12 feet.

V. DESCRIPTION OF THE STUDS

The type B studs are made of 16 gage sheet metal formed into a channel section with a flange of one (1) inch and a web of four (4) inches.

The studs were found to be of very uniform dimensions and had been formed to a high degree of accuracy.

VI. DESIGNATION OF SPECIMENS

The following system is employed to designate the studs.

The first figure or figures represent the stud length, the following letter the type of stud, the next figures the gage of metal employed, the next letter describes the type of end employed, and the final number denotes a particular one of identical specimens. Thus 6 B 16 P 1 denotes a 6 foot stud, type B, 16 gage metal, pin or free ends, and the first one of that type.

VII. METHOD OF TESTING

A. All tests were made in the 300,000 lb. Baldwin Southwark Column testing machine, using the 20,000 lb. dial. The test set-up is shown in figure 1.

Three studs of each length were tested by applying an axial load through a test base as shown in figure 2. This test base is constructed so that the end of the stud is clamped to the base by steel blocks which may be adjusted in location to give an accurately concentric load. Identical test blocks were used on each end of the studs, and steel plates, grooved to receive the knife edges of these blocks, were placed between the knife edges and the heads of the testing machine. See Plate 2. Thus by adjustment of the blocks the load may be applied to the centre of gravity of the cross section of the stud. For this series of tests the load axis (knife edge) was adjusted to coincide with the minor axis of the studs.

The lateral deflection was measured at the mid-length of the stud. A thin bronze wire was held taut between the centres of the test blocks or bases. A steel scale graduated to 1/100 ths. of an inch was attached to the center of the stud in a horizontal position. The displacement of the scale with respect to the wire was read by telescope.

For convenience this wire was attached slightly above the knife edge of the test base. See Plate II. The error so introduced has been investigated and found to be negligible. However for further tests it is planned to modify the base so that the wire may be fastened nearer the pivot.

Each stud, properly adjusted in the machine, was loaded slowly and the deflections obtained. Successive load increments were applied, in general, without returning to the initial load values. However, in several of the stud tests, loads in the region 50 to 90% of the ultimate were decreased to the initial load and no permanent set was observed. This is in agreement with the expected behaviour of these studs since due to the large l/r ratios no yielding should occur until shortly before the ultimate load is reached. As each increment was applied the deflections were observed and this was continued until the ultimate load was reached.

VIII. RESULTS

The load deflection diagrams Figs. 4,5,6,7, and 8, show the expected characteristics of a buckling curve. It is seen that the deflections are very small for moderate loads, and increase rapidly near the ultimate load. The ultimate loads of the three specimens of each length vary from the mean value by 3.8 per cent maximum to 0.9 per cent minimum. The distance from the end of the stud on the test base or block to the knife edge is one and one half inches. Thus the effective length of tested stud used in the table below is three inches greater than the actual length of stud.

TABLE I

l/r ratios for type B studs

Length	4'	6'	8'	10'	12'
l/r	182	269	355	441	529

The theoretical critical load was calculated by using Euler's formula, namely $P_{cr} = \frac{\pi^2 E I}{l^2}$, and using 29.5 x 10^6 for E and the distance between the knife edges of the test bases as the effective length of the studs.

TABLE II

Comparison of theoretical and actual ultimate load for type B studs

Length	Mean ultimate load lbs.	Euler Critical Load	Percent Difference
4'	2812	3060	8.1
6'	1332	1415	5.7
8'	795	812	2.1
10'	468	525	10.8
12'	313	368	14.9

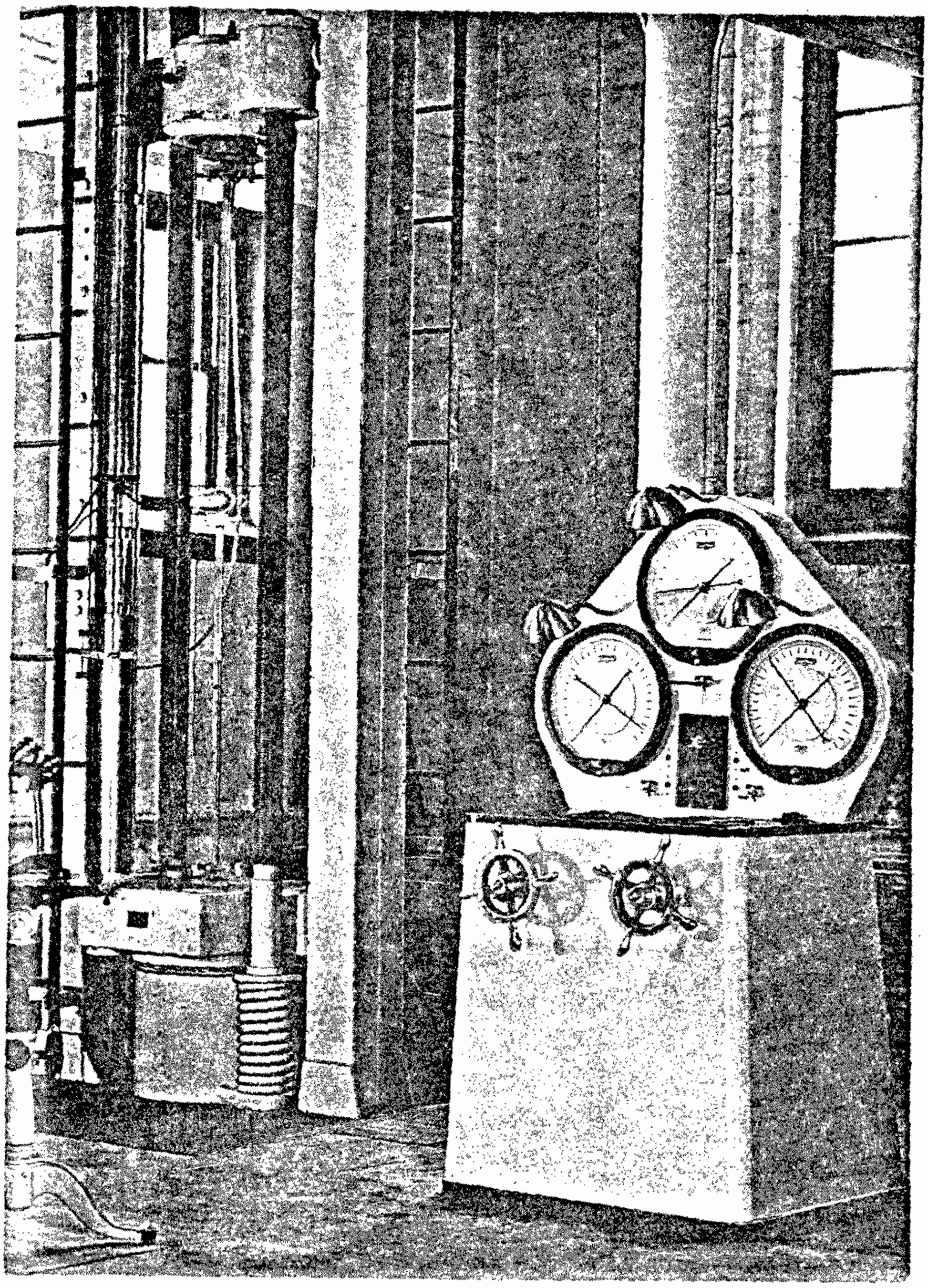


PLATE 1

Column testing machine and column test set-up

S -- Steel scales for measuring deflection and change of distance between ends.

W -- Fiduiciary taut wire for reading deflections of center of column with respect to ends.

T -- Telescope used for reading deflection scale.

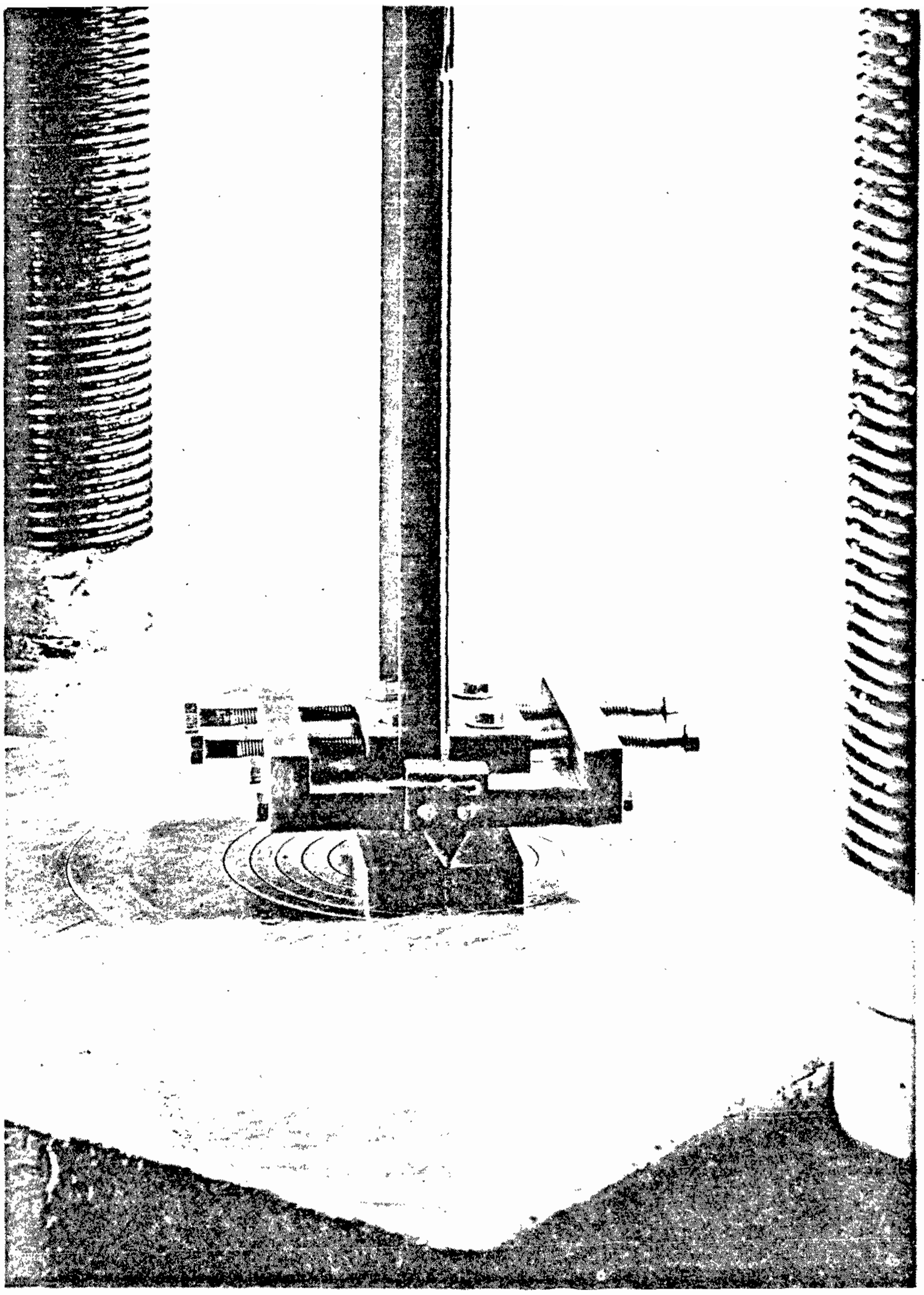
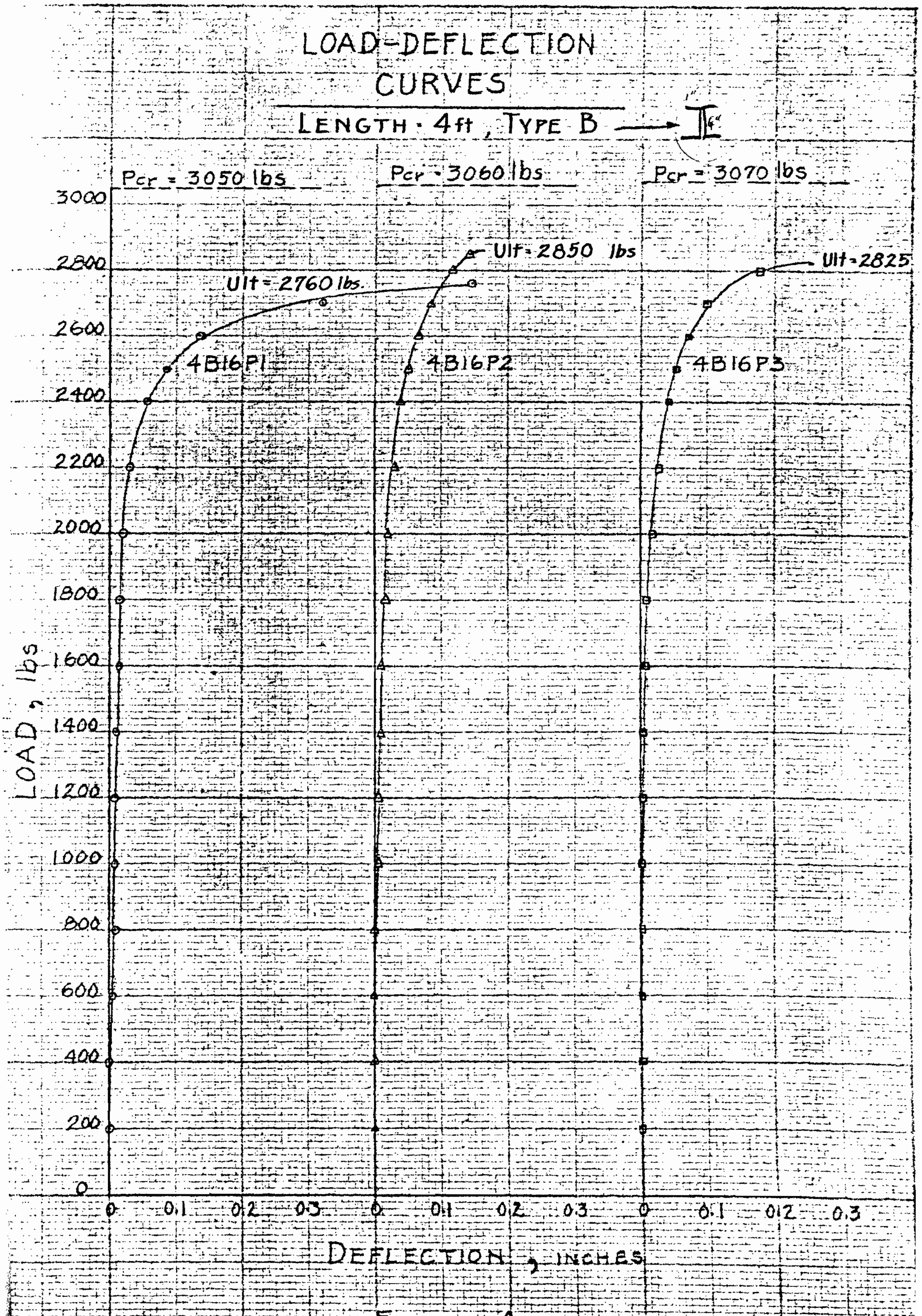


PLATE 2.

Test base used for pin-end stud tests



LOAD-DEFLECTION CURVES
LENGTH - 4ft, TYPE B
6"
Pcr = 3050 lbs
Pcr = 3060 lbs
Pcr = 3070 lbs
Ult = 2760 lbs.
Ult = 2850 lbs
Ult = 2825
4B16P1
4B16P2
4B16P3
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
LOAD, lbs
0
0.1
0.2
0.3
DEFLECTION, INCHES

FIGURE 4

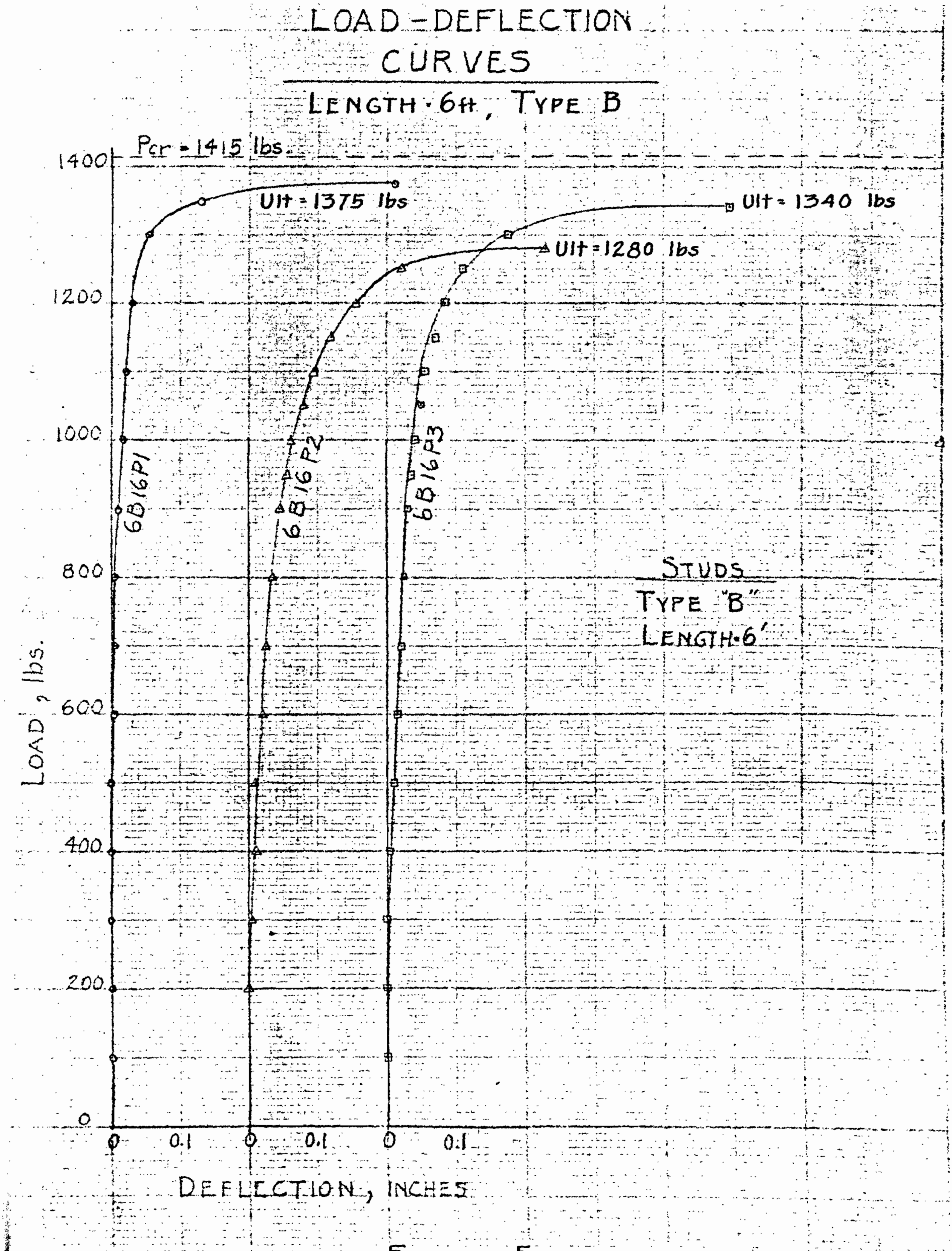

LOAD-DEFLECTION CURVES
LENGTH - 6ft, TYPE B
Pcr = 1415 lbs.
Ult = 1375 lbs
Ult = 1340 lbs
Ult = 1280 lbs
6B16P1
6B16P2
6B16P3
STUDS
TYPE "B"
LENGTH-6'
1400
1200
1000
800
600
400
200
0
LOAD, lbs.
0
0.1
0
0.1
0
0.1
DEFLECTION, INCHES

FIGURE 5

LOAD - DEFLECTION CURVES

LENGTH · 8 ft, TYPE B

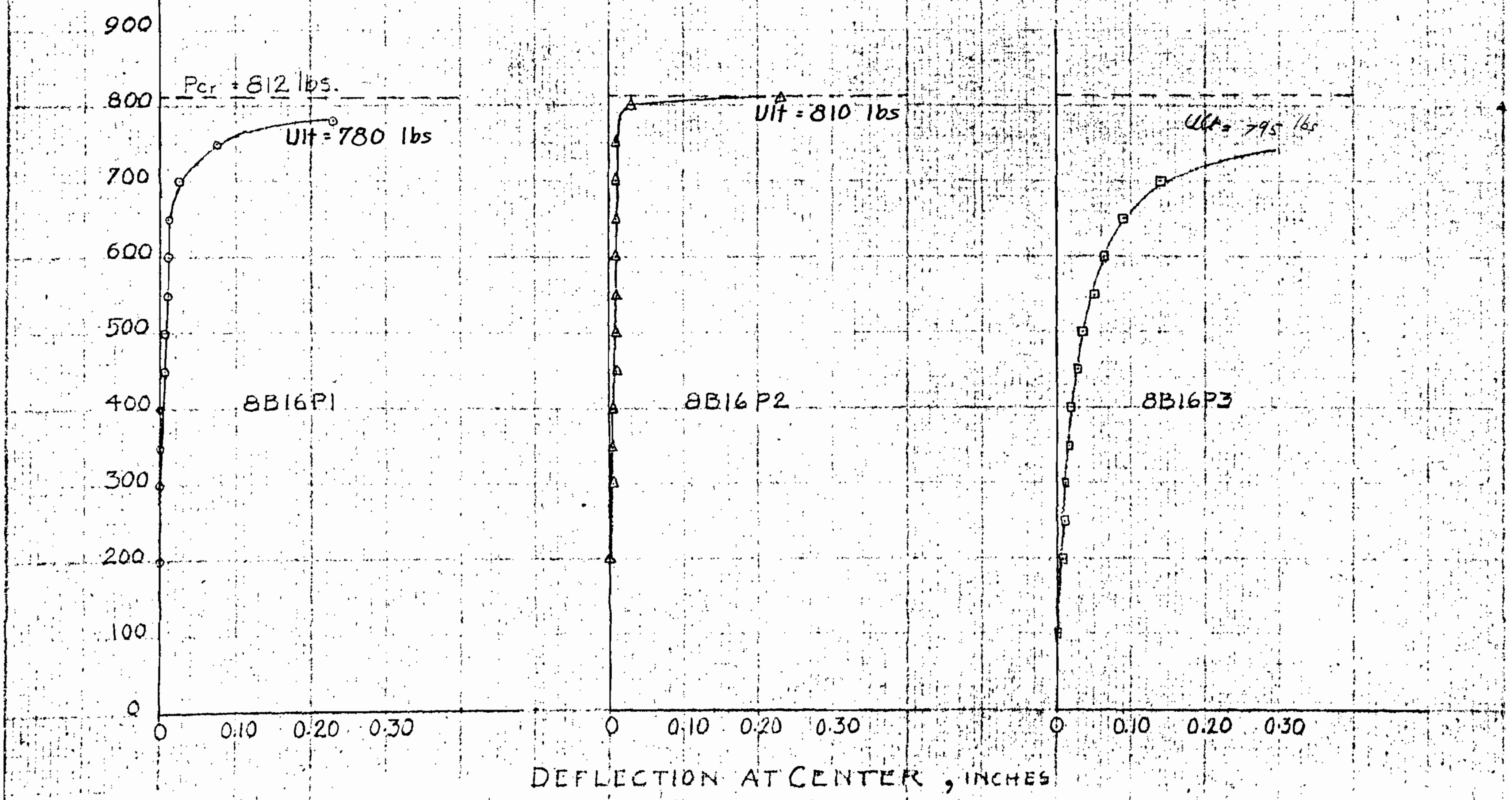


FIGURE 6

LOAD-DEFLECTION CURVES

LENGTH - 10ft, TYPE B

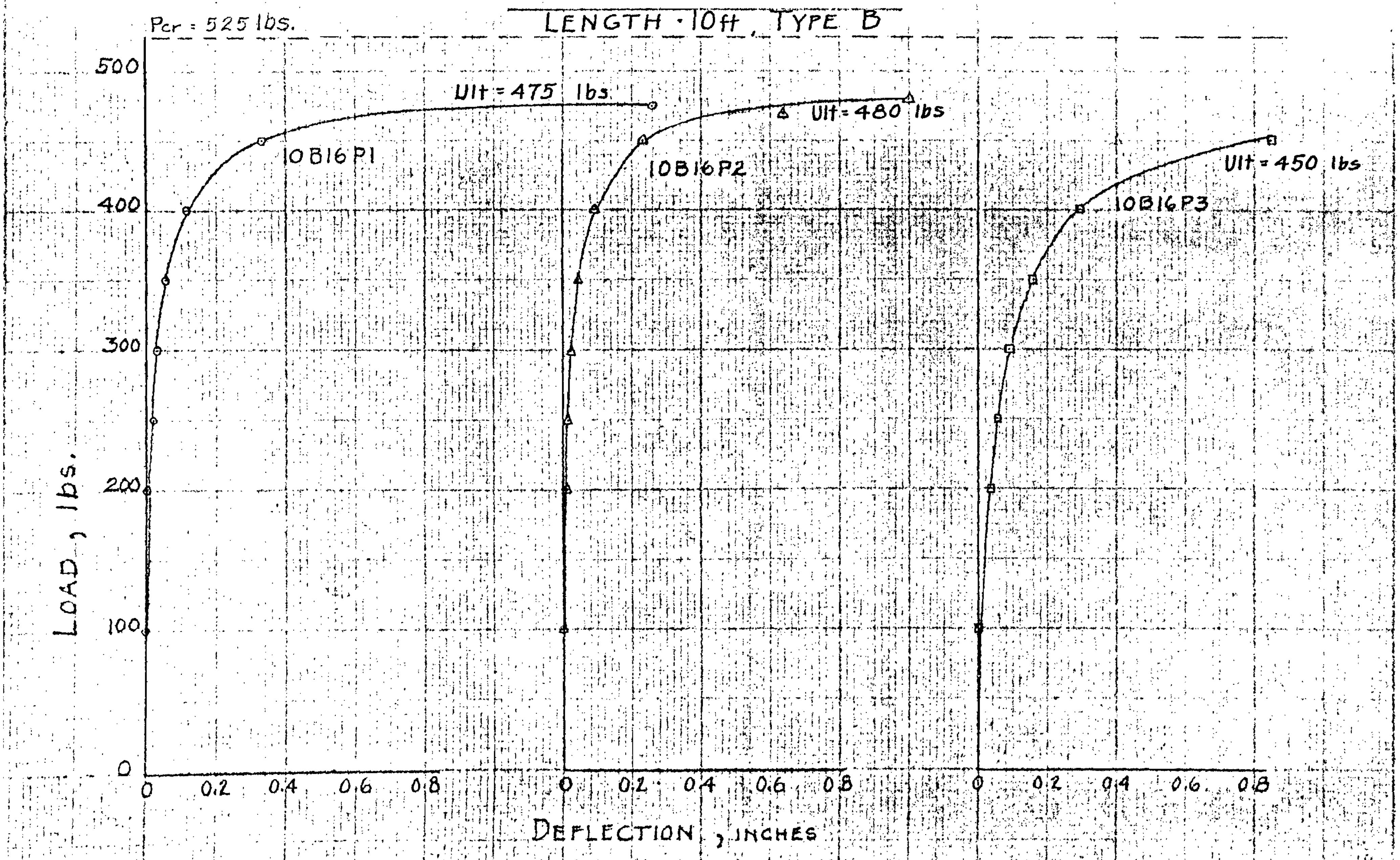


FIGURE 7

LOAD-DEFLECTION CURVES

LENGTH = 12 ft, TYPE B

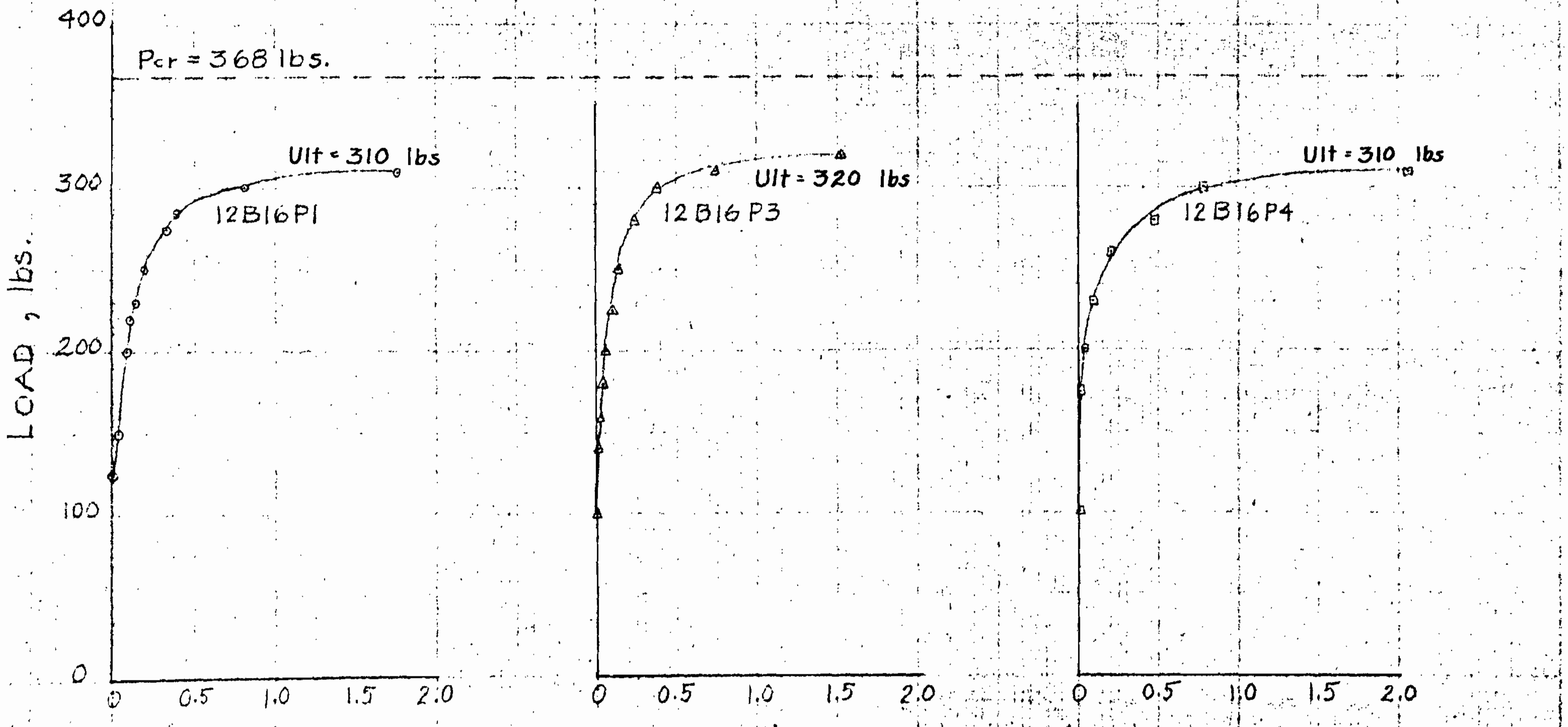


FIGURE 8