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Cornell University School of Civil Engineering Tests on light beams of cold-formed steel

Cornell University School of Civil Engineering

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SCHOOL OF CIVIL ENGINEERING, CORNELL UNIVERSITY

TESTS ON LIGHT BEAMS OF COLD FORMED STEEL

FOR THE AMERICAN IRON AND STEEL INSTITUTE

Thirty-~~second~~ third Progress Report

December - 1943

I. SCOPE OF THIS REPORT

24 symmetrical I-beams were tested in bending. They represent 12 different types of beams, with two beams of each type. The beams are formed from two identical channels, furnished with lips on both flanges, joined by bolting in the web. These tests complete the entire series of such I-beams, except for one type (two specimens) which arrived in damaged condition and are now being replaced by the manufacturer.

II. METHOD OF TESTING

The method of testing was exactly the same as described in Section III of the 28th Report, except that deflection readings were taken only on one side of the beams.

III. PURPOSE OF TESTS

These tests are designed to serve a dual purpose:

(a) They are primarily intended to serve as control tests for the future investigation of channels as beams. For this purpose the specimens are made up of two identical channels of the same type as will be tested as single channels in the main tests. Consequently the present tests should allow comparison between the carrying capacity, deflection and stress distribution of the channels with those of the corresponding symmetrical I-beams.

(b) In addition it is hoped that from these tests additional information on the behavior of I-beams with stiffened flanges will be obtained. In this respect the tests should supplement the ones previously carried out in this connection, particularly since the b/t ratios of the present tests are lower and therefore extend the range of those of the previous tests.

IV. GRAPHICAL REPRESENTATION OF RESULTS

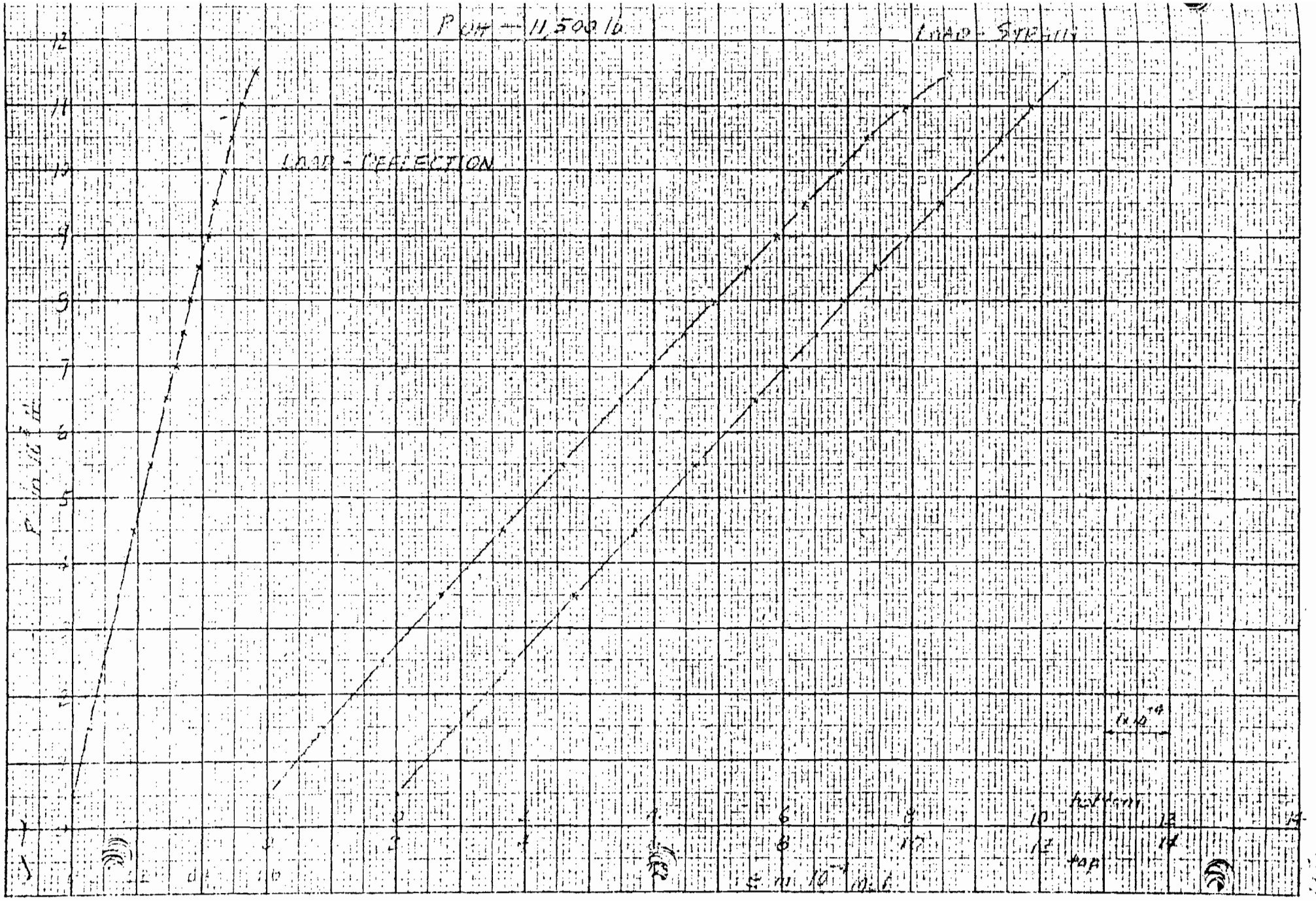
Drawings 297 to 320 contain the ultimate loads, the load - deflection and the load - strain curves of all specimens tested.

V. EVALUATION

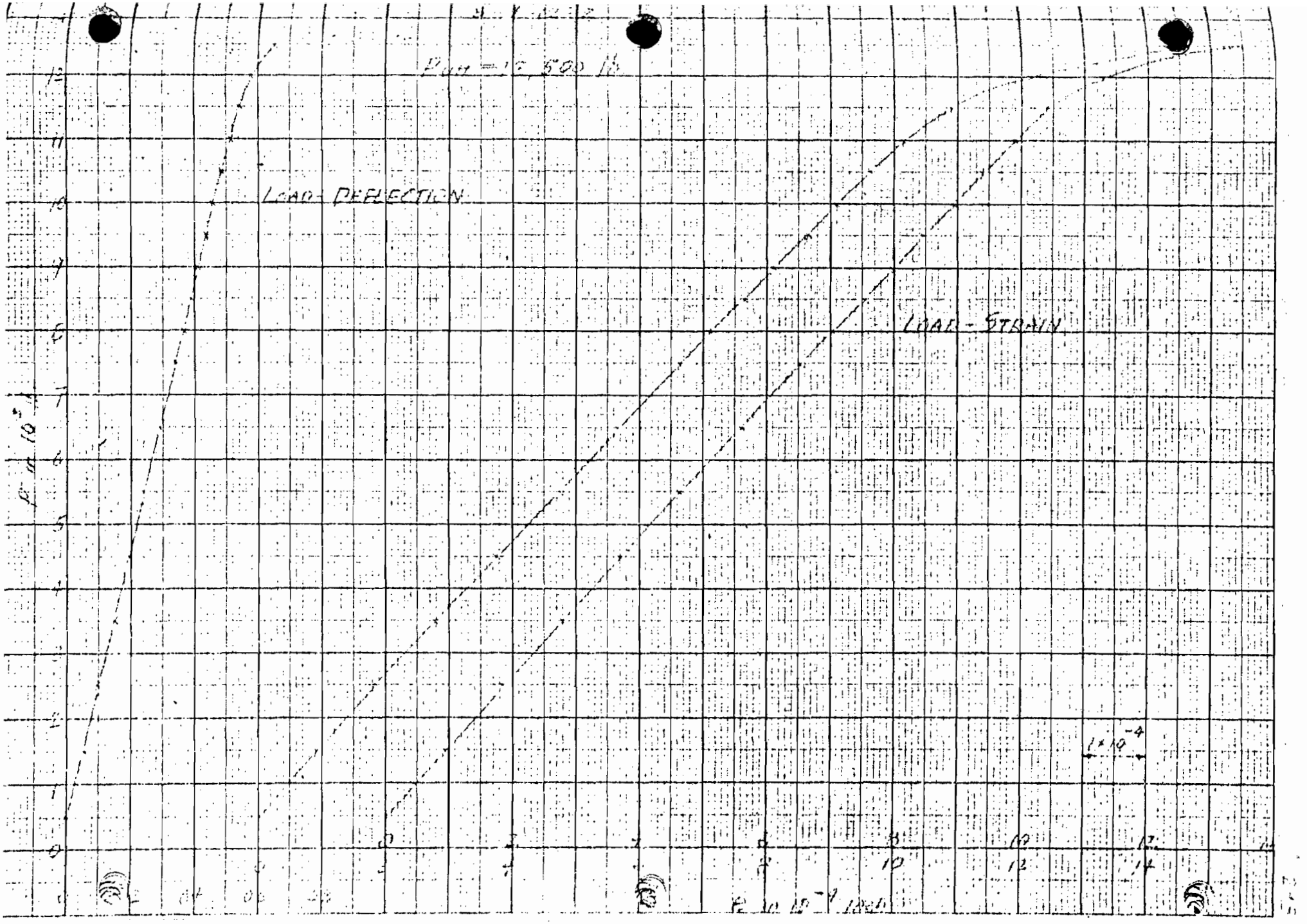
The complete evaluation of these beams as outlined in Section III, (b) above, will be made as soon as tension tests are completed on specimens cut from the steel from which the beams were formed.

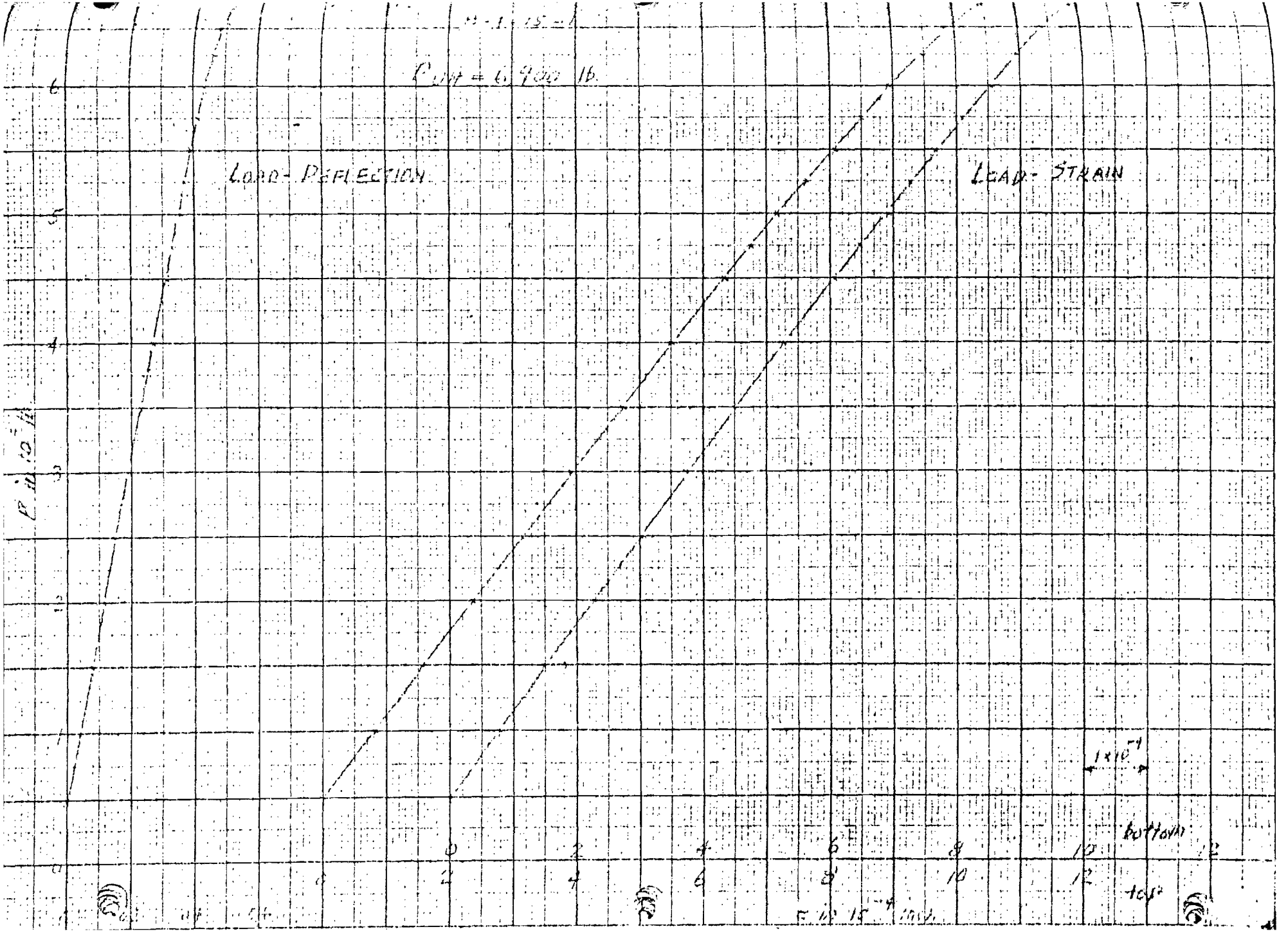
VI. SPECIAL OBSERVATIONS

The regularity of forming was rather uneven in this series. While a number of specimens was formed very accurately, others showed considerable nonuniformity. In particular it was found that on some specimens the depths of the two component channels were rather different, while on others the planes of the flanges of the two channels were not flush, one channel being shifted with respect to the other by as much as 1/8 inch. While these irregularities will not affect the ultimate load appreciably, they are bound, to some degree, to influence the deflections and the strains.

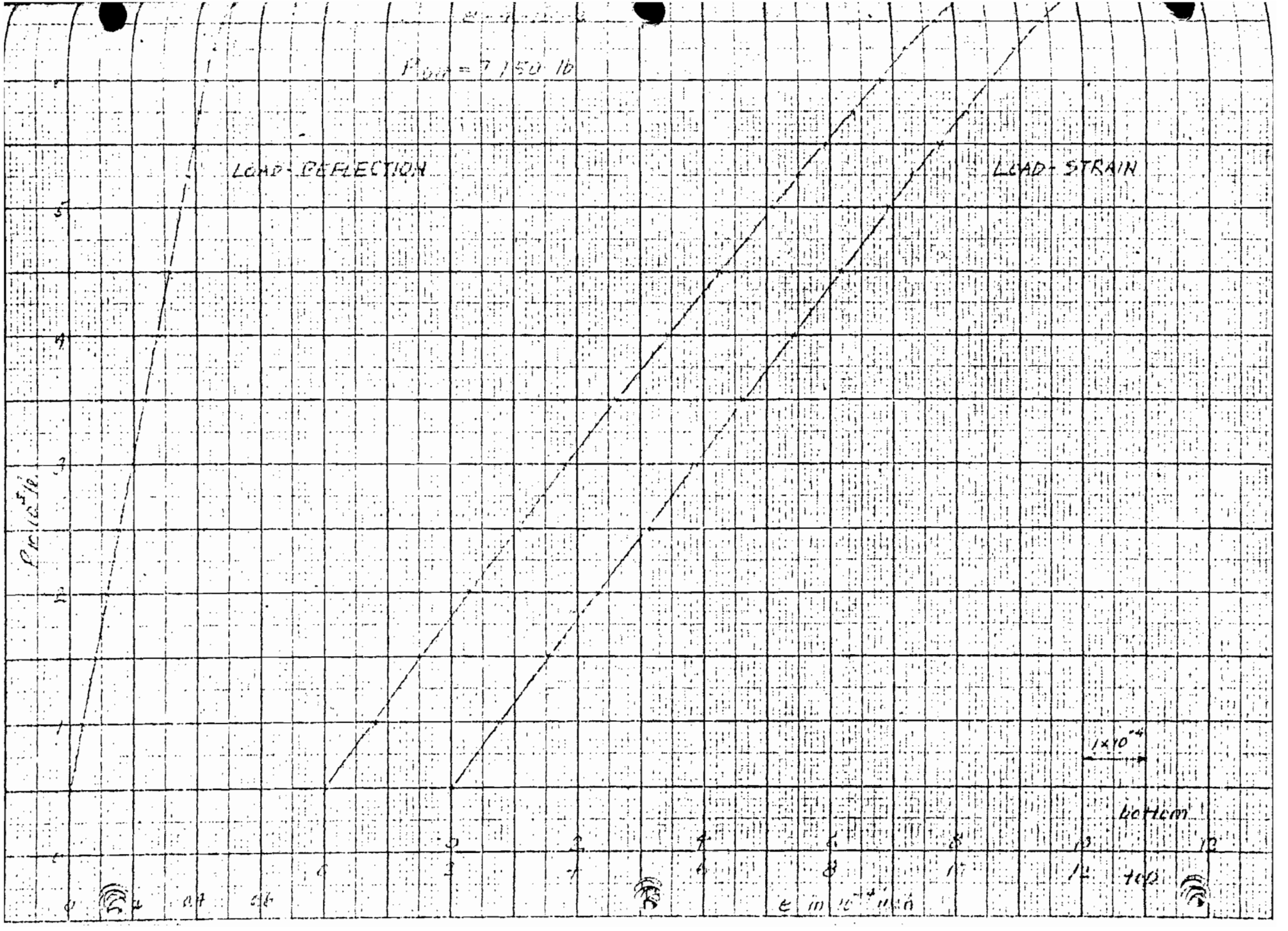


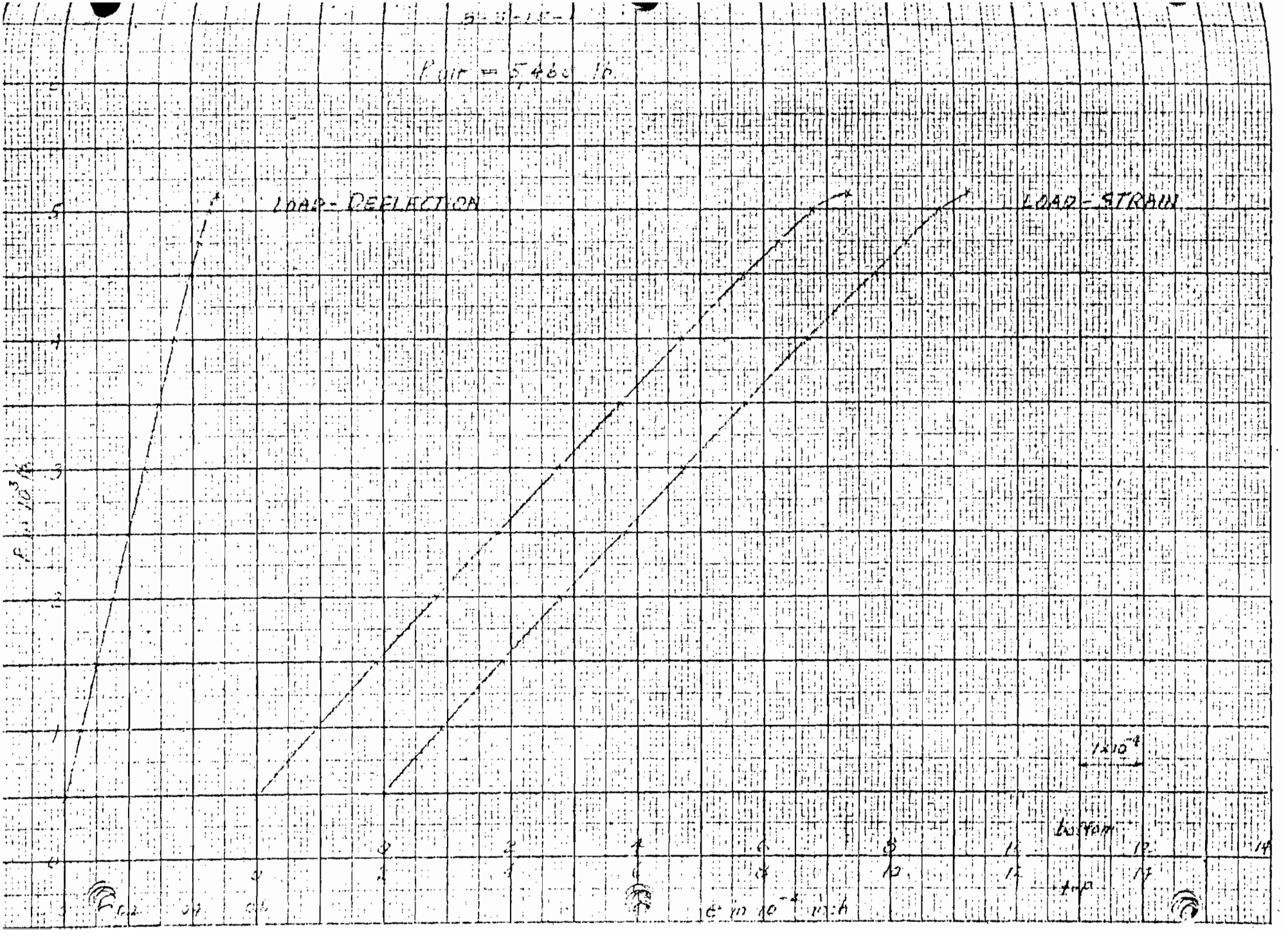
P OH — 11,500 lb
LOAD - STRAIN
LOAD - DEFLECTION
P in lb
bottom
top

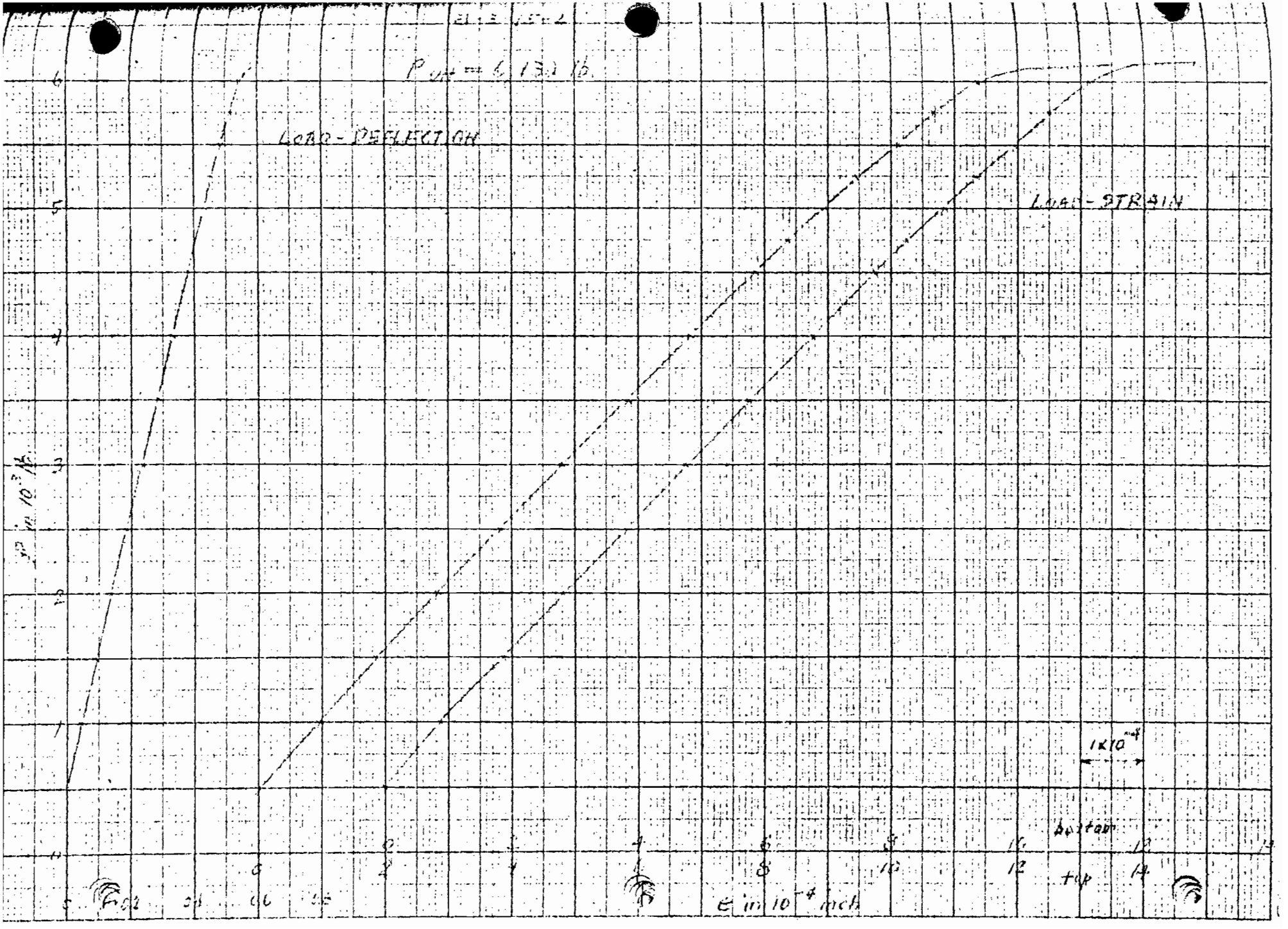

$P_{ult} = 12,500$ lb
LOAD - DEFLECTION
LOAD - STRAIN
1×10^{-4}



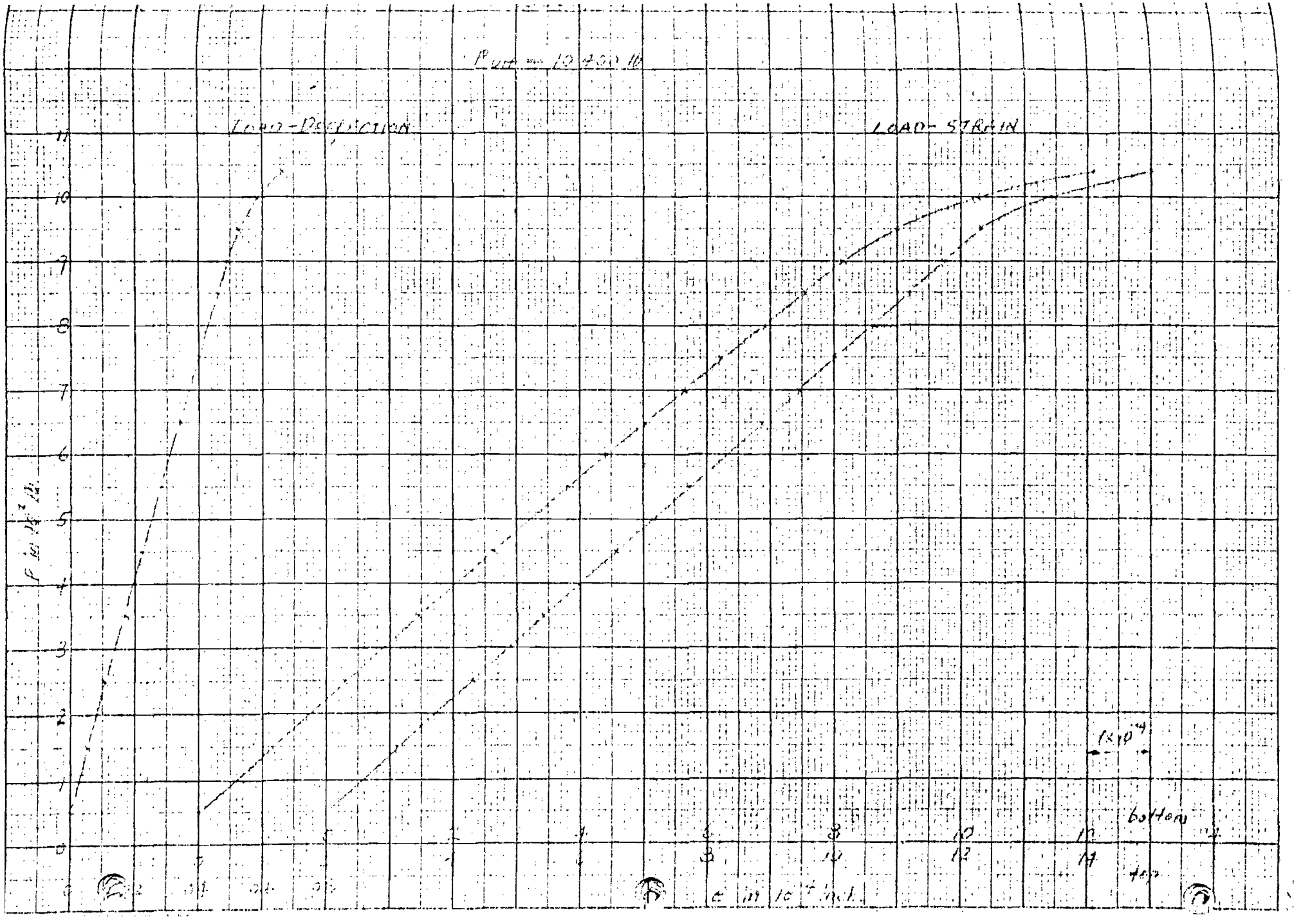
P_{ult} = 6,900 lb.
LOAD - DEFLECTION
LOAD - STRAIN
P in 10^{-3} lb
6
5
4
3
2
1
0
0
2
4
6
8
10
12
1×10^{-4}
bottom
top


$P_{ult} = 7150$ lb
LOAD - DEFLECTION
LOAD - STRAIN
P in 10^3 lb
1×10^{-4}
bottom
ϵ in 10^{-4} in/in

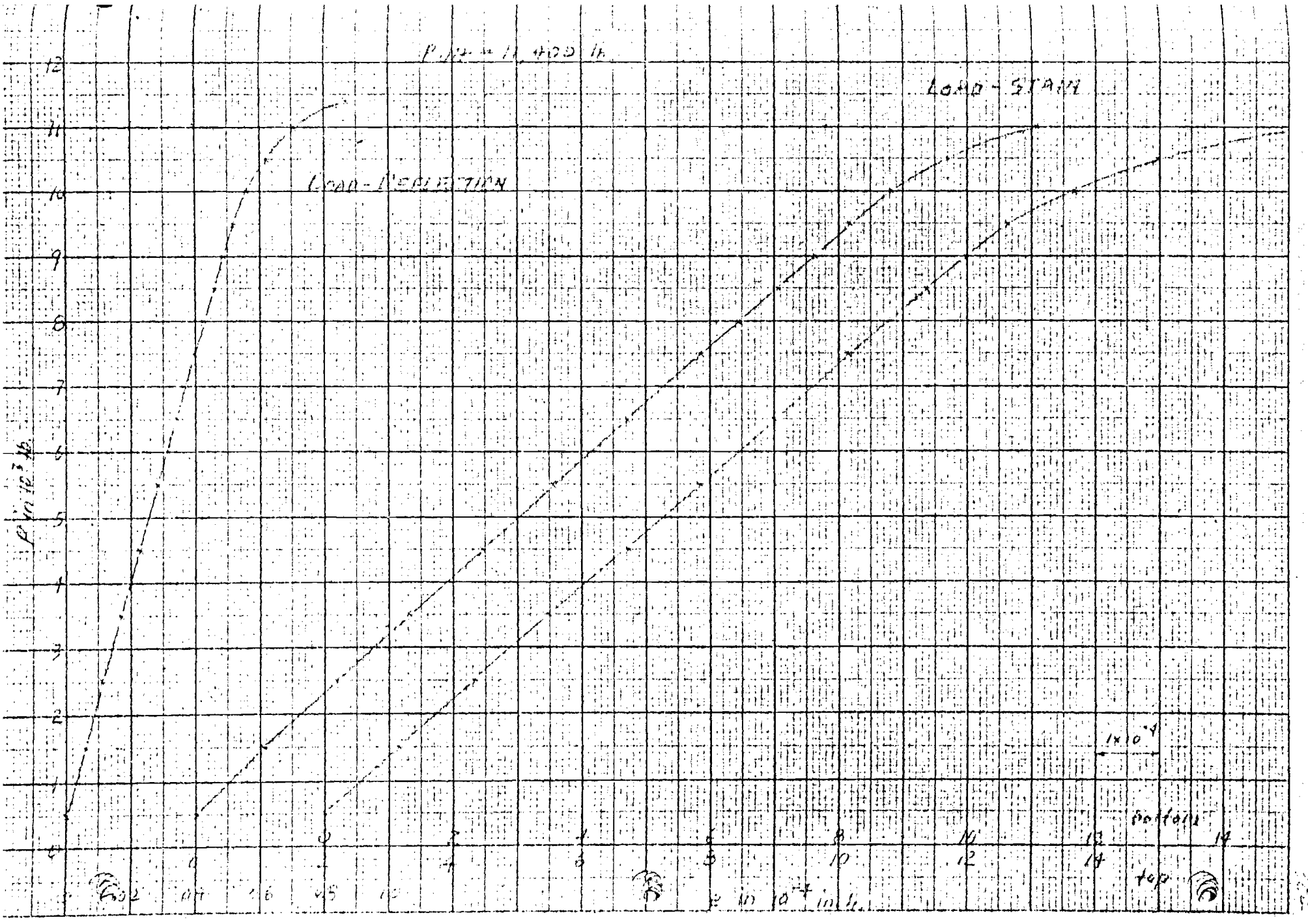

P_cr = 5,460 lb.
LOAD - DEFLECTION
LOAD - STRAIN
P, x 10^3 lb.
1 x 10^-4
bottom
top



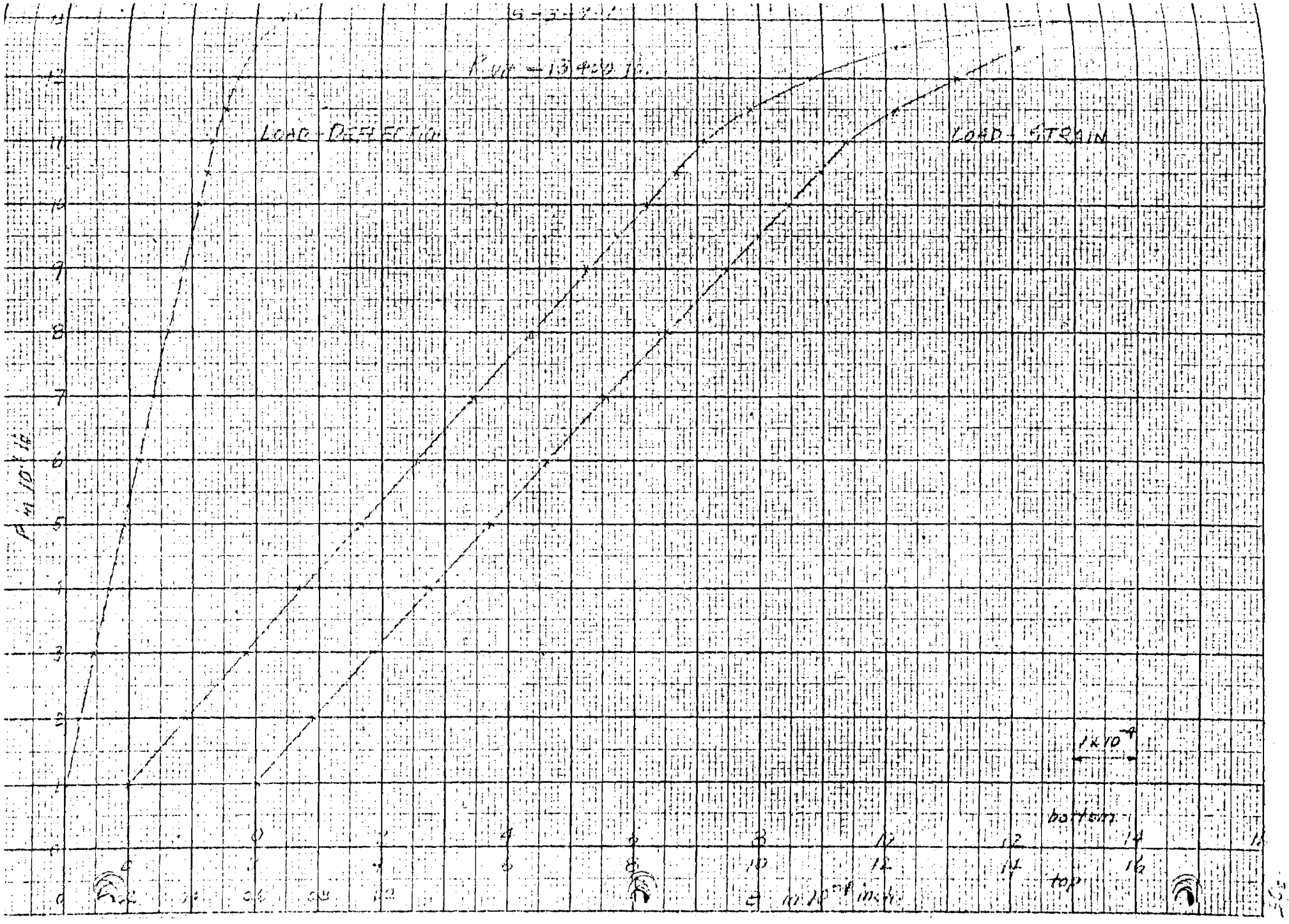
LOAD - DEFLECTION
LOAD - STRAIN
1x10^-4
bottom
top
ε in 10^-4 inch

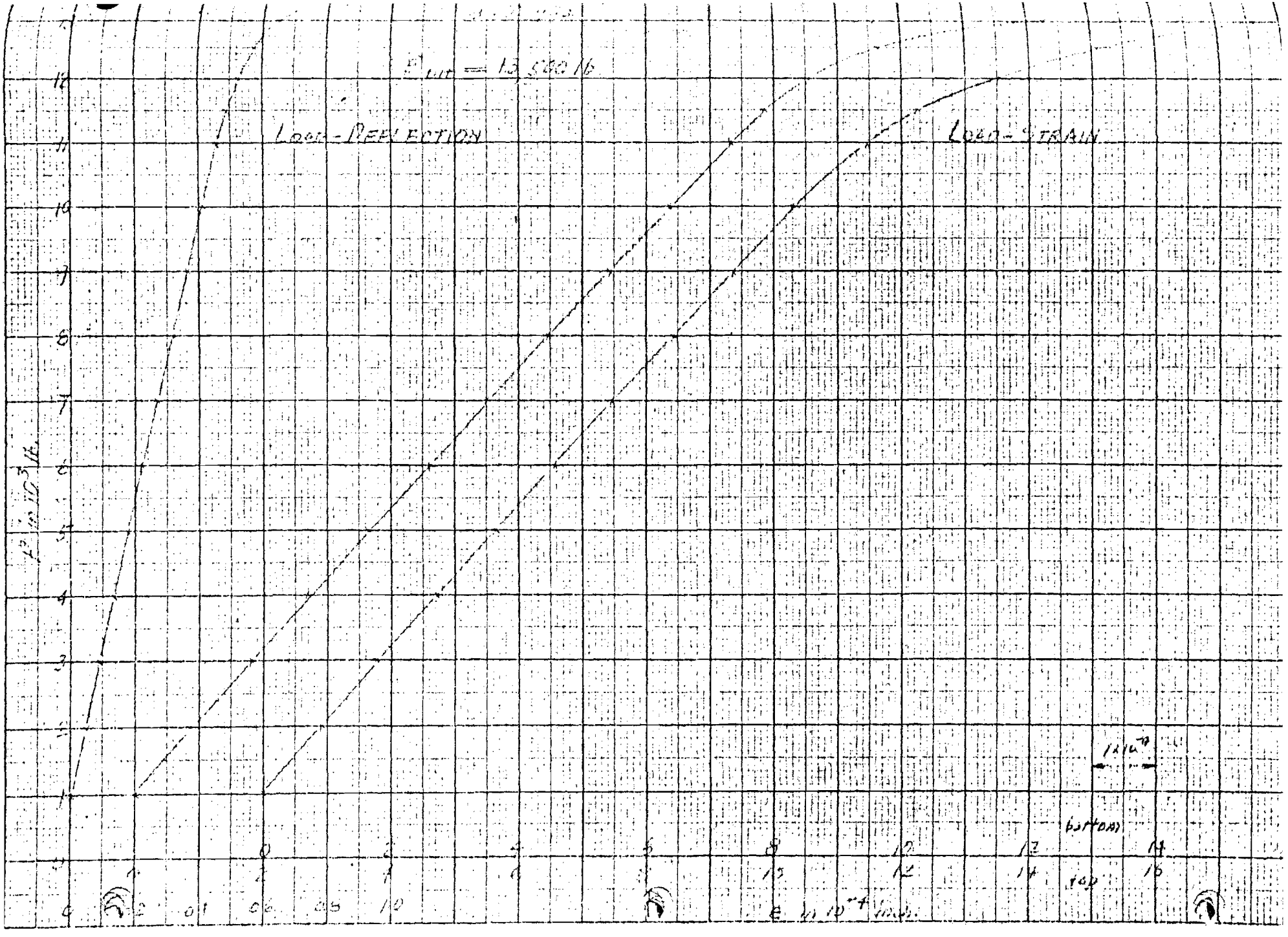


LOAD-DEFLECTION
LOAD-STRAIN
bottom
top

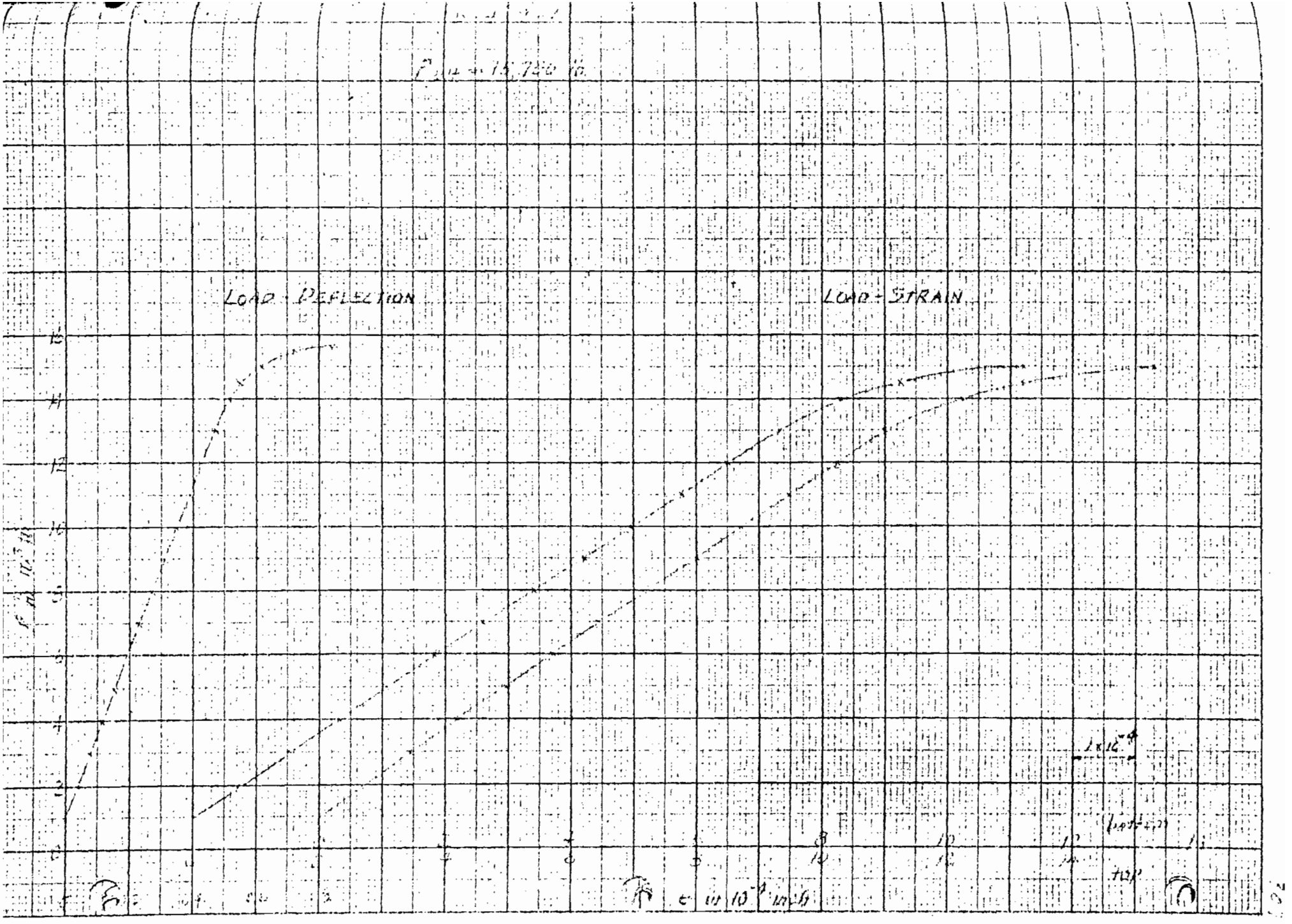


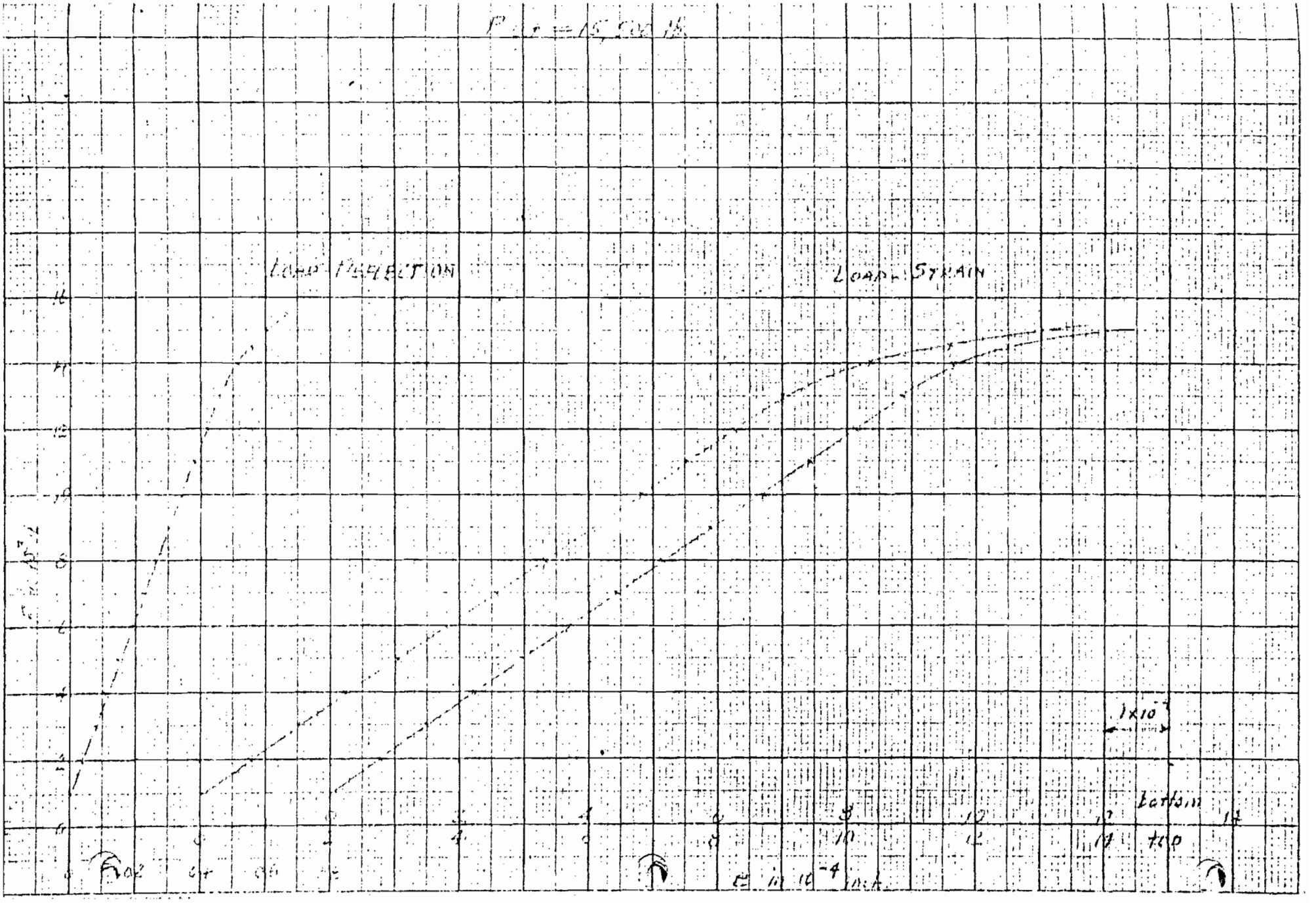
LOAD - STAIN
LOAD - DEFLECTION
P in 10³ lb.
e in 10⁻⁴ in.
bottom
top
1×10⁻⁴

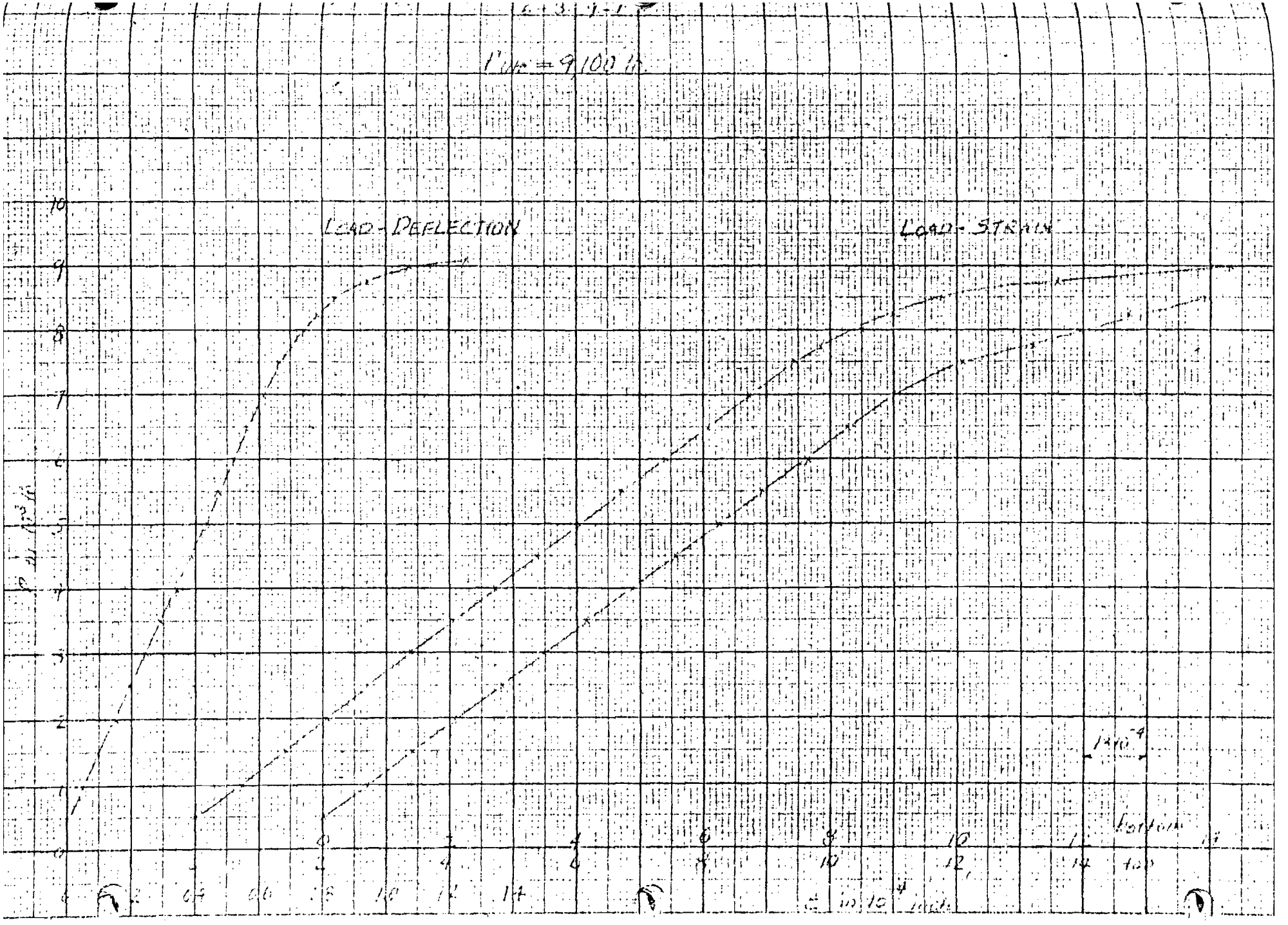

LOAD - DEFLECTION
LOAD - STRAIN
bottom
top
1 x 10^-4

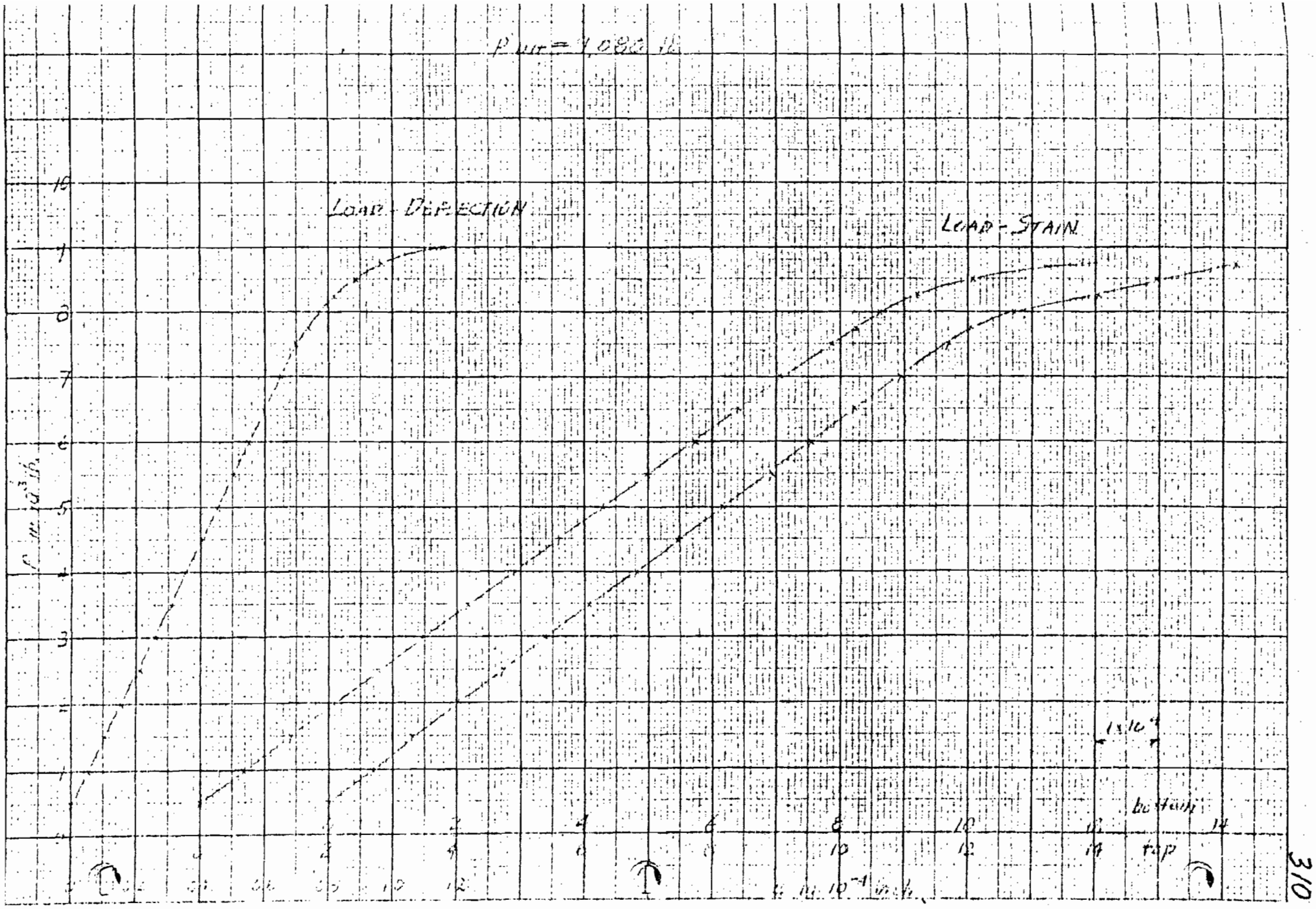


P_{ult} = 13,500 lb
LOAD-REFLECTION
LOAD-STRAIN
P in 10^3 lb
ϵ in 10^{-4} inch
bottom
top

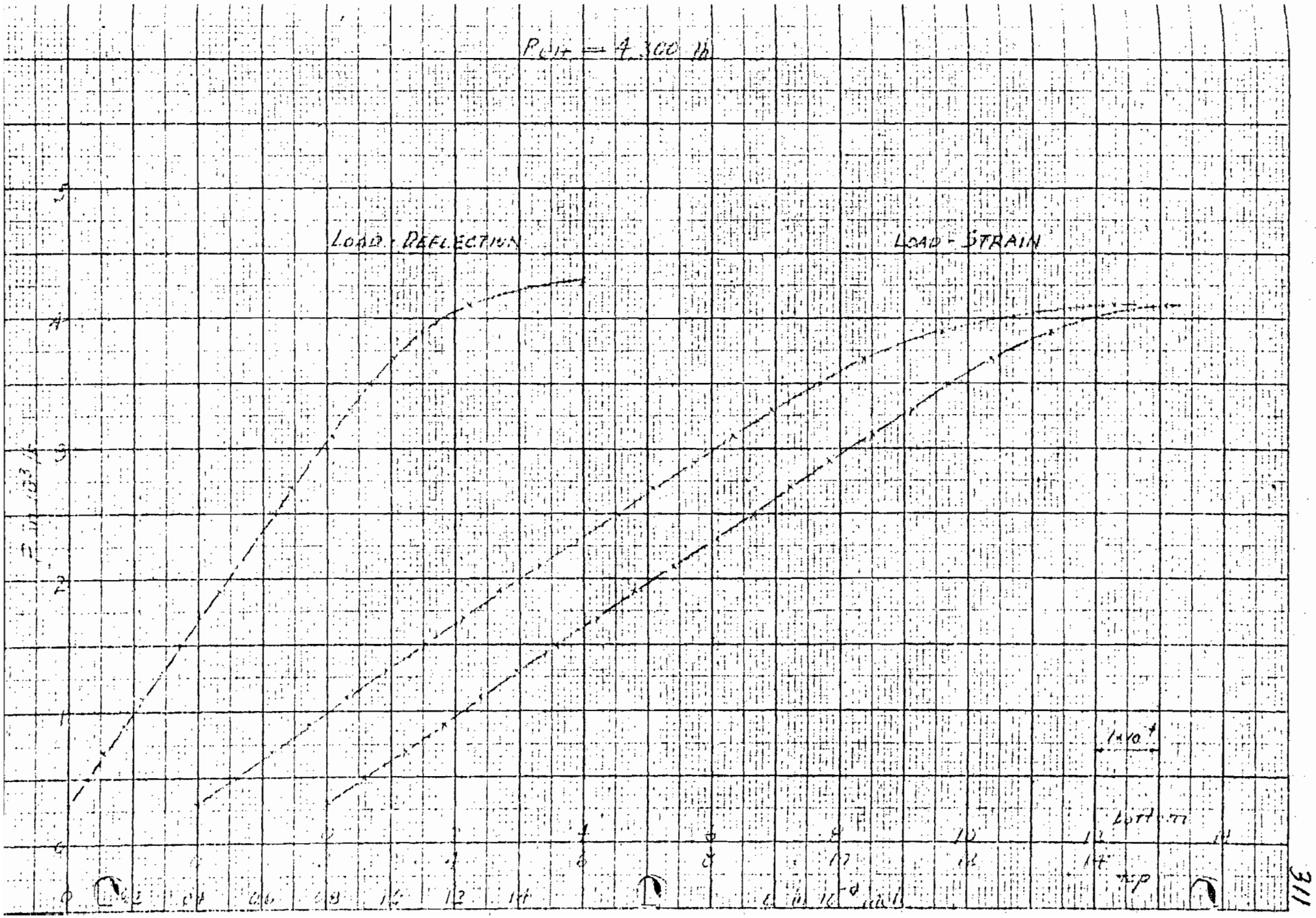

LOAD - DEFLECTION
LOAD - STRAIN

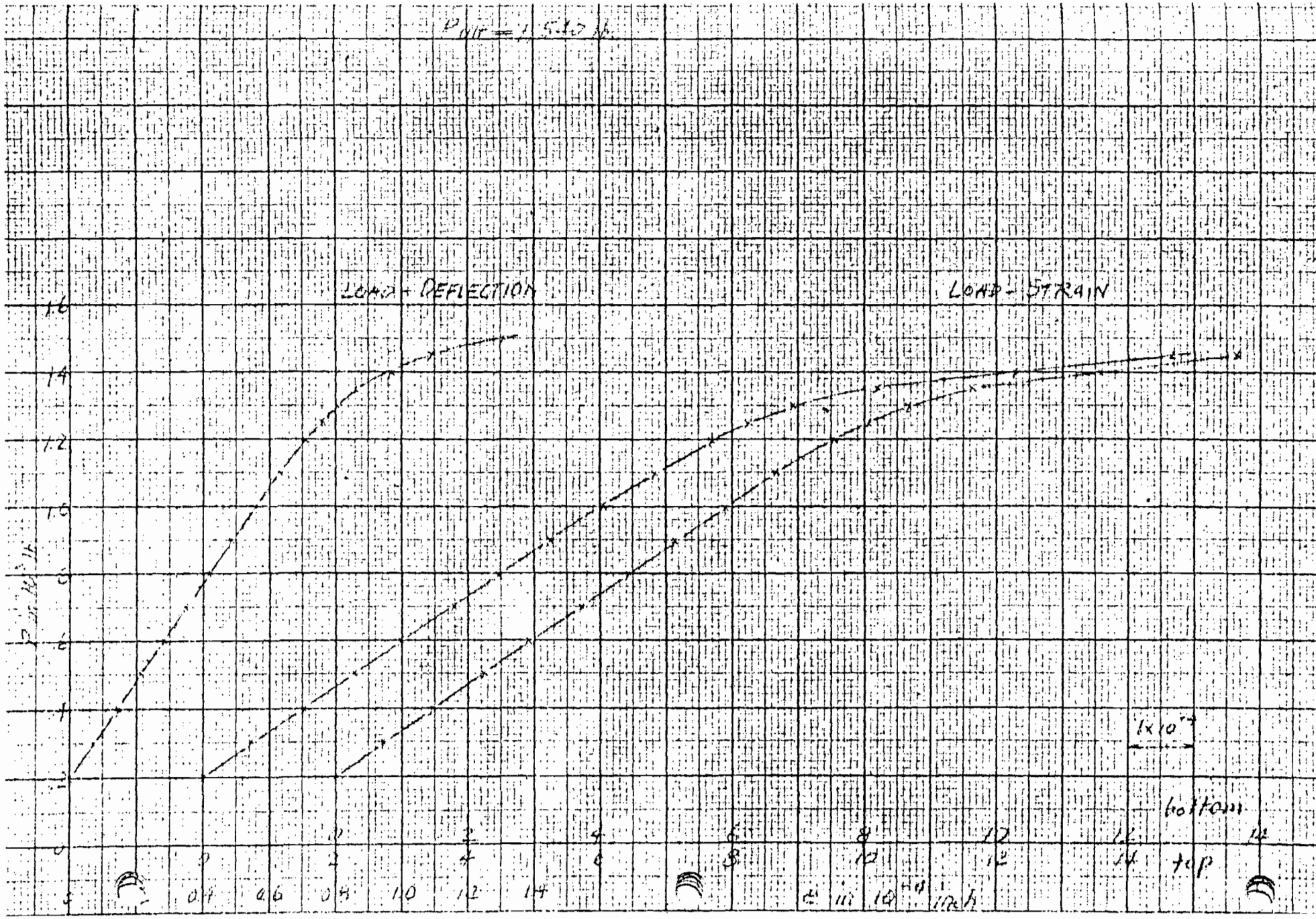

LOAD DEFLECTION
LOAD STRAIN
1x10^-3
bottom
top
ε in 10^-4 inch

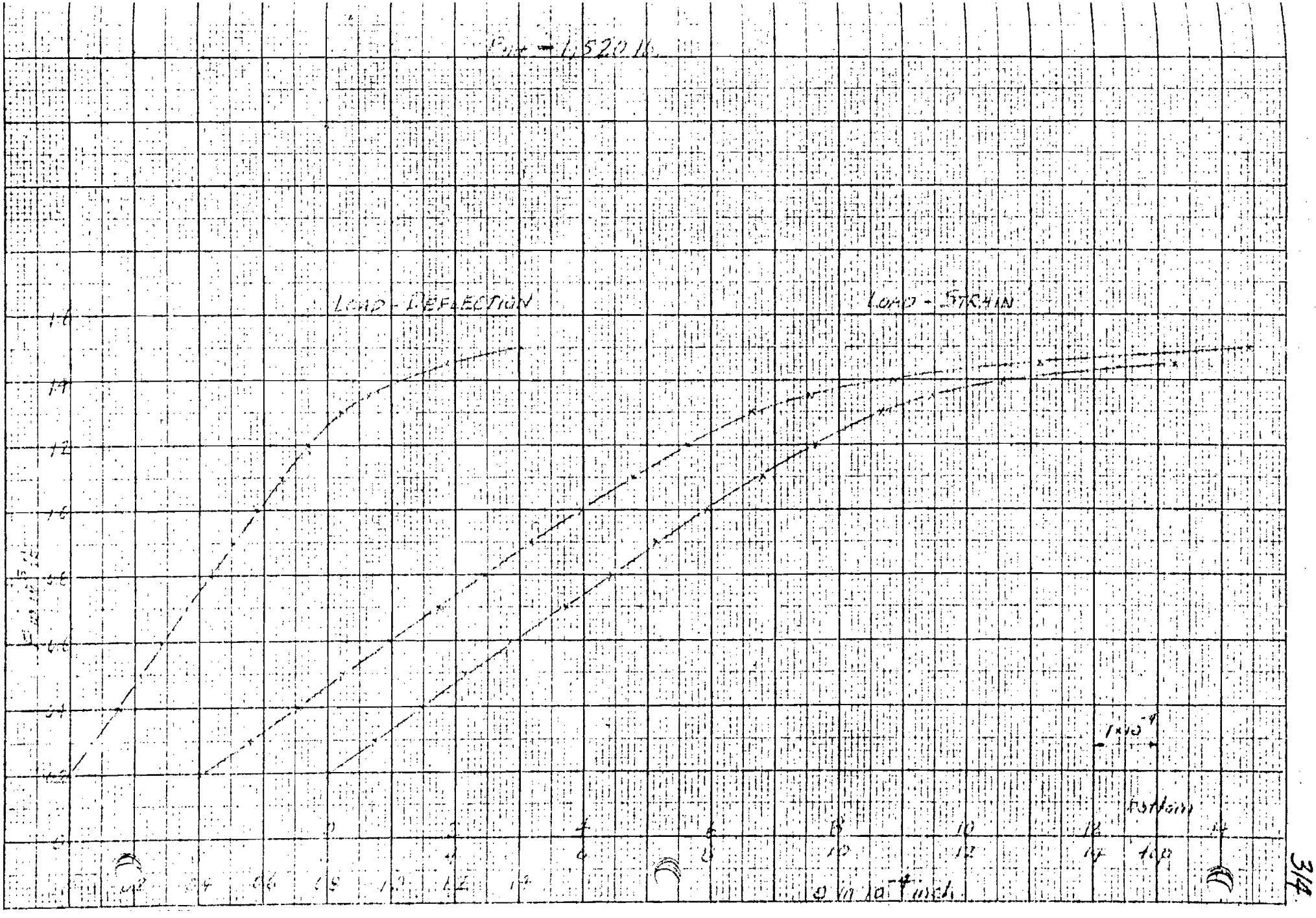

1" dia = 9,100 lb.
LOAD - DEFLECTION
LOAD - STRAIN



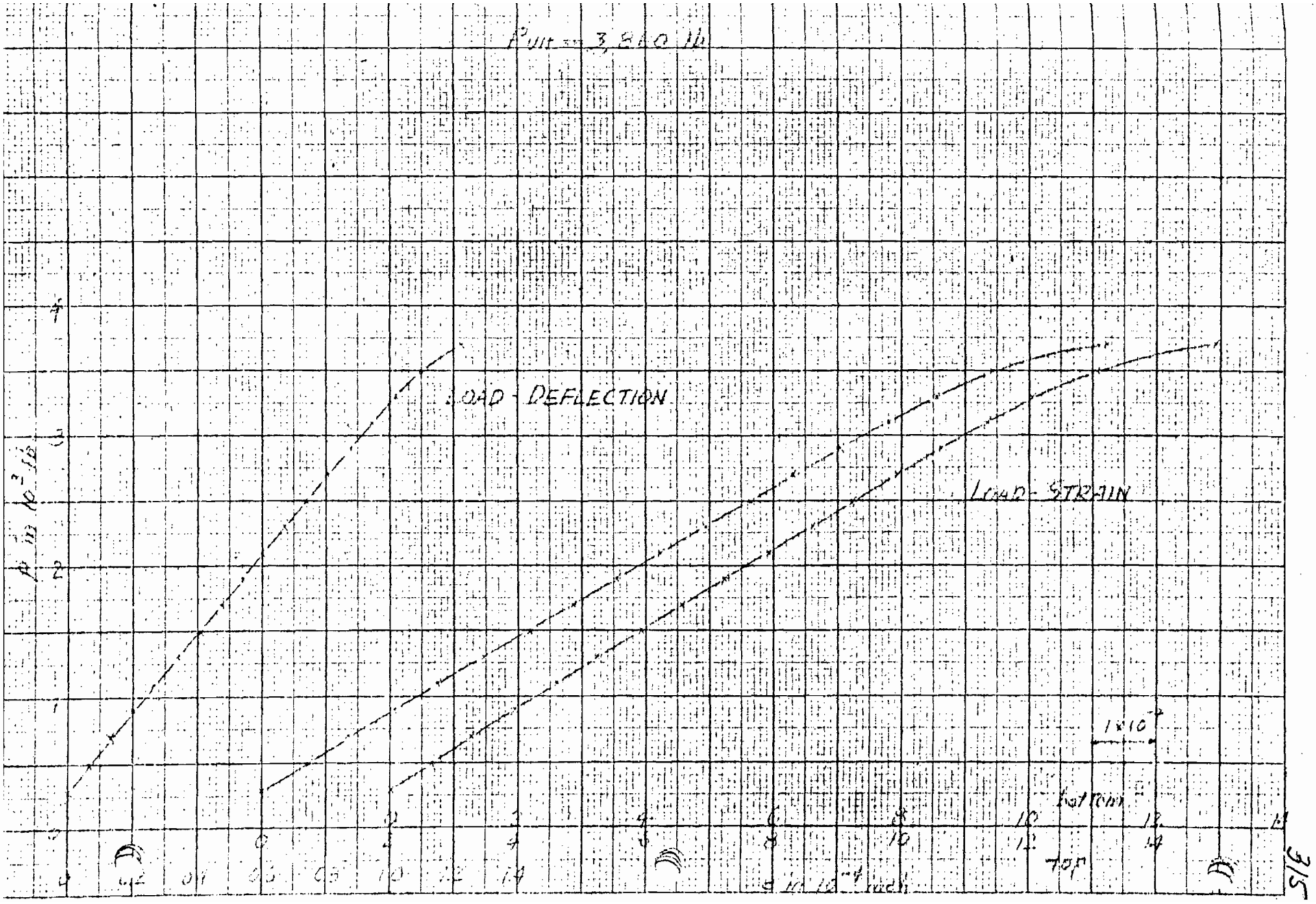
LOAD - DEFLECTION
LOAD - STAIN
bottom
top

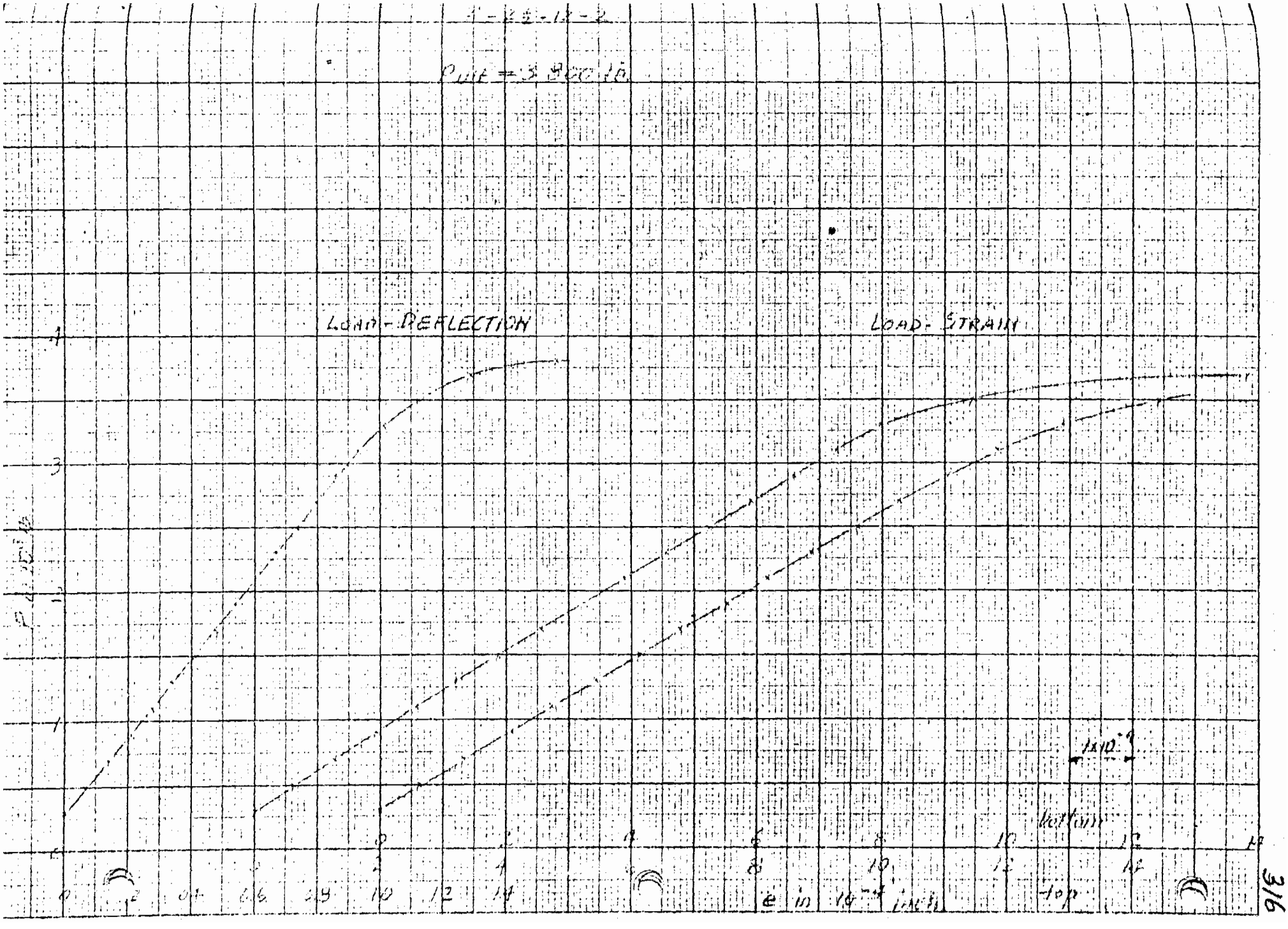

$P_{ult} = 4,300$ lb
LOAD - DEFLECTION
LOAD - STRAIN
1 x 10⁻⁴

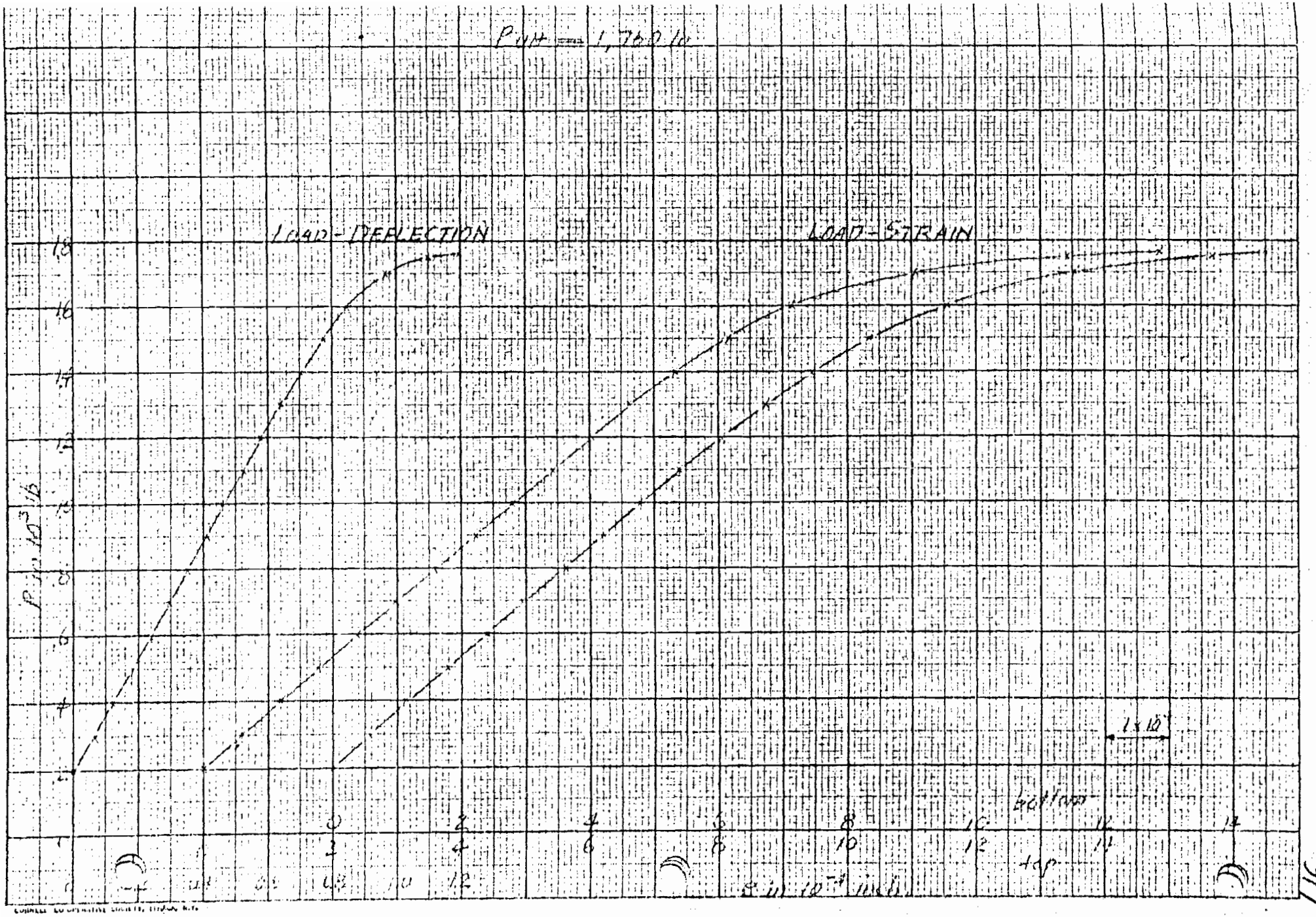

LOAD - DEFLECTION
LOAD - STRAIN
bottom
top
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
0.4
0.6
0.8
1.0
1.2
1.4
2
4
6
8
10
12
14



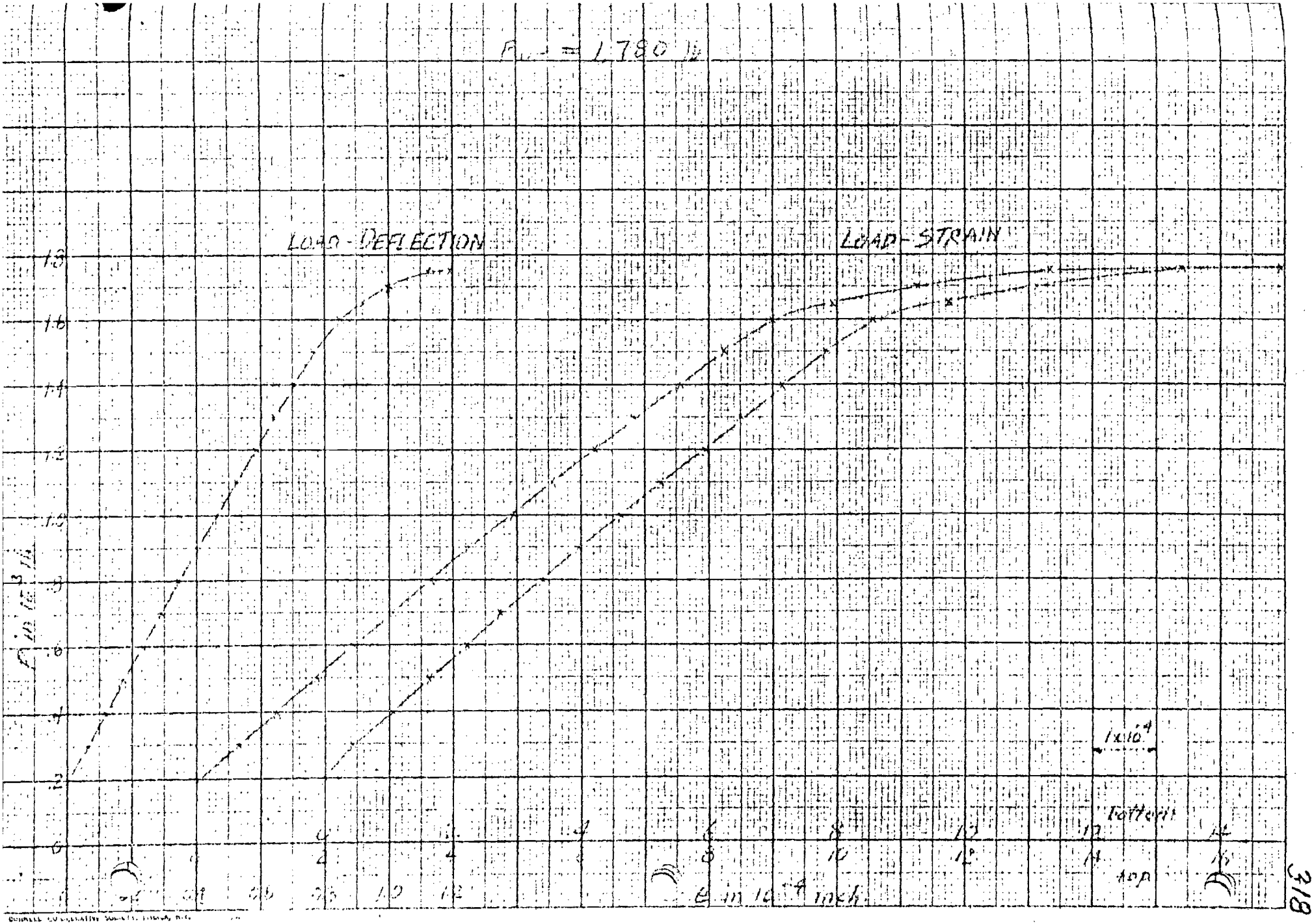
LOAD - DEFLECTION
LOAD - STRAIN
bottom
top


P_{ult} = 3,810 lb
LOAD - DEFLECTION
LOAD - STRAIN
1 x 10⁻⁴
bottom
top

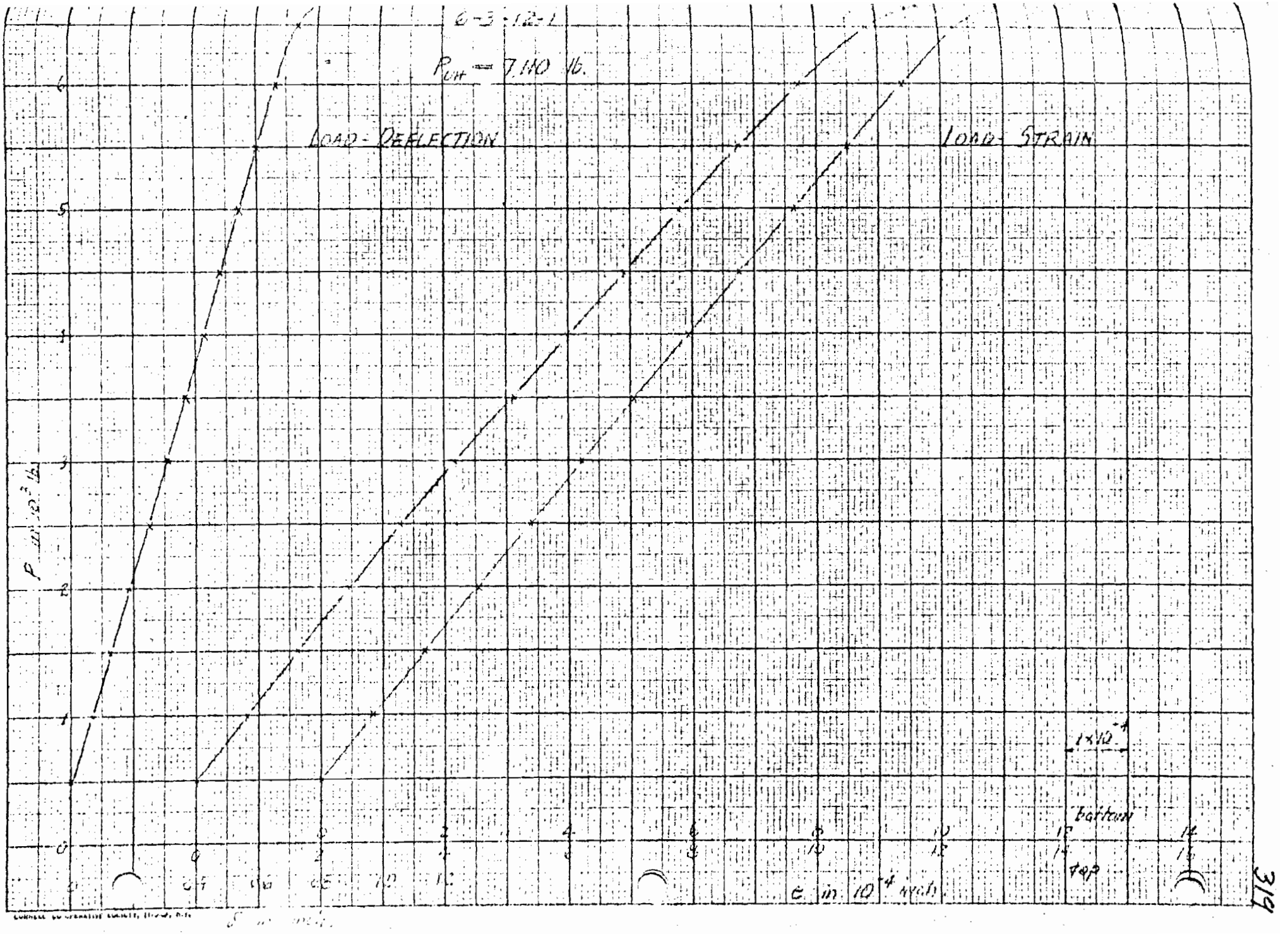

LOAD - REFLECTION
LOAD - STRAIN

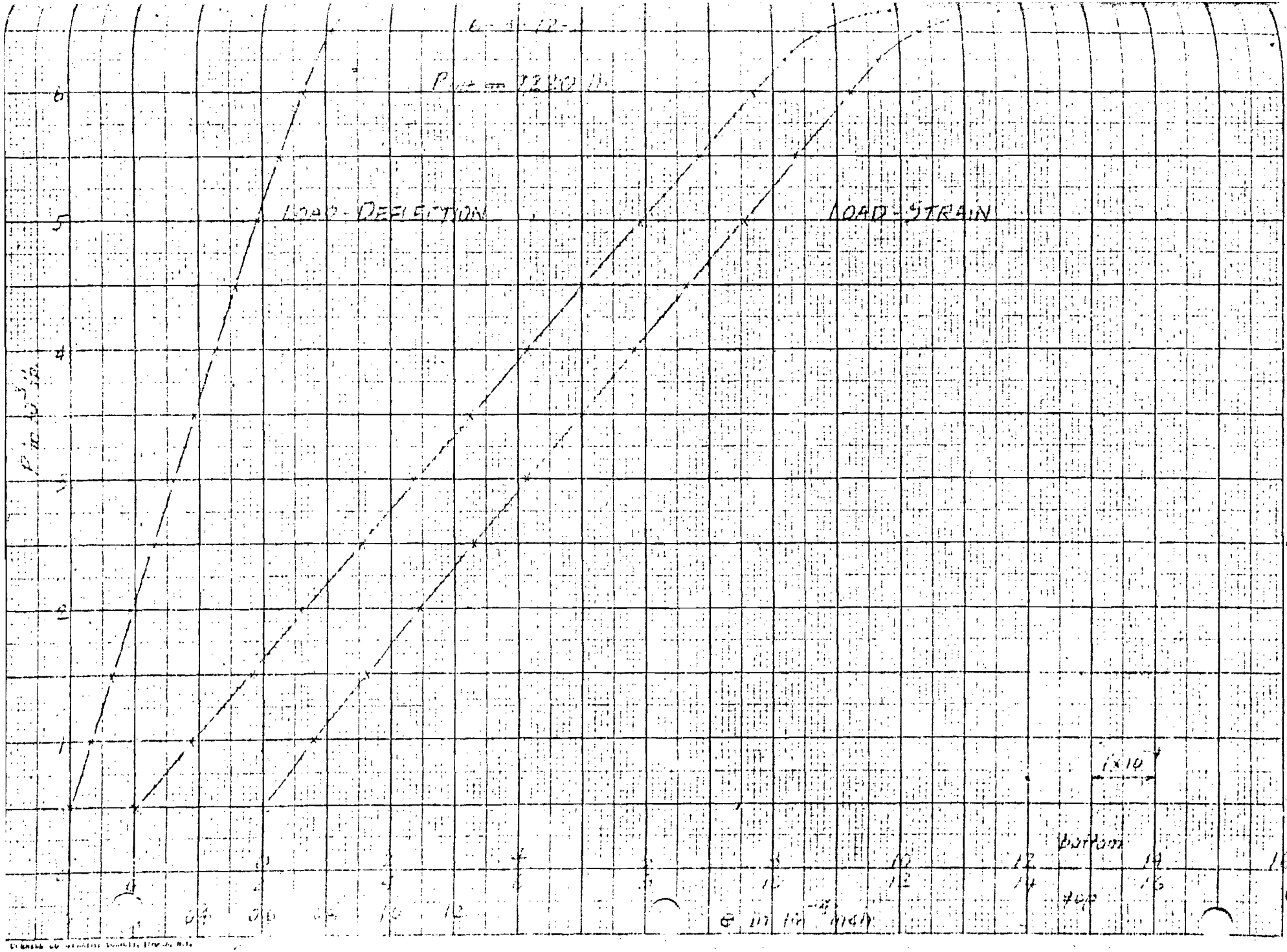


P_{UH} = 1,760 lb
LOAD-DEFLECTION
LOAD-STRAIN
P in 10^3 lb
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
2
4
6
8
10
12
14
bottom
top
1 x 10^{-4}



LOAD - DEFLECTION
LOAD - STRAIN
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1x10^-4
Bottom
Top


6-3-12-L
P_{UH} = 7.140 lb.
LOAD - DEFLECTION
LOAD - STRAIN
P in 10^3 lbs
δ in inches
ε in 10^{-4} inch/inch
1×10⁻⁴
Bottom
Top


LOAD - DEFLECTION
LOAD - STRAIN
1 x 10
bottom