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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 Progress Report

April, 1943

I. SCOPE OF THIS REPORT

(1) Ten tests were conducted on the following beams (a) 18 - 1/2 - 1, 2, and 3; and 16 - 1/2 - 2. These are the last tests of the original series of beams. Specimens 16 - 1/2 - 1 and 3 after welding showed bad distortions in shape and for this reason could not be used. (b) In order to supplement the tests, six more beams with unstiffened flanges were tested. For three of these beams left over studs of the old stud tests were used. These beams are 4 in. deep and are designated as 16 - 1 - 1, 2, 3, (4"). Three more beams were spot welded in our shop from left over plate elements of the stud investigation and are designated as 16 - 1 1/2 - 1, 2, 3, (4"). It was considered desirable to make these additional tests for the following two reasons: (a) The dimensions of these beams are of the kind most likely to be used in practice, whereas many of the other beams proved too wide for practical application; (b) all other beams were 8 in. deep and therefore it seemed desirable to include beams of a different depth. These tests conclude the series with unstiffened flanges.

(2) Parallel with the tests further work was done on the final evaluation of the entire series. This work is now completed and recommendations for design specifications are being worked out. The results of this evaluation and the corresponding recommendations will be communicated shortly.

II. GRAPHICAL REPRESENTATION OF RESULTS

Drawings 281 to 290 give the load deflection curves and the load strain curves for the beams listed above.

### III. METHOD OF TESTING

The method of testing was the same as described in the 28th Report. The span of beams 16 - 1 - 1, 2, 3, (4") and 16 - 1 1/2 - 1, 2, 3, (4") was 66 in. Two equal loads were applied on beams 16 - 1 at a distance of 24 in. from the supports and on beams 16 - 1 1/2 at 21 in. from the supports. The spans and load positions of the rest of the beams are as originally stipulated.

### IV. RESULTS

The ultimate load of each beam is given on the corresponding load deflection curve. It is seen that, for identical beams, these loads show little variation.

Of all the beams tested only beams 16 - 1 1/2 - 1, 2, 3, (4") kinked before failing. The kinking loads for these three beams are respectively 2000 lb., 1800 lb., and 1900 lb. Beams 16 - 1 - 1, 2, 3, (4") did not show any distortion at all, that is, they failed in pure yielding. Beams 16 - 1/2 - 1, 2, 3, and 16 - 1/2 - 2 all failed laterally without kinking. Pending the detailed evaluation it appears that this lateral failure was precipitated by yielding of the top flange.

### V. DISCUSSION

The half-width thickness ratios of the present beams cover about the same range as those of the thirtieth report. The general behavior of these beams was exactly the same as that discussed in the 30th report, that is, only beams with comparatively large w/t ratios developed kinks before failing. Reviewing the entire series of tests it becomes clear that this matter of flange distortion and kinking below failure is evidently one of the most decisive features on which a design procedure for beams with unstiffened flanges must be based. The evidence, in this respect, obtained from the entire series appears to be sufficient for developing design procedures.

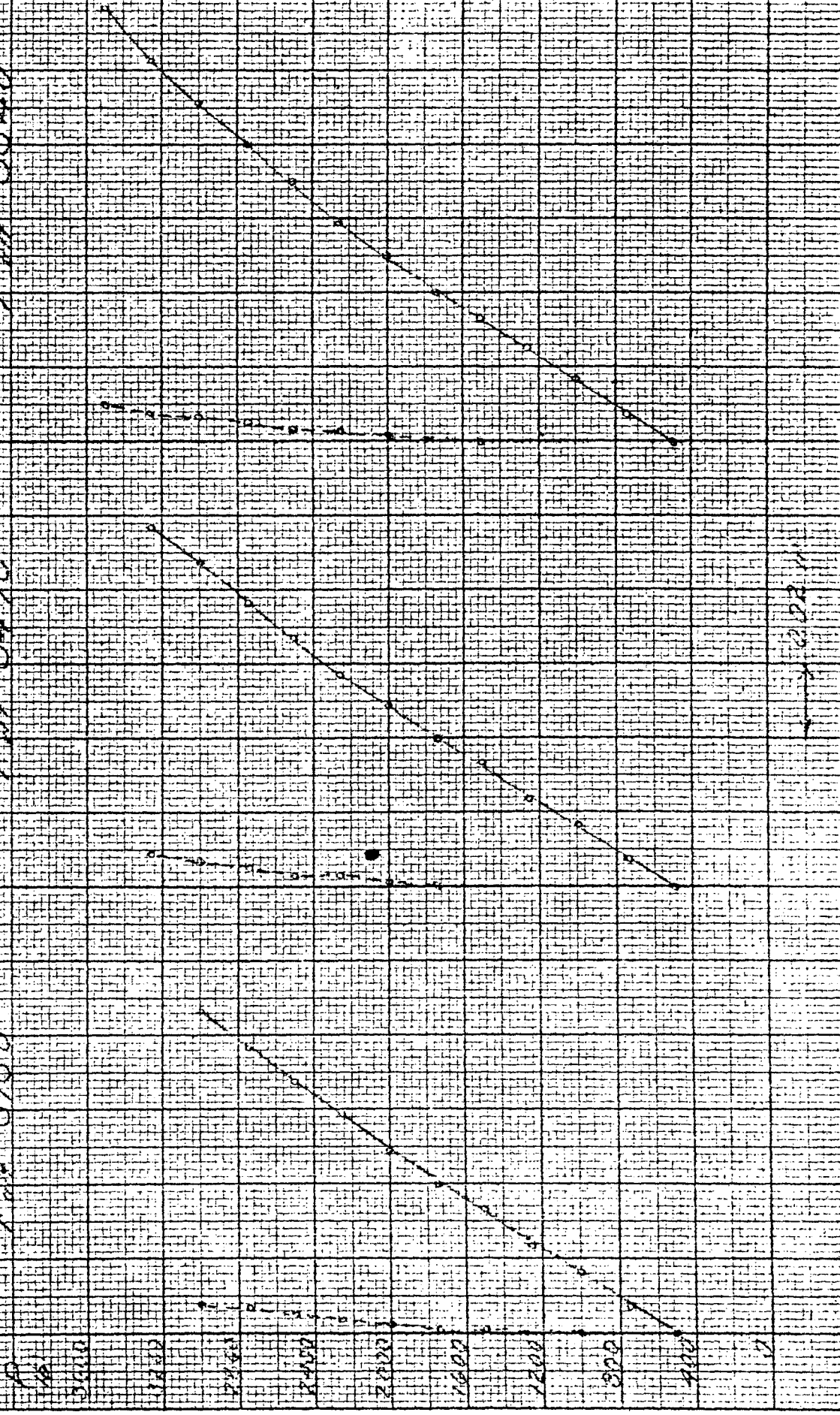
It is worth noting that of all beams tested in this series the two sets of 4 in. deep beams were the most perfect as to regularity of shape and lack of distortion.

Low Voltage Deflection

10 - 1/2 - 1  
Pwr 3100

15 - 1/2 - 3  
Pwr 3410

10 - 1/2 - 3  
Pwr 3510



1000

10307 4.5 DEFORMATION

10-11-1 (4")

P.W. 2910

P

W

2910

2800

2700

2600

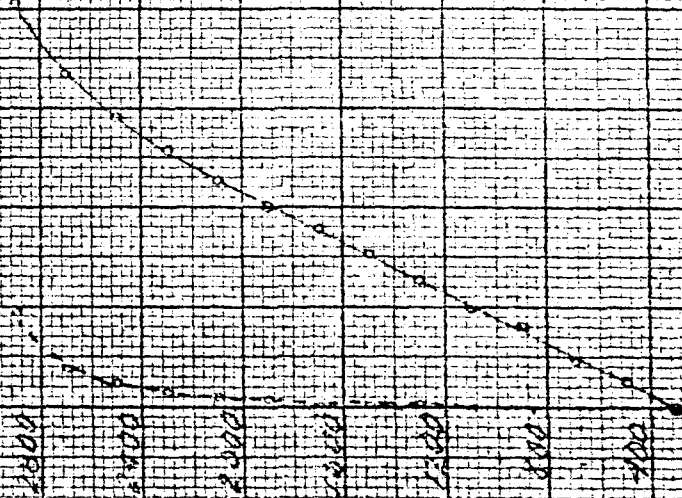
2500

2400

2300

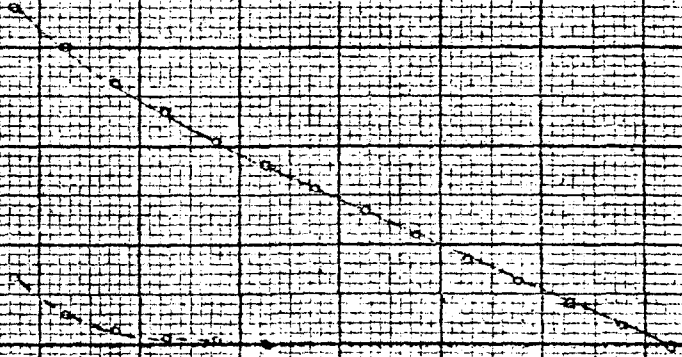
2200

0



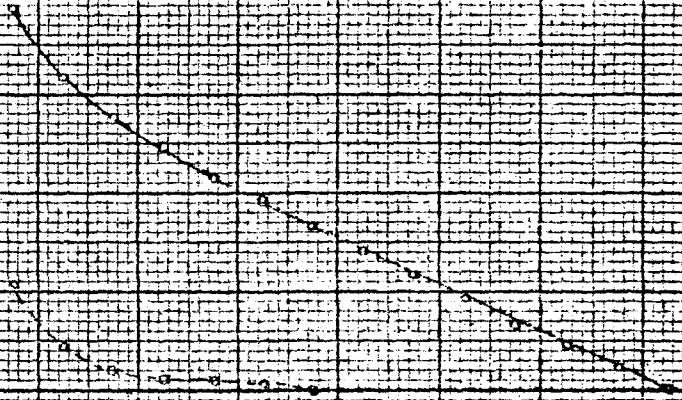
10-11-2 (4")

P.W. 2915



10-11-3 (4")

P.W. 2900



0.1 in



10000  
P.M.  
V.S. DISTRICT

16-11-1971  
P.M. 2520 (9)

16-11-1971  
P.M. 2980 (9)

16-11-1971  
P.M. 2920

P

10000

9700

9800

9900

10000

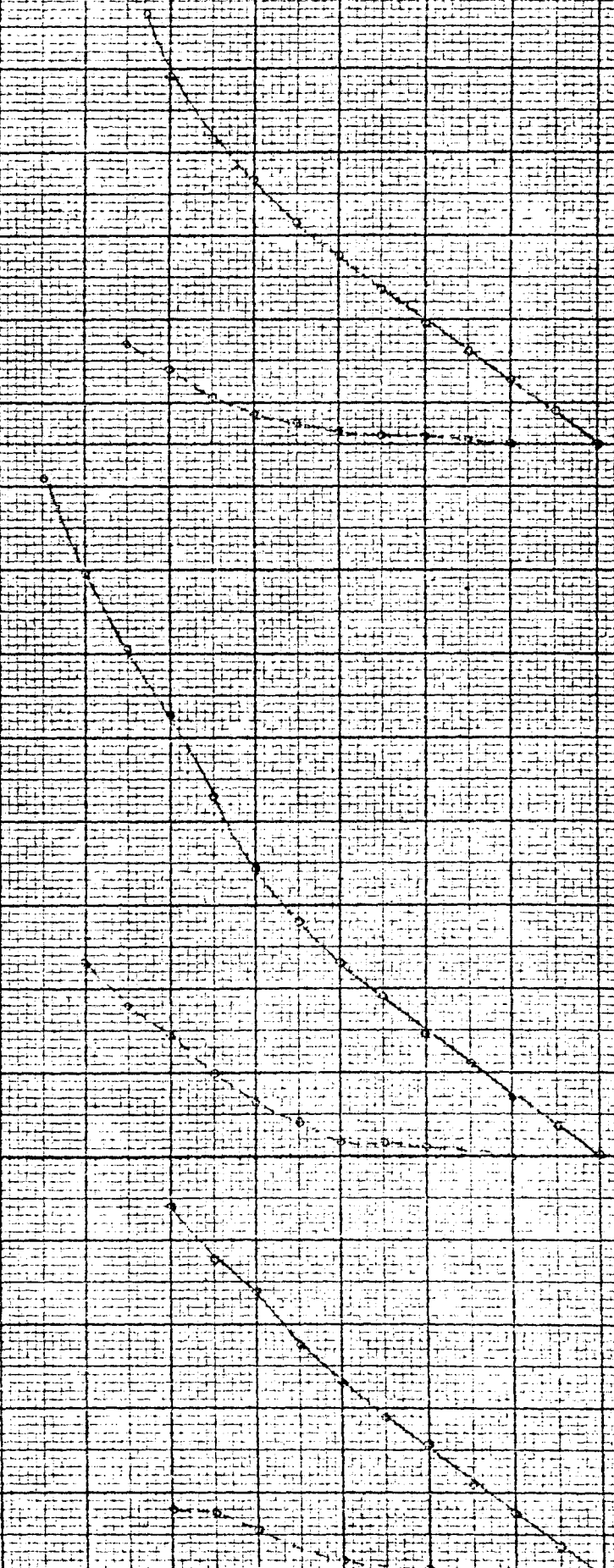
10100

10200

10300

10400

10500



0.125  
0.125

Level to Station

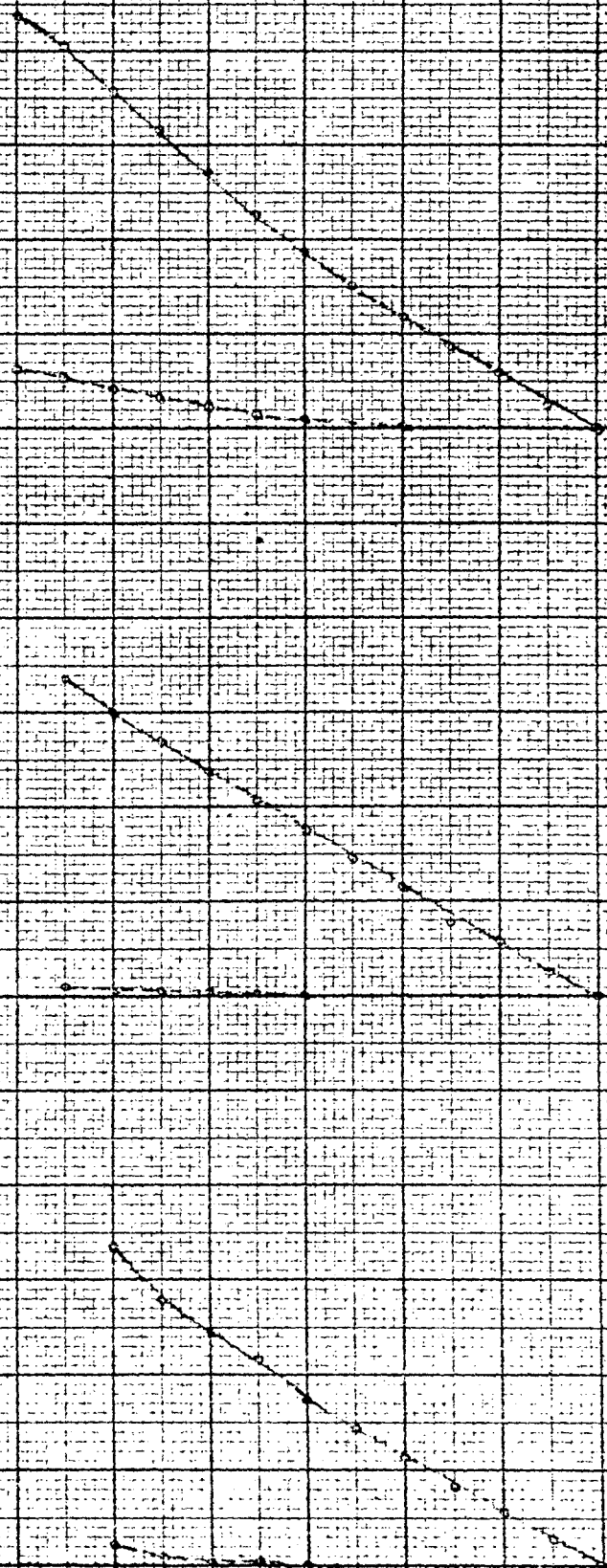
Upper Flange

18-10-1

18-10-2

18-10-3

A  
14  
3000  
5000  
7000  
9000  
11000  
13000  
15000  
17000  
19000  
21000



1/2 inch per

1951-52

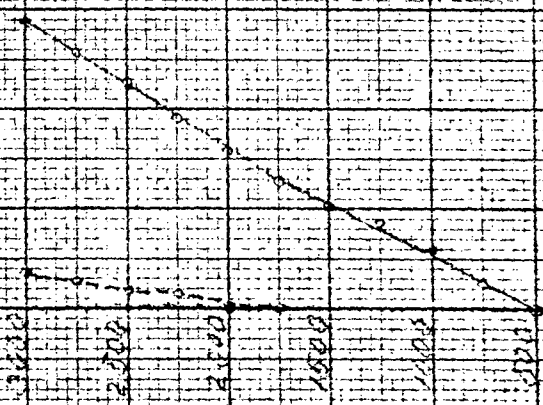
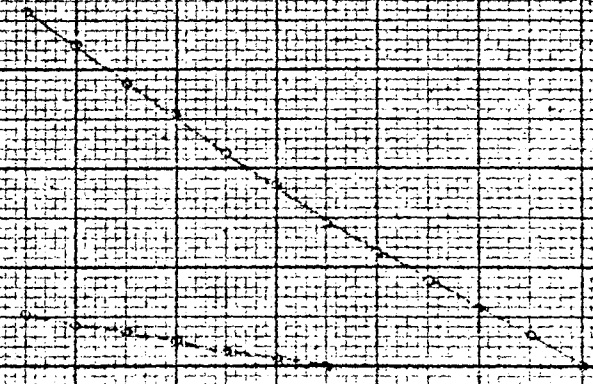
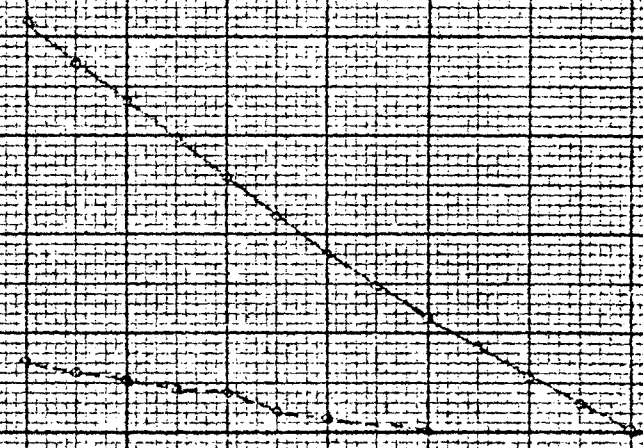
Lower Stage

18-16-5

18-16-2

18-16-1

1000  
1500  
2000  
2500  
3000  
3500



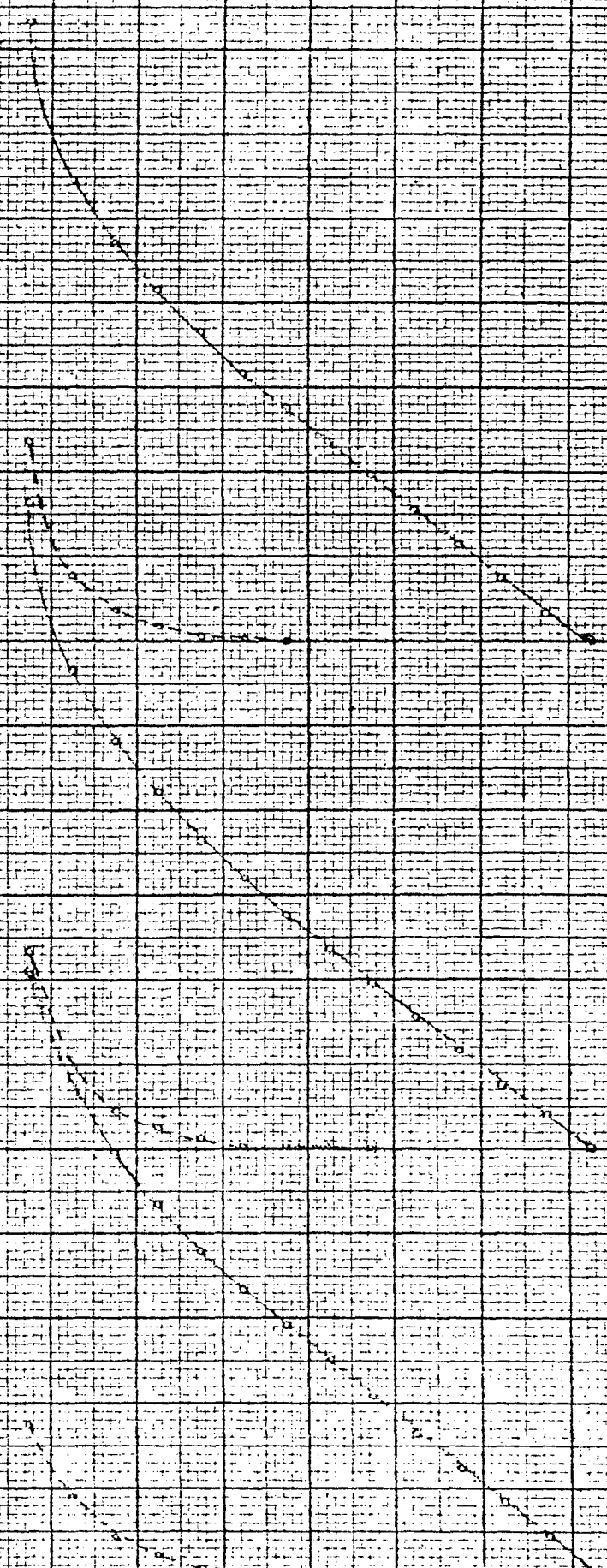
Upper Stage



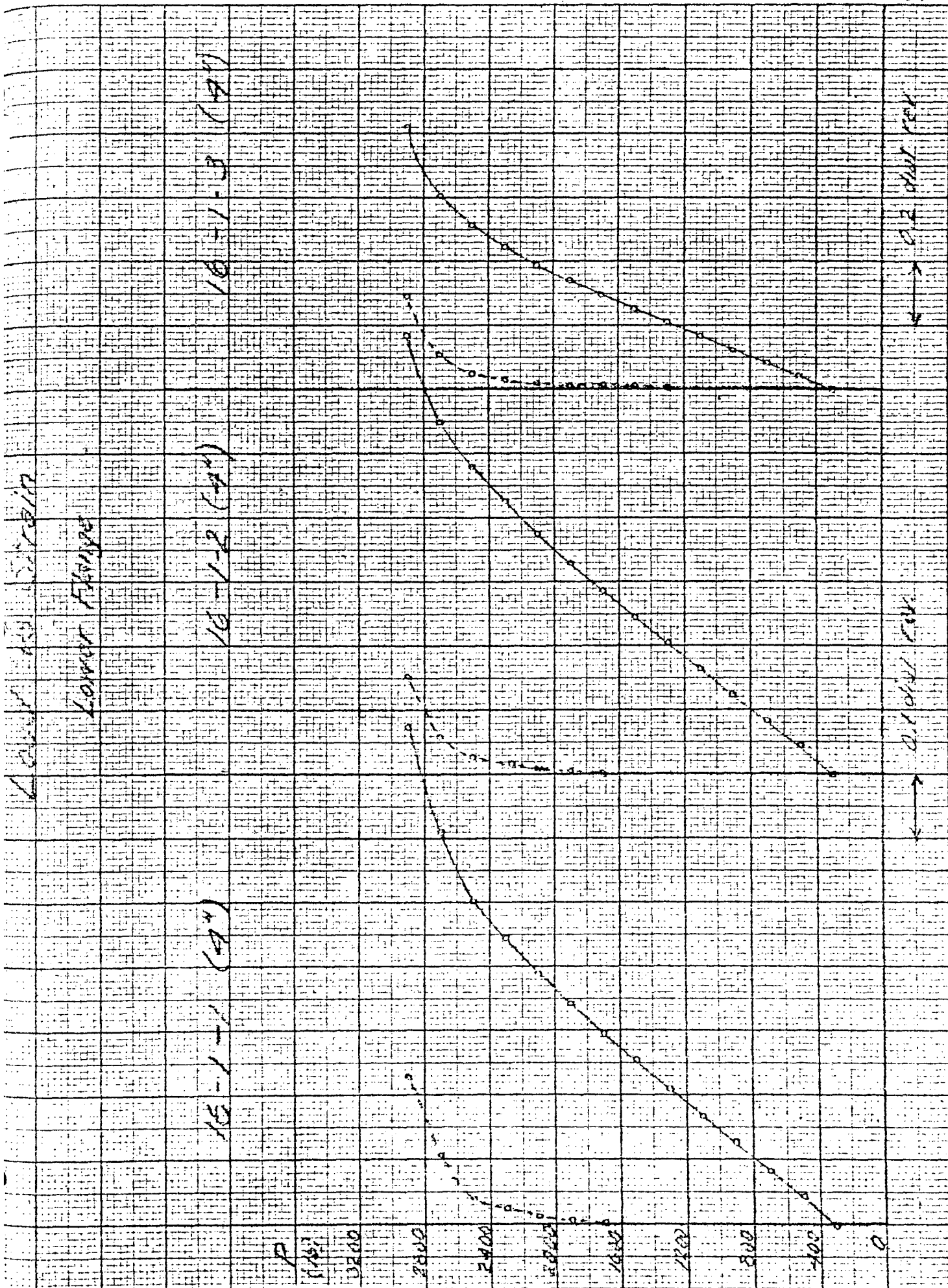
1. DEMY 1 STRIP  
Upper FLORES

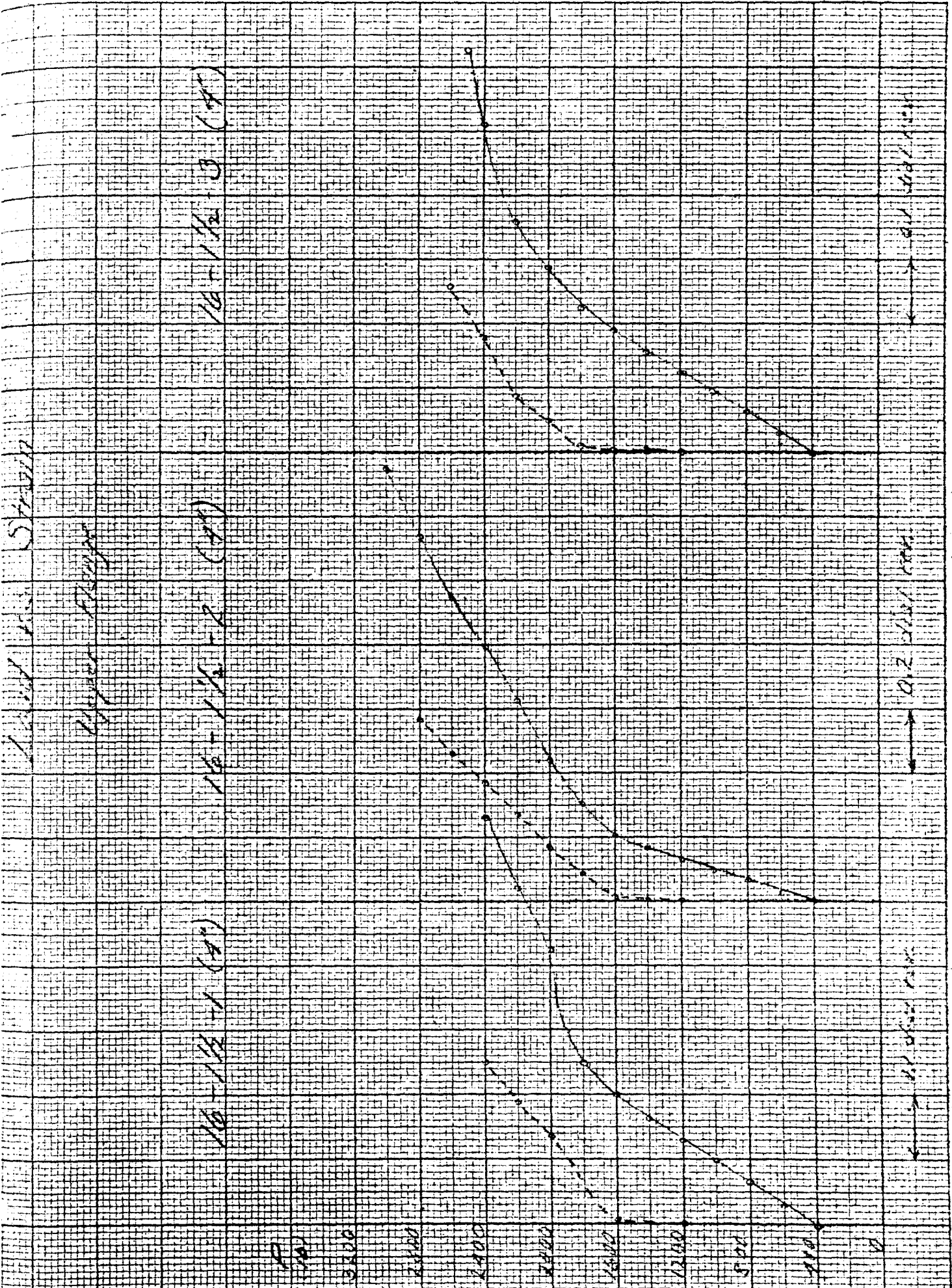
16-1-1 (4")  
16-1-2 (4")  
16-1-3 (4")

0  
100  
200  
300  
400  
500  
600  
700  
800  
900  
1000



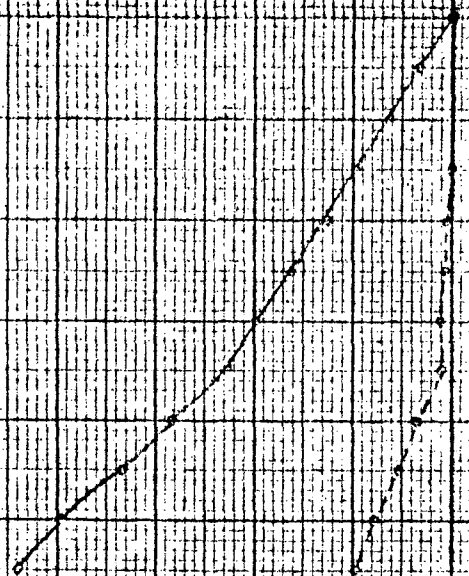
1000  
800  
600  
400  
200  
0



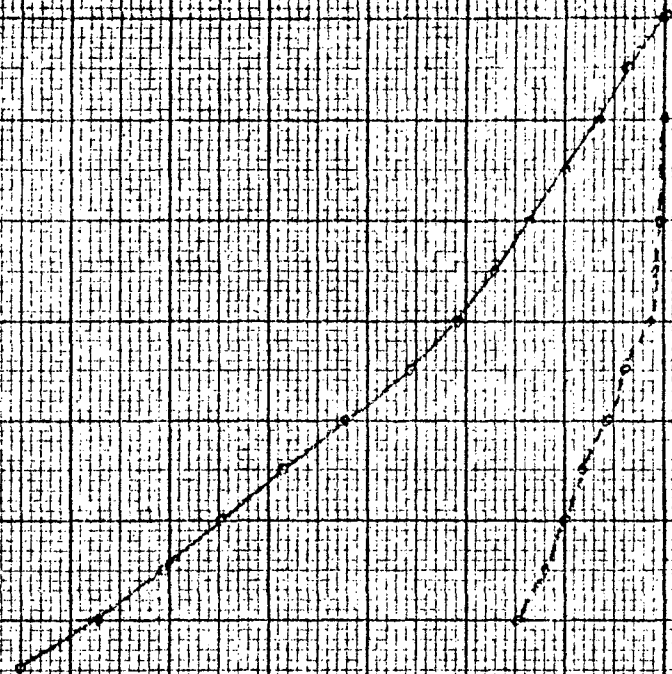




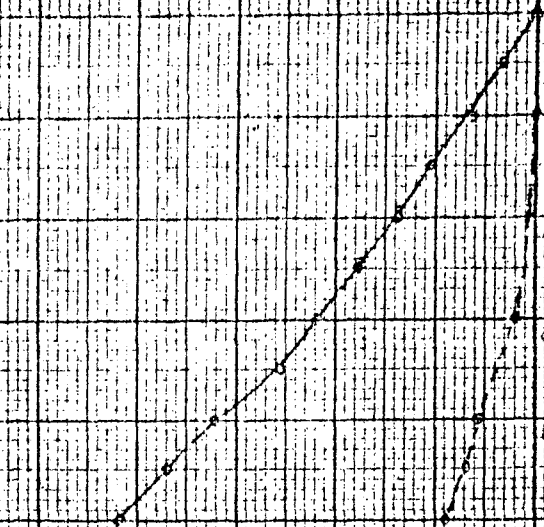
LOAD vs. STRAIN



(a) E-3/1-01



(b) 10-1/4-2 (3)



(c) 10-1/4-1 (2)

Yield strength values:  
0008  
0008  
0007  
0007  
0002  
0002  
0002  
0002  
(31)

Load vs. Strain  
Lower Flange

100-114-2

Upper Flings  
Lower Flings

Upper Flings

Upper Flings  
Lower Flings

PM 3000

P

1000

1100

1200

1300

1400

1500

1600

1700

1800

1900

2000

2100

2200

2300

0.23

0.23

