DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

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Ottawa, September 7, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2102.

Static Calibration in Compression of Two 2,000-Pound (SF-1-U) Sonntag Universal Fatigue Testing Machines.

(Copy No. 7.)

(Investigation)
(Report No. 2102.)

A B S T R A C T

Two 2,000-pound Sonntag Universal Fatigue Testing Machines, installed at the Physical Metallurgy Research Laboratories, have been calibrated statically in compression using a 5,000-pound Morehouse proving ring. The calibration constant for each machine, i.e., relation between true load and the spring deflection as measured by a dial gauge, has been derived.

Calibration constant for machine No. 46100 = 4.20 pounds/division.

Calibration constant for machine No. 48775 = 3.88 pounds/division.

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1. Introduction:

These machines were purchased from the Baldwin-Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa., for a special research project and to form part of the general fatigue testing equipment of these Laboratories. This report gives the results of static compression calibrations of both machines, carried out in accordance with the policy of the Laboratories.

2. Description of the Machines:

Preload capacity = 0 to 1,000 pounds tension or compression.

Dynamic load range = ±1,000 pounds.

Maximum dynamic load = 2,000 pounds tension or compression.

The function of this type of machine is to apply a vertical vibrating force to a specimen attached between a heavy stationary frame and a reciprocating platen. The alternating force is produced by an unbalanced rotating mass, supported between two bearings and driven by a synchronous motor at a constant speed of 1800 r.p.m. The vertical component of the centrifugal force is transmitted to the specimen and the horizontal component is absorbed by flex-plate guides or spring-loaded rollers.

The static preload is applied to the specimen through two helical springs by means of a hand-wheel and a worm gear reducer. It is measured by the extension or compression of the springs, the amount of which is indicated on a dial gauge. One division of the dial gauge corresponds to a spring deflection of 0.001 inch.

The two machines of this type which have been calibrated are No. 46100 and No. 48775. A photograph of one of them with a test-piece in position is shown in Figure 1.

3. Calibration Procedure and Results:

The calibrations were carried out in compression, using a 5,000-pound Morehouse proving ring, shown in Figure 2. This ring is the property of the P.M.R.L., and has been calibrated with dead weights by the National Bureau of Standards, Washington. It consists essentially of an elastic steel ring with a reed and a micrometer screw mounted on lugs at opposite ends of a vertical diameter. In taking a reading, the reed is caused to vibrate by moving the free end about half an inch

(Calibration Procedure and Results, cont'd) -

to one side and then releasing it. While the reed is vibrating, the micrometer anvil is advanced slowly until contact with the reed is indicated by a buzzing sound. The correct position is obtained when the sound dies away in 2 to 3 seconds. The micrometer dial reading can then be taken.

The procedure used in the calibration of machine No. 48775 with flex-plate guides was first to mount the ring in the machine in an axial position between the platen and the stationary frame. Zero readings of the proving ring micrometer and the dial gauge were taken. A compressive load of about 200 pounds was applied and the corresponding readings taken. The load was then removed and the zero readings checked. This procedure was repeated for loads of approximately 400, 600, 800 and 1,000 pounds in that order. This series of loadings and unloadings constituted the first calibration. A second calibration on similar lines was also carried out and the two sets of results are given in Table I and shown plotted in Figure 3.

TABLE I. - Static Compression Calibration of 2,000-Pound Sonntag Fatigue Machine No. 48775.

	True Load (Pounds)	Dial Gauge Deflection (in. x 10-3)
No. 1 -	(200	50.2
	(385	100.2
	(580	150.2
	(780	200.2
	(980	250.1
No. 2 -	(195	49.9
	(380	99.7
	(580	149.7
	(780	199.7
	(970	249.7

It will be seen from Figure 3 that the plotted points

(Calibration Procedure and Results, cont'd) -

lie sensibly on a straight line through the origin. The slope of this line gives the calibration constant, which corresponds to a value of 3.88 pounds/division.

The calibration of machine No. 46100 was carried out in a slightly different manner. Friction between the rollers and guides made it difficult to obtain a true zero reading of the dial gauge, and therefore, all calibration runs were started from a small arbitrary load. The load was increased to 1,000 pounds in increments of about 200 pounds and then reduced in a similar way, corresponding readings of the proving ring micrometer and the dial gauge being taken at the various points. A second calibration on similar lines was also carried out and the two sets of results are given in Table II and shown plotted in Figures 4 and 5.

TABLE II. - Static Compression Calibration of 2,000-Pound Sonntag Fatigue Machine No. 46100.

	True Load (Pounds)	Dial Gauge Reading (in. x 10-3)
No. 1 -	(55	753.1
	(220	714.8
	(425	664.9
	(640	615.2
	(845	564.9
	(1055	515.0
	(845	565.1
	(645	615.1
	(430	665.1
	(225	714.9
	(60	753.1
No. 2 -	(60	753.2
	(220	715.0
	(430	664.8
	(640	614.8
	(845	564.8
	(1055	515.0
	(850	565.0
	(645	615.2
	(435	665.0
	(225	715.0
	(65	753.0

From the points plotted in Figures 4 and 5, the value

(Calibration Procedure and Results, cont'd) -

derived for the calibration constant was 4.20 pounds/division.

4. Accuracy of Calibration:

The 5,000-pound proving ring used in these calibrations was itself calibrated by the National Bureau of Standards with dead-weight loading, and its accuracy for static loads up to 1,000 pounds is of the order of 0.2 per cent. From a consideration of the plotted points in Figures 3, 4 and 5, it is considered that the maximum error in using the derived calibration constants for the two machines would not exceed 5 pounds or 1 per cent, whichever is the greater.

5. Conclusion:

Static compression calibrations of the two 2,000-pound Sonntag fatigue machines installed at the P.M.R.L. have been carried out, using a 5,000-pound Morehouse proving ring. From the results obtained, the following calibration constants were derived:

4.20 pounds/division for machine No. 46100.

3.88 pounds/division for machine No. 48775.

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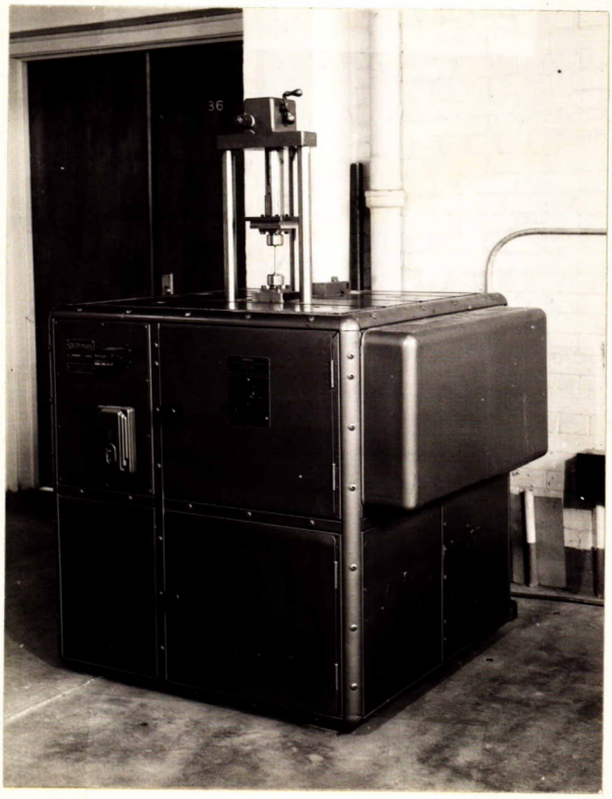
RCAT:SKJ(MC).

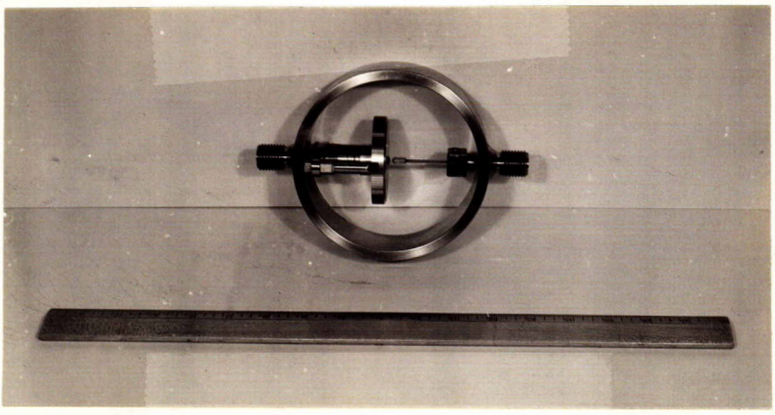
(Figures 1 to 5 follow, on Pages 6 to 9.)

Figure 1



2,000-Pound Sonntag Universal Fatigue Machine

Figure 2



5,000-Pound Morehouse Proving Ring.

RCAT:SKJ(MC).

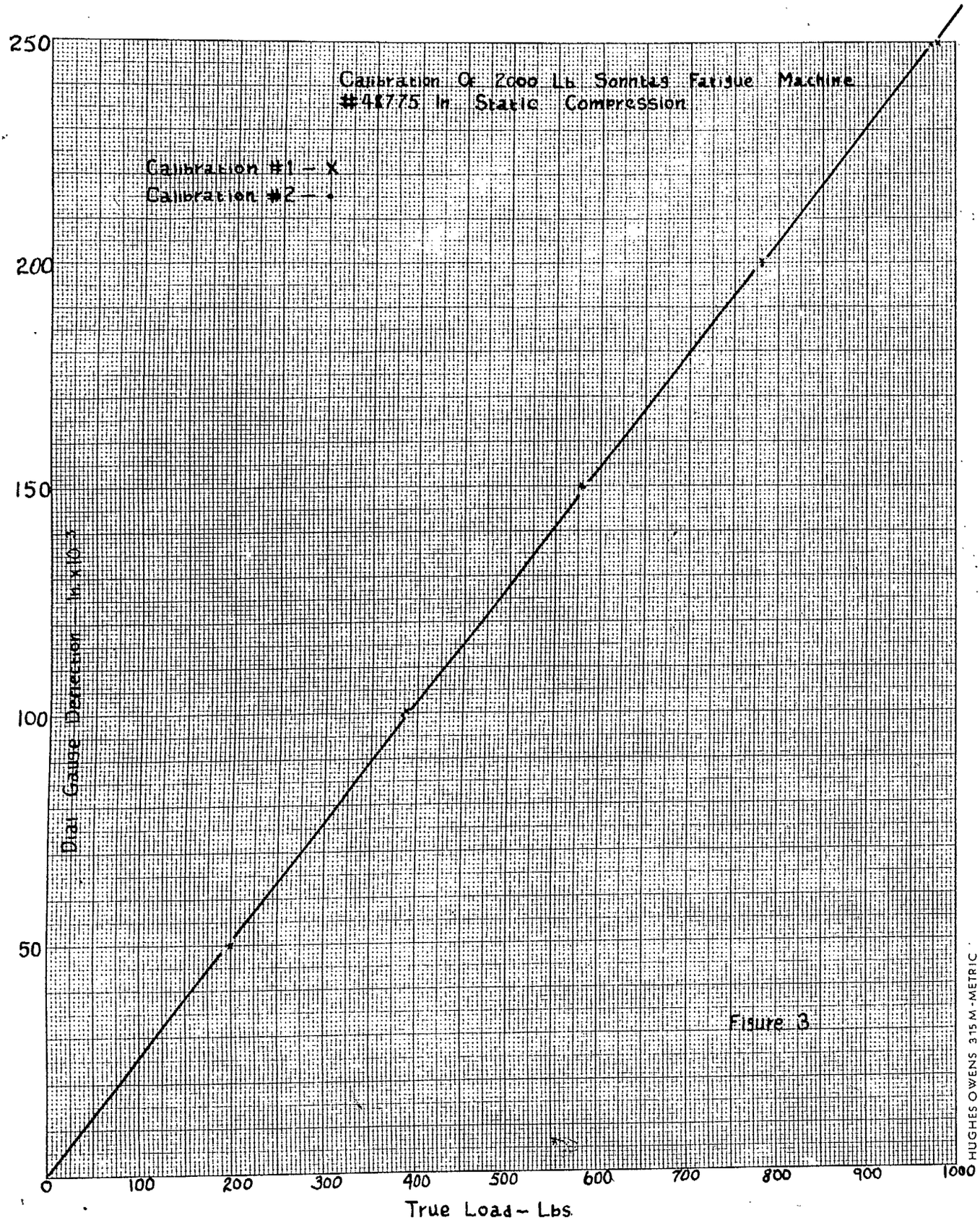

Calibration Of 2000 Lb Sonntag Fatigue Machine
#48775 In Static Compression
Calibration #1 – X
Calibration #2 – •
Dial Gauge Deflection – In. x 10⁻⁴
250
200
150
100
50
0
100
200
300
400
500
600
700
800
900
1000
True Load – Lbs
HUGHES OWENS 315 M-METRIC

Figure 3

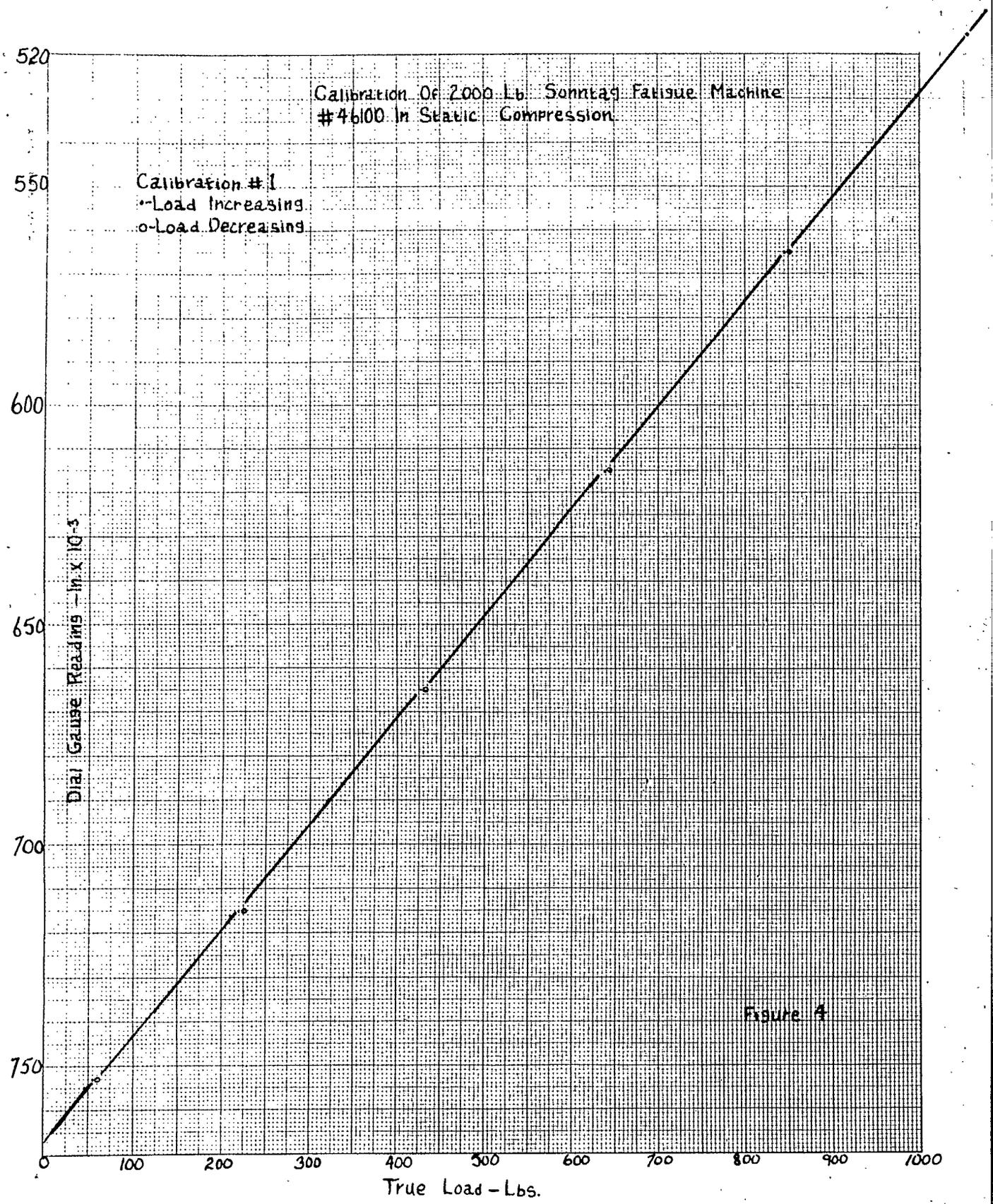

Calibration Of 2000 Lb. Sonntag Fatigue Machine
#46100 In Static Compression
Calibration #1
•-Load Increasing
o-Load Decreasing
Dial Gauge Reading — In x 10-3
520
550
600
650
700
750
0
100
200
300
400
500
600
700
800
900
1000
True Load - Lbs.

Figure 4

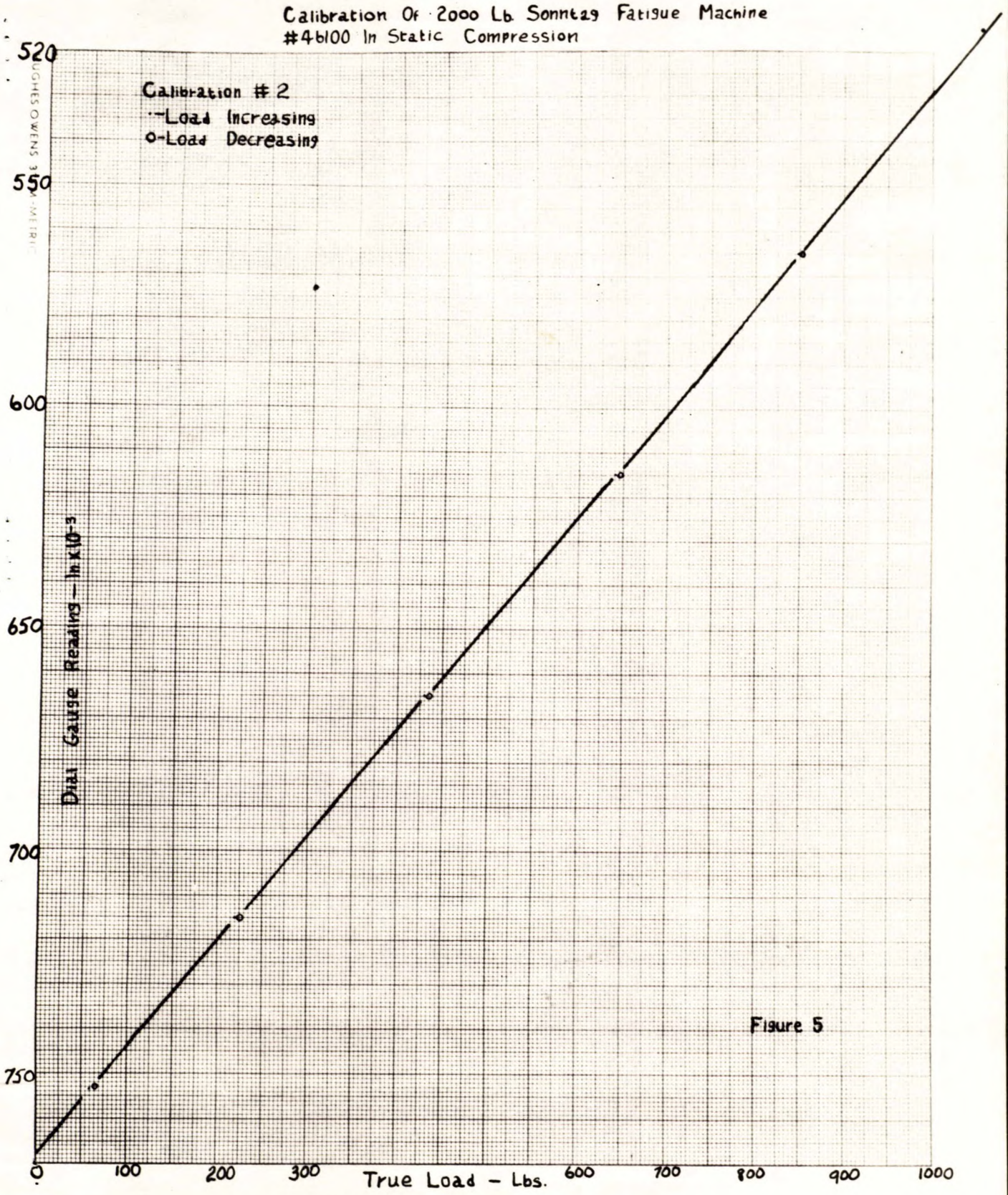

Calibration Of 2000 Lb Sonntag Fatigue Machine
#46100 In Static Compression
Calibration # 2
·-Load Increasing
o-Load Decreasing
Dial Gauge Reading — In x10⁻³
520
550
600
650
700
750
0
100
200
300
True Load — Lbs.
600
700
800
900
1000

Figure 5