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UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON

Superseding
LC 657

NATIONAL BUREAU OF STANDARDS SPECIFICATION FOR PROVING RINGS FOR CALIBRATING TESTING MACHINES

(April 15, 1946)

INTRODUCTION

The National Bureau of Standards has had more than twenty-five years of experience in calibrating testing machines which apply forces to engineering materials. This experience has indicated the advisability of frequent periodic calibration of such machines, if reliable test results are to be obtained. It also indicated the need for a calibrating device which would be sufficiently accurate for the purpose and at the same time more readily portable and convenient in use than the devices previously available. Proving rings were developed at the National Bureau of Standards to meet this need.

This specification is the result of over 20 years' experience in the development of proving rings and in calibrating them periodically in dead-weight calibrating machines. It contains requirements which have been found necessary to insure that proving rings complying with them will be satisfactory, reliable instruments for calibrating testing machines.

These technical requirements are identical with those in Letter Circular 657, which this specification supersedes. The simplified procedure for the recalibration of rings previously certified is justified by the experinece of the past twelve years.

I. DEFINITIONS

1. PROVING RING

A proving ring is an elastic ring, suitable for calibrating a testing machine, in which the deflection of the ring when loaded along a diameter is measured by means of a micrometer screw and a vibrating reed mounted diametrically in the ring.

2. READING

A reading is the value indicated by the micrometer dial when it has been adjusted to contact the vibrating reed.

3. DEFLECTION

The deflection of the ring for any load is the difference between the reading for that load and the reading for no load.

4. CALIBRATION FACTOR

The calibration factor for a given deflection is the ratio of the corresponding load to the deflection.

II. COMPLETE CALIBRATION

1. MARKING

The maker's name, the capacity load, and the serial number of the ring shall be legibly marked upon some part of the instrument.

2. MICROMETER DIAL

(a) The dial of the micrometer shall be of the uniformly graduated type. When successive graduation lines on the dial are set to one fixed index line, the positions of successive graduation lines nearly diametrically opposite referred to another fixed index shall differ from each other by not more than 1/20 of the smallest division of the dial.

(b) The smallest division of the dial shall be not less than 0.05 inch and not more than 0.10 inch.

(c) The width of any graduation line on the dial shall not exceed one-tenth of the average distance between adjacent graduation lines.

(d) The width of any index line shall be not less than 0.75 and not more than 1.25 times the average width of the graduation lines on the dial.

3. OVERLOAD

The ring shall be overloaded repeatedly to a load of not less than 9 percent nor more than 10 percent in excess of the capacity load. The difference between the no-load reading after the first overload and the no-load reading after any subsequent overload shall not exceed one-tenth of one percent of the deflection of the ring under capacity load.

4. STIFFNESS

Under the capacity load the ring shall deflect not less than 0.040 inch.

5. CONSTANCY

(a) Range 1/10 to 2/10-Capacity Load. - The observed deflection of the ring, for an applied load of not less than one-tenth nor more than two-tenths of the capacity load, shall differ from the average of at least three successive observations for the same applied load by not more than one-half of one percent of the deflection for the applied load.

(b) Range 2/10 to Capacity Load. - The observed deflection of the ring, for any applied load not less than two-tenths nor more than the capacity load, shall differ from the average of at least three successive observations for the same applied load by not more than one-tenth of one percent of the deflection for the capacity load.

(c) Disassembling. - The difference between the deflections of the ring, observed before and after the deflection-measuring apparatus is removed and then replaced, shall be not greater than the maxima specified in paragraphs II-5(a) and II-5(b) of this specification, under the loads there specified.

(d) Bearing Blocks. - A compression proving ring shall be loaded through plane, concave, and convex bearing blocks. The deflections of the proving ring for the minimum load and for the maximum load applied by dead weights during the calibration shall be determined when the load is applied to the lower boss of the ring through concave and convex bearing blocks. The differences between the average deflections observed using the concave bearing block and the average deflections observed using a plane bearing block for the same loads shall not exceed the maxima specified in paragraphs II-5(a) and II-5(b) of this specification. The differences between the average deflections observed using the convex bearing block and the average deflections observed using a plane bearing block for the same loads shall not exceed the maxima specified in paragraphs II-5(a) and II-5(b) of this specification. The concave and convex bearing blocks shall comply with the following requirements:

(1) They shall be steel.
(2) The Brinell numbers shall be not less than 400 and not more than 600.
(3) The radii of curvature of the spherical surfaces shall be not less than 9 feet and not more than 10 feet.

III. RECALIBRATION

1. CONSTANCY

(a) Range 1/10 to 2/10-Capacity Load. - The observed deflection of the ring, for an applied load of not less than one-tenth nor more than two-tenths of the capacity load, shall differ from the average of at least three successive observations for the same applied load by not more than one-half of one percent of the deflection for the applied load.

(b) Range 2/10 to Capacity Load. - The observed deflection of the ring, for any applied load not less than two-tenths nor more than the capacity load, shall differ from the average of at least three successive observations for the same applied load by not more than one-tenth of one percent of the deflection for the capacity load.

(c) Comparison with Last Calibration. - The observed deflections of the ring during recalibration shall differ from the deflections observed at the time of the last calibration by not more than the maxima specified in paragraphs III-1(a) and III-1(b) of this specification, under the loads there specified.

(d) Alternative Procedure. - If the ring fails to comply with the requirements of paragraph III-1(c) of this specification, the deflection-measuring apparatus shall be removed and then replaced. The difference between the deflections observed before and after this is done shall be not greater than the maxima specified in paragraphs III-1(a) and III-1(b) of this specification, under the loads there specified.

IV. METHOD OF CALIBRATION

1. COMPLETE CALIBRATION

The proving ring shall be calibrated in accordance with the requirements given in section II, Complete Calibration:

(a) If the ring has not been calibrated by the National Bureau of Standards since the revision of this specification on April 4, 1934.

(b) If the ring was not certified when last calibrated by the National Bureau of Standards.

(c) If the ring has been reparied or modified since its last calibration by the National Bureau of Standards.

2. RECALIBRATION

Except as provided in paragraphs IV-1(a), IV-1(b), and IV-1(c), Complete Calibration, a ring shall be recalibrated in accordance with the requirements given in section III, Recalibration.

3. LOADS NOT EXCEEDING 110,000 LB

For loads not exceeding 110,000 lb the proving ring shall be calibrated by applying dead weights known to within 0.02 percent.

4. LOADS EXCEEDING 110,000 LB

For loads exceeding 110,000 lb the applied load shall be known to within 0.1 percent.

5. LOADING PROCEDURE

The proving ring shall be calibrated under increasing loads. Compressive loads, except as provided in paragraph II-5(d), shall be applied to the lower boss of the ring through a plane, hardened-steel bearing block and to the upper boss either through a ball or a soft-steel block. Tensile loads shall be applied to the ring through the pulling rods provided with the ring.

6. TEMPERATURE CORRECTION

To compensate for temperature changes which occur during calibration, the deflections of the proving ring shall be corrected for temperature using the formula

$$d_{70} = d_t \left[1 + K (t - 70)\right],$$

where d_{70} = deflection of ring at a temperature of 70° Fahrenheit

d_t = deflection of ring at a temperature of t degrees Fahrenheit

K = temperature coefficient

t = temperature, degrees Fahrenheit, during test.

The coefficient K depends upon the chemical composition of the steel of which the ring is made and its heat treatment. For steels having a total alloying content not exceeding five percent, the value $K = -0.00015$ per degree Fahrenheit is sufficiently accurate. For some other steels values of K have been found

ranging from -0.00011 to -0.00024. When the proving ring is submitted for calibration, the value of K shall be furnished this Bureau by the person submitting the ring or by the manufacturer of the ring.

V. METHOD OF REPORTING RESULTS

1. CERTIFICATES OF CALIBRATION

For a ring which complies with the requirements of this specification, a certificate of calibration will be issued including a calibration graph showing the calibration factor as a function of the ring deflection.

2. REPORTS

For a ring which does not comply with the requirements of this specification, a report will be issued giving the results in the form of a table and stating wherein the ring fails to comply.