HLW:HV

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
LC 409

SPECIFICATION FOR PROVING RINGS FOR CALIBRATING TESTING MACHINES

Superseding
LC 294

(April 9, 1934)

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 with the vibrating reed.

3. DEFLECTION

The deflection of the ring for any load is equal to the difference between the reading for that load and the reading for zero load.

4. CALIBRATION FACTOR

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

II. REQUIREMENTS

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 of the micrometer 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 of the micrometer shall not exceed one-tenth of the average distance between adjacent graduation lines.

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

3. OVERLOAD

The ring shall be overloaded repeatedly to a load of not less than 9 per cent nor more than 10 per cent more than its capacity load. The difference between the zero load reading after the first overload and the zero load reading after any subsequent overload shall not exceed one-tenth of one per cent of the deflection of the ring under capacity load.

4. STIFFNESS

When under its 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 per cent 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 per cent 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. - This paragraph applies only to proving rings calibrated under compressive loads. The deflections of a 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 used shall be made of steel, Brinell number not less than 400 nor more than 600; and shall have spherical surfaces, radii of curvature not less than 9 feet nor more than 10 feet.

6. METHOD OF CALIBRATION

(a) Loads Not Exceeding 110,000 lb. - For loads not exceeding 110,000 lb. proving rings shall be calibrated by applying dead weights known to within 0.02 per cent.

(b) Loads Exceeding 110,000 lb. - For loads exceeding 110,000 lb. the applied load shall be known to within 0.1 per cent.

(c) Loading Procedure. - All proving rings shall be calibrated under increasing loads. Compressive loads 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.

(d) Temperature Correction. - To compensate for temperature changes which occur during calibration, the deflections of a 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 for a temperature of 70 degrees Fahrenheit

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

K = temperature coefficient of Young's Modulus of Elasticity

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 per

cent 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 a 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.

III. METHOD OF REPORTING RESULTS

1. CERTIFICATES

For rings which satisfy the requirements of this specification a certificate will be issued including a chart showing the calibration factor as a function of the ring deflection.

2. REPORTS

For rings which do not satisfy 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 with this specification.