

## CRD-C 516-71

## METHOD OF TEST FOR VERIFICATION OF COMPRESSION TESTING MACHINES USING CALIBRATED PROVING RINGS

### 1. Scope

1.1 This method covers the procedure for testing compression machines to conformance with the requirements specified for load indication. The procedures described below are based on those given in CRD-C 512.

### 2. Apparatus

2.1 The apparatus required for the testing described in this method should comply with the applicable provisions of CRD-C 512 and consists of the following:

2.1.1 Proving ring.- The instrument used in verifying a compression testing machine shall be an elastic ring in which the deflection, when loaded along a diameter, is measured by means of a micrometer screw and a vibrating reed mounted diametrically in the ring, see Fig. 1. Forces are applied to the ring, A, through the

integral external bosses, B and C. The resulting deflection of the ring is measured with a micrometer screw, D, and a vibrating reed, E, which are attached to integral bosses, F and G. By means of a graduated dial, H, and an index pointer, I, the deflection of the ring may be measured in divisions of the micrometer dial.

2.1.2 Hardened bearing plates, upper and lower.- The testing machine must be provided with hardened flat bearing plates as shown in Fig. 1, a set of which must be available before the proving rings can be used to calibrate the machine. Their size and thickness must be sufficient to reduce the stress on bearing surfaces of the machine to a safe figure (approximately 20,000 psi or less). They must be hardened to Rockwell C50-55 and the surfaces ground flat and parallel.

2.1.3 Upper boss pad.- Always use a piece of machined cold rolled steel as an upper boss pad, as shown in Fig. 1. Never load the spherical surface of the upper boss directly against the hardened bearing plate or other hardened surface. These boss pads are to be used only once on each side and then discarded or remachined. Applicable size of pad will depend on ring capacity.

200,000 ring - 3- by 3- by 1-in. pad  
 100,000 ring - 2- by 2- by 1/2-in. pad  
 10,000 ring - 1-1/2- by 1-1/2- by 1/2-in. pad  
 2,000 ring - 1- by 1- by 1/4-in. pad

2.1.4 Thermometer.- A thermometer graduated in degrees Celsius shall be used for measuring the temperature of the air surrounding the proving ring.

2.1.5 Vibration starter.- A pencil or some suitable instrument shall be used to set the vibrating reed in motion. Do not use the fingers for this purpose.

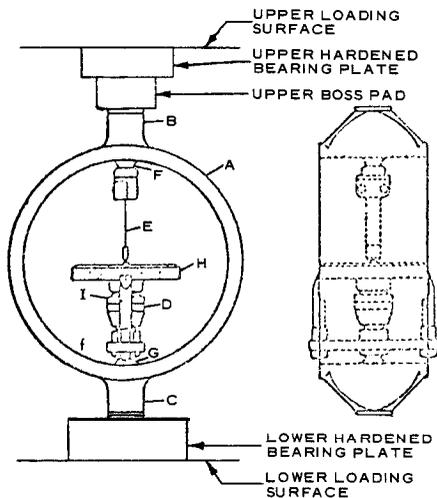


Fig. 1. Standard proving ring setup for a compression calibration in a testing machine. See Par. 2.1.1 for a description of legend

### 3. Procedure

#### 3.1 The verification of compression

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testing machines shall be performed in the following manner.

3.1.1 Allow the ring to reach the temperature that will exist during the test. Place the thermometer against the ring metal or in a suitable holder close enough to accurately measure the temperature of the air surrounding the ring. The time required to stabilize the ring temperature maybe as much as 4 to 12 hr. During this period, the ring should be close to the compression machine. Temperature should be observed frequently during verification to detect any changes.

3.1.2 Remove the upper spherically seated bearing block and replace with the hardened bearing plate. Insert the calibration apparatus as shown in Fig. 1 so that it is centered on the ram below, essentially centered on the fixed head above, and the ring index is facing the operator (see Section 4.2).

3.1.3 Take a zero load reading. Rotate the dial counterclockwise until the contact button is almost touching the reed. When the ring is equipped with a manually operated vibrating reed, set the reed in motion, using the pencil or instrument so that the vibration forms an arc about 1/2 in. long. Continue turning the dial until contact is made with the end of the vibrating reed and the oscillation of the reed is slightly checked or damped. Adjust the setting until the oscillation is damped out in about 2 sec. If the ring is equipped with an electrically driven reed, the best results are obtained by turning the dial to advance the button just far enough to interfere with the vibration of the reed. This condition can be detected better by watching the change in amplitude of the reed than by listening for the change in intensity or frequency of the sound. Readings taken by advancing the button until a large change in amplitude is produced or until the motion is nearly stopped have been found much less reliable than readings taken in the manner described above. The proving ring reading is the value indicated by the index line, or vernier. If the ring has only a single line index, the reading is easily estimated to the nearest

tenth of a division. The number of hundreds of divisions is obtained by counting the dial revolutions after determining the no-load setting.

3.1.4 Preload the ring. A preliminary preload, preferably to capacity, is desirable to stabilize the no-load reading of the ring. Turn the dial to a reading equal to the capacity load deflection plus the no-load reading. In addition, allow 10-20 extra divisions for a safety factor. Apply a load equal to the capacity of the ring, going slowly as the capacity is approached. Watch the ring for any sign of contact between the reed and the micrometer button, and be prepared to signal the operator to stop loading the ring if contact is made. This precaution is necessary to prevent overloading the ring because of possible excessive error in the load indication of the machine. After removing the load, take and record a no-load reading of the proving ring. On large capacity rings, 100,000 lb and higher capacities, wait 30 to 60 sec after removal of the load in order to equalize temperature effects.

3.1.5 Select the test loads. For any loading range, the testing machine shall be verified by at least five test loads, except for testing machines designed to measure only a smaller number of definite loads, such as certain hardness testing machines. The difference between any two successive test loads shall not exceed one-third of the difference between the maximum and minimum test loads. If it is desired to establish the lower limit of a loading range lower than 10 percent of the capacity of the range, the lower limit shall be verified by applying five approximately equal test loads, none of which shall differ from the lowest by more than 5 percent.

3.1.6 Apply the test load. Turn the dial to a reading equal to the no-load reading plus the estimated deflection of the ring for the load to be verified. Always remember that the proving ring dial must be backed off before any compression load is applied. Having done this, apply load carefully, and as the designated test point is approached have the machine operator adjust to the slowest speed at which

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the machine will load in a positive manner. This may require skillful manipulation by the operator, depending on the type of machine. When this condition has been achieved and the testing machine indicator will pass the test load mark within the next 5 or 10 sec, have the operator give a signal such as "ready." Set the vibrating reed in motion and turn the dial to the right until a light contact is established. Reverse the dial direction and follow the slowly increasing load at the proper damping rate, keeping the reed in motion. When the machine operator signals that the indicator is exactly opposite the test load on the machine, stop turning the proving ring dial. Carefully remove the hand holding the dial so the setting is not disturbed. At the same time, allow the vibration of the reed to die of its own accord. Do not worry if the increasing testing machine load lightly jams the reed and contact button together, as the proving ring is designed to be used in this way. Do not attempt to free the reed while it is jammed either by pushing it aside or by turning the dial. Always slack off the testing machine load first, and then back off the dial. As soon as the testing machine indicator has passed the highest test load mark, the operator should release the load slowly, and record the proving ring reading.

3.1.7 Take a new no-load reading. The deflection of the ring is computed as the difference between the load reading and the average of the no-load readings observed immediately before and after the application of the load.

3.1.8 Record the temperature of the air near the ring so that the proper temperature corrections may be applied.

3.1.9 Calculate the corrected ring readings as follows:

3.1.9.1 Determine the ring deflections for each test load as explained in Par. 3.17.

3.1.9.2 Correct the ring deflection for each test load for temperature either by using a table or the following formula:

$$D_{23} = D_t - 0.00027 (T-23)D_t$$

where:

$D_{23}$  = deflection at temperature of 23 C,

$D_t$  = deflection at test temperature, and

T = test temperature.

3.1.10 Compute the corrected ring load in pounds using the corrected ring deflection and the NBS load indications for the ring.

3.1.11 Calculate the error and the percentage of error from these data as follows:

$$\text{Error} = A - B$$

$$\text{Percentage of error} = \frac{A - B}{B} (100)$$

where:

A = load indicated by machine being calibrated (lb)

B = applied load in pounds as determined by calibrating device

3.1.12 Check points should be taken in each instance where the error indication exceeds the allowable percentage of error, where the zero readings of the ring change more than 0.1 between determinations, and in instances where there is doubt regarding the accuracy of the check at a given point. If the error is on the borderline, two consecutive readings, either in or out of tolerance, should be obtained prior to arriving at a final decision. The check point is of great value, and therefore, should never be omitted unless the machine is in obviously bad mechanical condition.

3.1.13 The maximum hand on each dial of a compression machine should be tested to determine its operating condition. A check at two points is considered adequate. One point should be midway on the upward travel, and the other point should be above one-half the dial capacity. Do not make tests where the hands are obviously defective.

#### 4. Special Considerations

4.1 It is recommended that rings be calibrated after intervals of from 1 to

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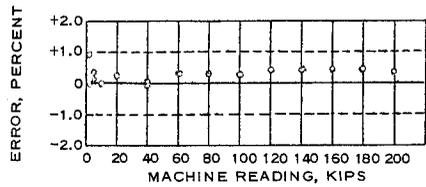
2 years, or immediately after repair or serious overloading.

4.2 There will be some instances where the proving ring cannot be inserted in the machine so that the front faces the person taking the readings. In such cases, it may be possible that the ring may be more easily read using mirrors and lights.

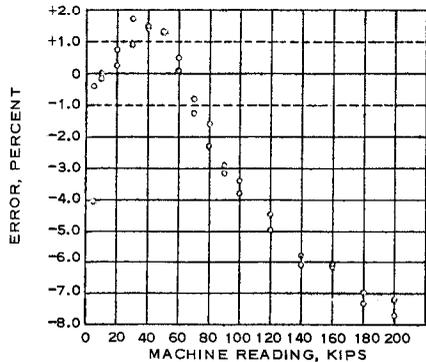
4.3 In hydraulic machines where the weighing system is directly connected to the loading system, errors may vary with the position of the ram. The errors can be expected to be found greatest near the extreme limits of the ram travel and at the high and low loads. It is recommended that the usual series of verification tests be made at the ram position usually used.

#### 5. Report

5.1 Report calibrations of compression testing machines by graphs as illustrated in Fig. 2.



a. TESTING MACHINE IN GOOD CONDITION



b. TESTING MACHINE IN NEED OF REPAIRS

Fig. 2. Calibration results obtained on testing machines