Operation & Maintenance

Instructions

for

Morehouse Proving Rings
(Analog & Digital Models)

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Table of Contents

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Introduction

Origin and Use

Morehouse Proving Rings are recognized as the premier force standard wherever highly accurate force calibrations are performed. This reputation has been earned by uncompromising conformance to the standards originally established and maintained by the United States National Institute of Standards & Technology.

Morehouse Proving Rings were originally developed to serve as a portable force Standard that could be accurately calibrated and then transported and used to measure forces applied by a testing machine. Today, Morehouse Proving Rings are used extensively by commercial industry, governments, and the military, not only for the calibration of testing machines, but as force standards for calibrating load cells, force transducers, dynamometers, load rings, force links, and other force measurement devices.

Morehouse manufactures different series of Proving Rings, which offer varying degrees of accuracy. The series Proving Ring needed is selected on the basis of the accuracy requirements of the calibrations to be performed. Most series are available as compression type or as dual mode; tension and compression type Proving Rings. Many Proving Rings are available with digital indicators.

Morehouse Digital Proving Ring with Indicator

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Nomenclature and Definition of Terms Used

1. **Ring Reading:** On analog Proving Rings the reading is the value indicated by the single index line pointer or vernier index. If the Proving Ring has only a single index line pointer, the reading is easily estimated to the nearest tenth of a division. If the Proving Ring is supplied with a vernier index, standard on series 50, 200, and 1000 Proving Rings, the reading is made to the nearest tenth of a division and estimated to the nearest twentieth of a division. The vernier index is engraved with either a "0" at each end of the scale or a "0" on the left and a "1" on the right. The vernier is read from left-to-right when the Proving Ring is loaded in compression and right to left when loaded in tension. The number of hundreds of division is obtained by observing the number of revolutions of the dial, or from the optional full-scale indicator, if one was ordered with the Proving Ring. Full-scale indicators are standard on series 1000 Proving Rings.

   On Digital Proving Rings the operator reads "counts" directly from the digital display. The operator is not required to manually move a dial and vibrate a reed.

2. **Deflection:** ASTM E74 provides two methods for determining deflection. For the first method the Proving Ring's deflection is the difference between the Proving Ring reading taken under load and the average Proving Ring reading for no load taken before and after each load or series of loads. For the second method deflection is the difference between the Proving Ring under load and the no load reading before each load or series of loads. For this method the no load reading after each load or series of loads is ignored.

3. **Temperature Correction:** The Proving Ring reading must be corrected for temperature when used at a temperature other than that which the calibration was performed. The temperature correction is the amount that must be added (or subtracted) to the Proving Ring reading. The temperature at which the Proving Ring was calibrated is shown on the calibration report provided for the Proving Ring.

Principle of Operation

As a force is applied to the Morehouse Proving Ring the deflection, or change of diameter of the ring, is measured by a precision micrometer and a vibrating reed mounted diametrically within the ring or a precision linear gauge and digital display.

The reed is set in motion on analog Proving Rings so that it vibrates in an arc and the dial of the micrometer is turned until it advances into the arc in which the reed is vibrating and slowly stops the vibration. At this point, a reading is taken. The sensitivity of the vibrating reed and micrometer is equivalent to 0.000005 of an inch.

On a Digital Proving Ring the operator reads "counts" directly from the digital display. The operator is not required to manually move a dial and vibrate a reed.

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Calibration

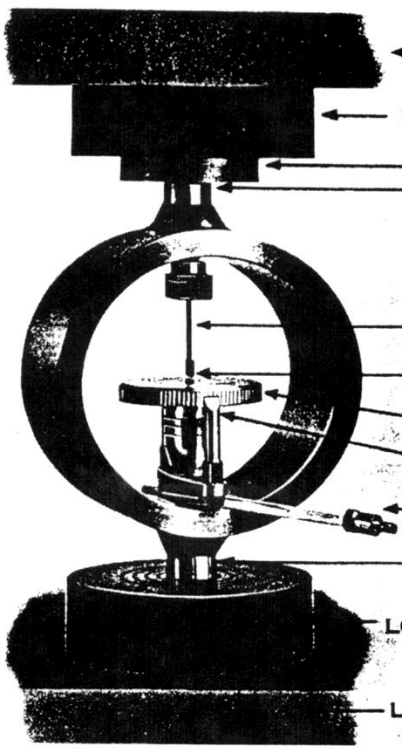
All Proving Rings are calibrated against known standards in accordance with the American Society for Testing & Materials (ASTM) specification E-74, either at the U.S. National Institute of Standards & Technology (NIST), or in our laboratory using standards calibrated by NIST.

At Morehouse Instrument Company's force calibration laboratory, the capability exists to calibrate up to 2,250,000 pounds-force (lbf), or the equivalent in kilograms (kgf) or Newtons (N), for Proving Rings and other types of force measuring instruments.

Whether calibrated by Morehouse, or directly by NIST, a calibration report is supplied. This report includes a "Certificate of Calibration" stating how the Proving Ring was calibrated, temperature at which the calibration was performed, list of the calibration forces applied, and the corresponding deflections and coefficients (constants) for the fitted calibration equation.

Instructions

These instructions are issued as a guide to the user of all types of Morehouse Proving Rings. They include many of the basic methods and ideas recommended by the United States National Institute of Standards & Technology, and the American Society for Testing & Materials specification entitled "Standard Practice of Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines".



Operation

Preparation for Use

Remove the Proving Ring from its case and place it near the position where it is to be used. Allow sufficient time for the Proving Ring to reach the temperature equilibrium that will prevail during its use. It is recommended Digital Proving Rings be powered up for at least 15 minutes prior to use. Where possible, a thermometer should be affixed to the Proving Ring with tape or putty to monitor the temperature of the Proving Ring. The thermometer should always be affixed near the bottom of the ring.

When it is not possible to affix the thermometer to the Proving Ring, monitor the temperature as close as possible to the Proving Ring. The thermometer should be protected so sudden changes in the ambient temperature at the place where the Proving Ring is being used do not affect the reading of the thermometer. This can be accomplished by protecting the bulb end of the thermometer from drafts that may be prevalent in the place the Proving Ring is being used.

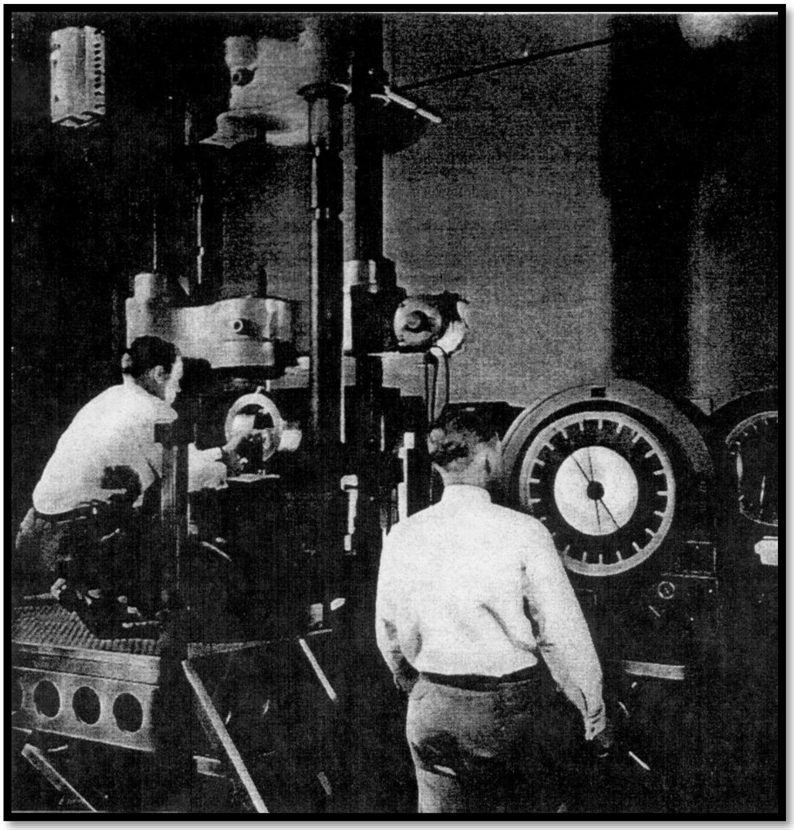


Figure 2-1: *Calibrating a material testing machine*

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Proving Ring Setup

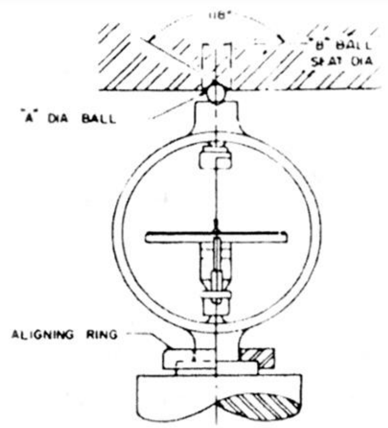

Figure 2-2:
Proving Ring setup in a Morehouse Universal Calibrating Machine.

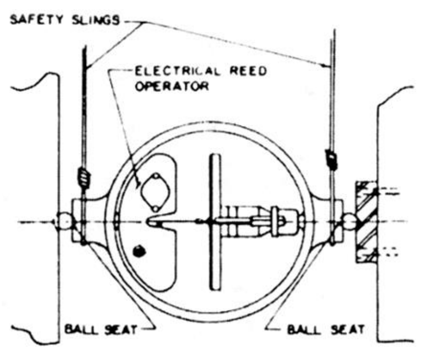

Figure 2-3:
Proving Ring in a horizontal setup.

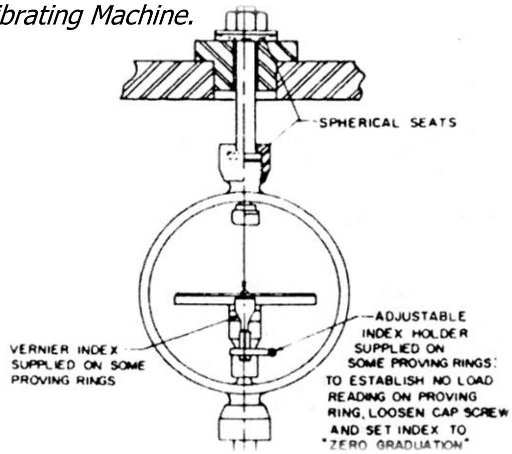

Figure 2-4:
Proving Ring setup for a tension calibration of a testing

Following are important safety precautions when making calibration setups:

1. Use a steel bearing plate of suitable diameter and thickness to reduce the bearing stress to a safe figure whenever the surface against which the Proving Ring is to bear is mild steel or some other mild material. Hardened steel bearing plates are available in various capacities from Morehouse Instrument Company. Write for details. **CAUTION: Proving Rings should never be loaded directly against cast iron or other brittle material.**

Setup (Continued)

2. While slight non-axial loading of a Proving Ring will not cause a serious error, Proving Rings should be loaded on their axis. A two-degree misalignment, which is readily observable with the naked eye, may cause an error approaching 1/10 of 1%. **CAUTION: Do not load between surfaces that exceed one-degree deviation from parallel.**

CAUTION:

Never load through two balls as shown in Figure 2-3 unless all load bearing components are restrained from lateral movement under load. Do not use this method for loads above 50,000 lbf.

3. Never load the spherical surface of the upper boss directly against a hardened bearing plate, or other hardened surface. A soft steel plate of the appropriate size and thickness to safely carry the load should be used for an upper boss pad. Soft steel plates for use as upper boss pads are available from Morehouse Instrument Company. Upper boss pads should be replaced as the old ones become deformed and work hardened. Write for details.

4. When using a ball for loading, be certain that the ball is the proper size to withstand the force to be applied, is made of hardened chrome alloy steel, and that the Proving Ring has a ball set. **CAUTION: Never use a carbide ball. Carbide is brittle and may shatter.**

Table 2-1
Hardened chrome alloy steel load ball capacities and ball seat sizes.

Capacity in lbf	Load Ball Diameter	Ball Seat Diameter
0 – 3,300	3/8″	11/32″
3,300 – 33,000	7/16″	3/8″
33,000 – 66,000	5/8″	½″
66,000 – 120,000	7/8″	¾″
120,000 – 220,000	1.5″	1″
220,000 – 330,000	1.75″	1.25″

5. When loading through a ball, the Proving Ring and the opposing surface should have a conical ball seat approximating the dimensions shown in Table 2-1. If the opposing surface does not have a ball seat a soft steel plate of the appropriate size and thickness may be used. Use of steel loading balls is not recommended above 300,000 lbf. Do not confuse the lathe center in the top and bottom of the external bosses with a ball seat. Ball seats are standard on Series 1000 Proving rings and are an option on all other Series Proving Rings. For added safety, it is recommended that a ball retainer clip as illustrated in Bulletin 271 be used when using a load ball. Write for details.

Electric Reed Vibrators

Many analog Proving Rings are supplied with electric reed vibrators. They are standard on Series 1000 Proving Rings and are an optional accessory on all other series Proving Rings. The electric reed vibrator is a self-powered unit that provides a regular and steady vibration of the vibrating reed in the Proving Ring. It helps the operator achieve greater accuracy through more consistent dampening of the Proving Ring's vibrating reed.

Electric reed vibrators attach easily to the upper internal boss of any series analog Proving Ring. If they were not ordered and installed when the Proving Ring was purchased, they can be added at any time. The electric reed vibrator can be installed without affecting the calibration of the Proving Ring. Since it is an accessory, and not an integral part of the Proving Ring, it can be removed leaving the Proving Ring completely operable and its calibration unaffected.

The instructions for manipulating the dial are the same as for an analog Proving Ring with a manually operated vibrating reed. Observing the dampening action as the contact button is advanced into the path of the vibrating reed, rather than listening for a change in sound can obtain the highest degree of accuracy. It is not recommended to stop the action of the vibrating reed before taking the reading.

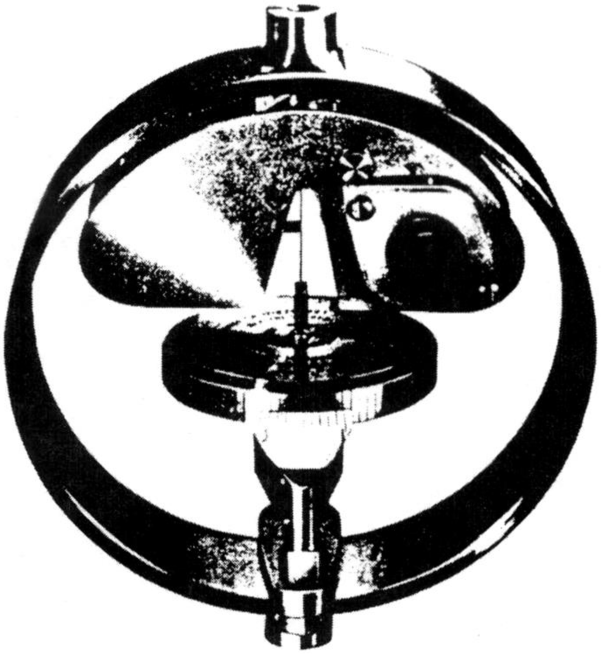

Figure 2-5: *Proving Ring with electric reed vibrator & vernier index*

Temperature Compensation

The Proving Ring reading must be corrected for temperature when it is used at a temperature other than which the calibration was performed. The temperature correction is the amount that must be added (or subtracted) to the Proving Ring reading. The temperature to which the Proving Ring was calibrated is shown on the calibration report provided for the Proving Ring. The temperature correction is obtained from the charts contained at the end of this manual, or from the following formulas:

When temperature is monitored on the Centigrade scale: $\mathbf{D_{23} = D_t - 0.00027\ (T - 23)\ D_t}$

When temperature is monitored on the Fahrenheit scale: $\mathbf{D_{73.4} = D_t - 0.00015\ (T - 73.4)\ D_t}$

Where:
$\mathbf{D_{23}}$= Deflection at a temperature of 23º C.
$\mathbf{D_{73.4}}$= Deflection at a temperature of 73.4º F.
$\mathbf{D_t}$= Deflection – Proving Ring reading in divisions
T = Temperature at which the Proving Ring is used.
This should be on the same scale to which the correction is being made.

Operating The Proving Ring

Before proceeding with an actual calibration, it is advisable for the inexperienced user to practice operating an analog Proving Ring. Following is the procedure for operating an analog Proving Ring with a manual-vibrating reed.

1. Rotate the dial counter clockwise (the edge nearest the operator moving to his right) until the contact button is almost touching the vibrating reed.
2. Using the rounded end of a pencil, set the reed in motion so that it vibrates in an arc about 1/2" long. Do not use the fingers to set the reed in motion as the warmth of the body expands the reed and makes the readings unreliable.
3. Continue to turn the dial with one hand until the contact button touches the arc in which the reed is vibrating and slightly checks or dampens out the oscillation. Make the setting such that the oscillation is dampened out in about two seconds.
4. Learn to recognize the sound of the reed at this setting so that the setting will always be made in the same way. Some people find that watching the tip of the reed and forming a mental picture of the dampening out process is easier than to remember the sound of the setting.
5. The deflection of the Proving Ring is the difference between the reading for the setting under no load and the reading under load. The tightness or looseness of the setting does not affect the results, provided it is done the same way both times

Detailed procedures for calibrating the various types of testing machines and other force measuring instruments are beyond the scope of this manual. In general, however, such calibration consists of applying a series of forces to the Proving Ring and the instrument being calibrated. The indicated force applied to the Proving Ring is compared with that of the instrument being calibrated. The difference between these readings is the error of the instrument being calibrated.

Following is a procedure for using an analog Proving Ring with a manually operated vibrating reed to perform a calibration of a material testing machine in compression. Regardless of whether a testing machine, load cell, hydraulic press, or other type of load measuring system is to be calibrated, the same general procedure would be followed.

Special instructions for calibrating and calculating the applied load when a tare load is encountered are treated in a separate section of this manual.

Make a calibration setup according to one of the previous illustrations in Figures 2-2 through 2-4. The Proving Ring, together with the accessories and adapters through which the forces are applied, take the place of the specimen in the testing machine.

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Proceed as follows:

1. Note the no load reading of the Proving Ring and turn the dial to a reading equal to the capacity load deflection plus the no load reading plus 8 to 10 extra divisions for a safety factor.
2. Carefully center the Proving Ring on the axis of the testing machine and apply a load equal to the capacity of the Proving Ring or the highest force to which it is to be used, whichever is lower. Apply the load slowly and watch the Proving Ring for any sign of contact between the vibrating reed and the micrometer contact. Be prepared to stop loading the Proving Ring, but do not change the setting of the dial. This precaution is necessary to prevent overloading the Proving Ring because of possible excessive error in the load indicator of the testing machine. After the Proving Ring has been preloaded remove the load from the Proving Ring. Repeat this step at least two times.
3. After preloading the Proving Ring as described in Step 2 above, record the no load reading of the Proving Ring. (On large capacity rings such as those with capacities of 200,000 lbf and higher, wait 30 to 60 seconds after removal of the load to equalize temperature effects before taking the no load reading.
4. Turn the dial to a reading equal to the no load reading plus the estimated deflection of the Proving Ring for the load to be calibrated. Always remember that the Proving Ring dial must be backed off (turned toward the left) before any compression load is applied.
5. Carefully apply the desired load. When nearing the desired load adjust the loading speed to the slowest possible rate at which the Proving Ring and testing machine will be loaded in a positive manner. This may require a little skillful manipulation depending upon the type of machine being used to control the load.
6. When this condition has been achieved and the testing machine indicator will pass the test load mark within the next five or ten seconds set the vibrating reed in motion and turn the dial to the right until a light contact is established. Now, reverse the dial direction and follow the slowly increasing load at the proper damping rate, keeping the reed in motion with the other hand.
7. When the testing machine indicator is exactly opposite the test load mark stop the loading and stop turning the Proving Ring dial so the setting is not disturbed. At the same time, allow the vibration of the reed to die out of its own accord. Do not worry about the fact that a slight increasing load will lightly jam the reed and contact button together. The Proving Ri0ng design is to be used in this way. However, never attempt to free the reed while it is jammed either by pushing it aside or by turning the dial. Always release the load first and then back off the dial. If this precaution is observed, a jam serious enough to cause the reed to buckle quite noticeably will not damage the Proving Ring.
8. Record the Proving Ring reading.
9. Release the load and return to zero or go back to Step 4 and proceed to the next force to be calibrated.
10. The difference between the applied force indicated by the Proving Ring and the indication of the testing machine is the error of the testing machine.

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Instructions for Tension Proving Rings

Tension Proving Rings are supplied with pulling rods with a spherical seated coupling at the connection with the ring, and a spherical seated washer and nut at the outer end. This combination is intended to provide as much versatility as possible for connection to testing machines, but some auxiliary fittings such as spacers and washers may be needed.

The spherical connectors will assist in aligning the Proving Ring when it is attached to the machine. Be sure to align the Proving Ring as accurately as possible before the load is applied, as no spherical bearing can be depended upon to adjust itself under load.

In reading the Proving Ring during use in tension, the red numbers are used. Frequently the no load reading is a negative number. In this case the no load reading will have to be added to the Proving Ring reading under load to obtain the deflection.

The vernier index is engraved with a zero at each end of the scale. Typically, the vernier is read from left-to-right when the Proving Ring is loaded in compression. However, when the Proving Ring is loaded in tension the vernier index is usually read from right to left.

It should be remembered that for tension loads the dial must be backed off before the load is removed, instead of before the application, as in compression calibration.

Quadratic Equation for Determining Applied Force

The following formula can be used to calculate the force applied to the Proving Ring. Before using this formula, the Proving Ring reading should be corrected for temperature, and the no load reading.

$$L = \frac{2 * (D - A)}{B + \sqrt{B^2 - 4C * (A - D)}}$$

Where:

L	=	Applied Force
A	=	A Coefficient from Calibration Report
B	=	B Coefficient from Calibration Report
C	=	C Coefficient from Calibration Report
D	=	Net Indication in Div. after subtracting average no load reading and correcting for temperature.

Tare Load Correction

Tare Load

Tare loads are a "pre-load" or force on the calibration standard that is not to be part of the force measured. Tare loads are normally encountered in calibrating load cells, or in precision weighing. Figures 4-1 and 4-2 illustrate the use of Proving Rings used to calibrate load cells in a Morehouse Universal Calibrating Machine. The tare load in these illustrations consists of the combined weight of the machine's moveable yoke, the load cell being calibrated, bearing plate(s), load ball(s), and adapter fittings.

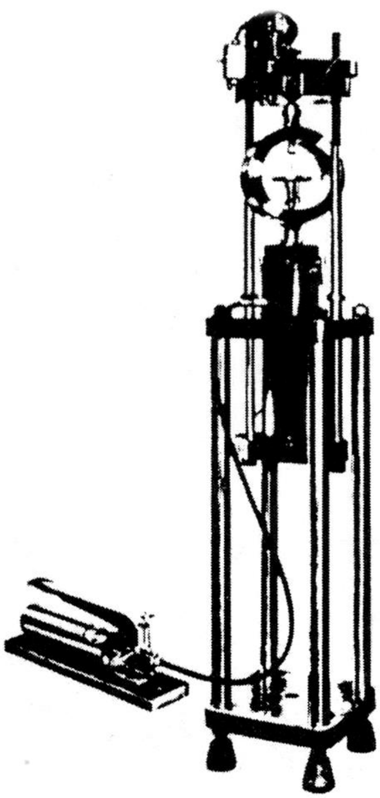

Figure 4-1: *Calibrating a load cell in compression, with a proving ring in a Morehouse Universal Calibrating Machine.*

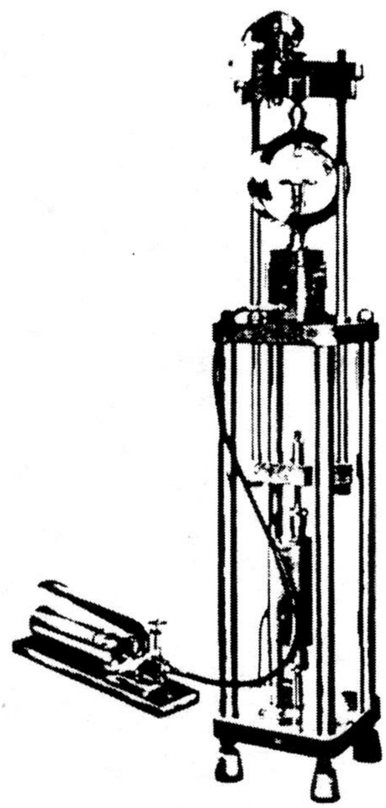

Figure 4-2: *Calibrating a load cell in tension, with a proving ring in a Morehouse Universal Calibrating Machine.*

The errors caused by not compensating for the tare load can be determined by treating the Proving Ring reading with the tare load applied as the no load reading, and then calculating the load applied to the system being calibrated accordingly. Comparing the results of this calculation with the results of a calculation made according to one of the methods described for correcting for tare loads will indicate the error.

In some types of calibration, the resulting error by not compensating for the tare load may be too small to justify the effort of compensating for it. Generally, if the tare load on the Proving Ring does not amount to more than 1% of the capacity of the Proving Ring, it is usually not necessary to calculate a correction. In these cases, the tare load reading may be treated as the no load reading.

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Tare Load Correction Factor & Formula

Method and formula to correct for tare loads:

1. Take and record a no load reading before application of the tare load.
2. Apply the tare load and calculate the weight of the tare load.
3. Apply the calibrating force and record the reading in divisions.
4. Subtract the tare load from the Proving Ring's reading, in divisions, for the force applied.
5. Any change in the tare load reading during calibration should be calculated as a change in the Proving Ring's no load reading, when determining the total force applied to the system being calibrated.
6. Calculate the tare load factor as follows: **TCF = (2C * L * T) - A**

   Where:

TCF	=	Tare Load Correction Factor
C	=	Coefficient from calibration report.
L	=	Applied force
T	=	Weight of Tare Load Computed in Step 2
A	=	'A' Coefficient from calibration report

7. Add or subtract the Tare Load Correction Factor (TCF), depending on the sign of the TCF, to the reading of the Proving Ring before computing the applied load.

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Maintenance

Care of The Proving Ring

A Proving Ring is made of high strength alloy steel. It is rugged and will retain the calibration under adverse conditions. The micrometer screw is the heart of the instrument and should be protected against any treatment that can damage the threads.

Never lift a Proving Ring by the screw, index posts, by the mounting for the vibrating reed, or the digital sensor. Sometimes a large Proving Ring must be handled in a rope sling; if this is necessary, make sure the sling does not bear against the micrometer screw, vibrating reed, or against any part of the internal bosses. Some large Proving Rings are provided with a thread tapped in the upper external boss. This allows an eye bolt to be used to handle the Proving Ring.

The steel ring will easily rust and should be wiped with an oily cloth after each handling. The dial and index posts are of rust resistant material. Should the ring become rusted, the rust may occasionally be carefully removed by hand with fine emery paper following the direction of the grinding marks on the ring.

The external bosses of the Proving Ring are carefully formed at the factory. The lower boss is flat and the upper boss is spherical with a radius equal to the height of the ring. In placing the Proving Ring on a metal surface, set it down carefully to avoid raising a burr or upsetting the metal of the boss. As noted in the paragraph on calibrating a testing machine, never load the upper boss directly against the compression head of the machine. Use a mild steel pad between the boss and machine head and replace the pad when it becomes deformed or work hardened.

Calibration

The calibration of the Proving Ring remains practically unchanged under normal service conditions. However, a severe overload will change the calibration. Every precaution should be taken to avoid such an accident. If an overload occurs, immediately note the zero load reading of the Proving Ring and compare it with the zero load readings taken before the overload. If the change in the zero load reading is 1 % or more of the deflection at the Proving Ring's capacity, the calibration may have been affected. In this case the Proving Ring should be returned to Morehouse Instrument Company for repair and recalibration.

The question of how frequently a Proving Ring should be recalibrated is difficult to answer. Most industrial and government specifications require the time interval between calibrations be established and maintained to assure accuracy and reliability. Reliability is defined as the probability that the Proving Ring will remain in tolerance throughout the established interval.

Proving Rings do not exhibit any appreciable change with time. The main causes of change are overloads and wear between the vibrating reed and the spherical tip of the micrometer screw. The latter cause is dependent on the amount of use the Proving Ring gets and on how tight a setting the operator habitually makes. In a plant where one person uses the Proving Ring under careful supervision only a few times a year, an interval of five or more years between calibrations may be satisfactory. On the other hand, where the Proving Ring is in daily service by a variety of personnel, calibrations should be performed more frequently. Errors due to wear between the vibrating reed and the spherical tip of the micrometer screw are eliminated on Digital Proving Rings.

All Proving Rings should be returned to Morehouse Instrument Company for inspection prior to calibration. Any repairs or alterations, which are not up to the standards maintained in our factory, may cause the Proving Ring to fail when used.

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Installation & Adjustment Instructions for Morehouse Electric Reed Vibrators

Use of Electric Reed Vibrators

Electric reed vibrators are standard on Series 1000 Proving Rings and are an optional accessory on all other series analog Proving Rings. The electric reed vibrator is a self-powered unit that provides a regular, steady vibration of the vibrating reed in the Proving Ring. It helps the operator achieve greater accuracy through more consistent dampening of the Proving Ring's vibrating reed.

Installation

An Electric reed vibrator attaches easily to the upper internal boss of any Proving Ring. If they were not ordered and installed when the Proving Ring was purchased, they can be installed at any time. The electric reed vibrator can be installed without affecting the calibration of the Proving Ring. Since it is an accessory, and not an integral part of the Proving Ring, it can be removed leaving the Proving Ring completely operable and its calibration unaffected. Following are instructions for the installation of electric reed vibrators:

1. Remove four rear cover plate screws and rear cover plate.
2. Refer to Figure 6-4, and notice the detail of the lock setscrew. The setscrew has a cone end which bears on the cone end of the brass lock pin. Turning the setscrew in forces the lock pin against the side of the reed holder. This action forces the electric reed vibrator square with and against the reed holder.
3. Remove the tape that keeps the brass lock pin from falling out of its socket. Care should be taken when removing the tape and during installation to prevent loss of the lock pin. Make sure that the cone end of the lock setscrew will bear on a portion of the cone on the brass lock pin. The lock pin must be able to slide forward freely when the lock setscrew is turned in. The lock pin must not extend too far past the flat part of the vibrator clamp plate or it will not clear the sides of the reed holder when the vibrator is slid into position.
4. With the switch of the electric reed vibrator facing the index that will be used in reading the Proving Ring, slide the front plate assembly over the reed holder. The protruding convex screw heads on the reed holder must be aligned with the grooves on the inside of the vibrator. Push the vibrating reed to the side so the armature stem will slide past it.
5. Attach the rear cover plate to the vibrator by replacing the four screws that were previously removed. Tighten the screws and then loosen them 1/2 turn.
6. Gently hold the electric reed vibrator so the inside of the front cover bears against the front of the reed holder, and the top of the groove in the front vibrator plate is resting on the convex protrusions from the reed holder. While holding the vibrator in this position tighten the lock setscrew by inserting the Allen wrench through the access hole in the rear cover plate. As the screw is tightened, a slight shifting of the vibrator will be noticed as it is squared with and brought against the opposite side of the reed holder.
7. Tighten the four rear cover plate screws. Inspect the vibrator assembly to make sure the vibrating reed is not being pushed off center by the armature stem and that the adjusting screw can be advanced as described in step 3 of the adjustment instructions. If the vibrating reed is being pushed off center refer to step 4 of the adjustment instructions.

Adjustments

The electric reed vibrator has been adjusted at the factory prior to shipping. The electric contacts have been adjusted to have a clearance of about .005", when the armature is tight against the end of the coils. The armature stem has also been adjusted to the proper length.

It may be necessary to periodically adjust the electric reed vibrator. A socket set screw wrench and small open-end wrench of the proper size are provided. If the electric reed vibrator fails to start on its own when turned on, the armature stem should be adjusted as follows:

1. Turn switch on (up position)
2. Insert a pin or straightened paper clip through the hole in the armature stem. This prevents it from turning while advancing (counter clockwise) the hex head screw in the end of the stem. Use the small open-end wrench provided and turns the hex head screw counter clockwise. This will advance it toward the vibrating reed.
3. The hex head screw should be advanced about l/8 turn at a time until the vibrator starts to operate.
4. If the vibrating reed is pushed slightly off center (about 1/16") by the electric reed vibrator, the hex head screw has been advanced too far. The hex head screw should then be turned in the opposite direction.
5. Once the vibrator starts to work, turn the switch off, and then on again to make sure it will start each time the switch is turned on. Continue to make minor adjustments until it starts when the switch is turned on.
6. In some cases, particularly in the smaller capacity Proving rings, it is impossible to back off the armature stem hex head screw enough to permit the electric reed vibrator to start. This is usually caused by an improper clamping action of the brass lock pin that causes the vibrator to shift out of alignment. This condition is readily noticed by observing the alignment of the front cover plate or the rear cover plate with the inside diameter of the Proving Ring (see Figure 6-1).
7. If the condition described above is experienced, loosen the rear cover plate screws 1 full turn and loosen the lock set screw 3/4 to 1 full turn. Then, shift the electric reed vibrator until the cover plate is brought into alignment with the inside diameter of the Proving Ring, (see Figure 6-2). Alignment according to your sight is good enough. While holding the electric reed vibrator in alignment, tighten the rear cover plate screws. This should give a clamping action on the reed holder. If there is no clamping action refer to step 8.
8. If no clamping action, as described in step 7 is experienced, place a shim on the end of the reed holder where the rear cover plate will bear (see Figure 6-3). We normally use 1, 2, or 3 thicknesses of ordinary masking tape. If more than two thicknesses are required, the additional thicknesses should be divided evenly between the front and rear of the reed holder.
9. After the proper clamping action is obtained, tighten the lock set screw. Now the armature stem adjustment can be made.

Varying degrees of vibrating reed amplitude can be obtained by using different adjustments on the hex head armature stem adjusting screw and the contact adjusting screw. For maximum amplitude, advance the armature stem adjusting screw as far as possible while still allowing the electric reed vibrator to continue to operate. Then vary the contact adjusting screw until maximum amplitude is observed. The contact adjusting screw is extremely sensitive. Do not turn the screw more than about 1/10 of a turn at a time. It is suggested that these adjustments be made while the electric reed vibrator is turned on.

Battery Replacement

The battery is replaced by removing the two battery case screws on the front cover plate. Use a C size battery (alkaline) or equivalent.

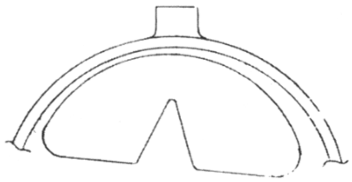

Figure 6-1:
Misalignment of cover plate of electric reed vibrator with inside diameter of proving ring

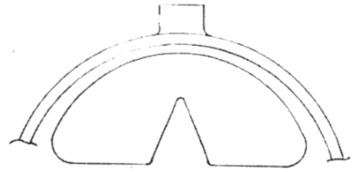

Figure 6-2:
Cover plate of electric reed vibrator in alignment with inside diameter of proving ring

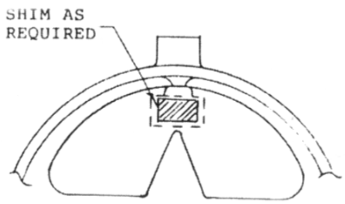

Figure 6-3:
Placement of shim(s) for proper clamping action between cover plates of electric reed vibrator and reed holder.

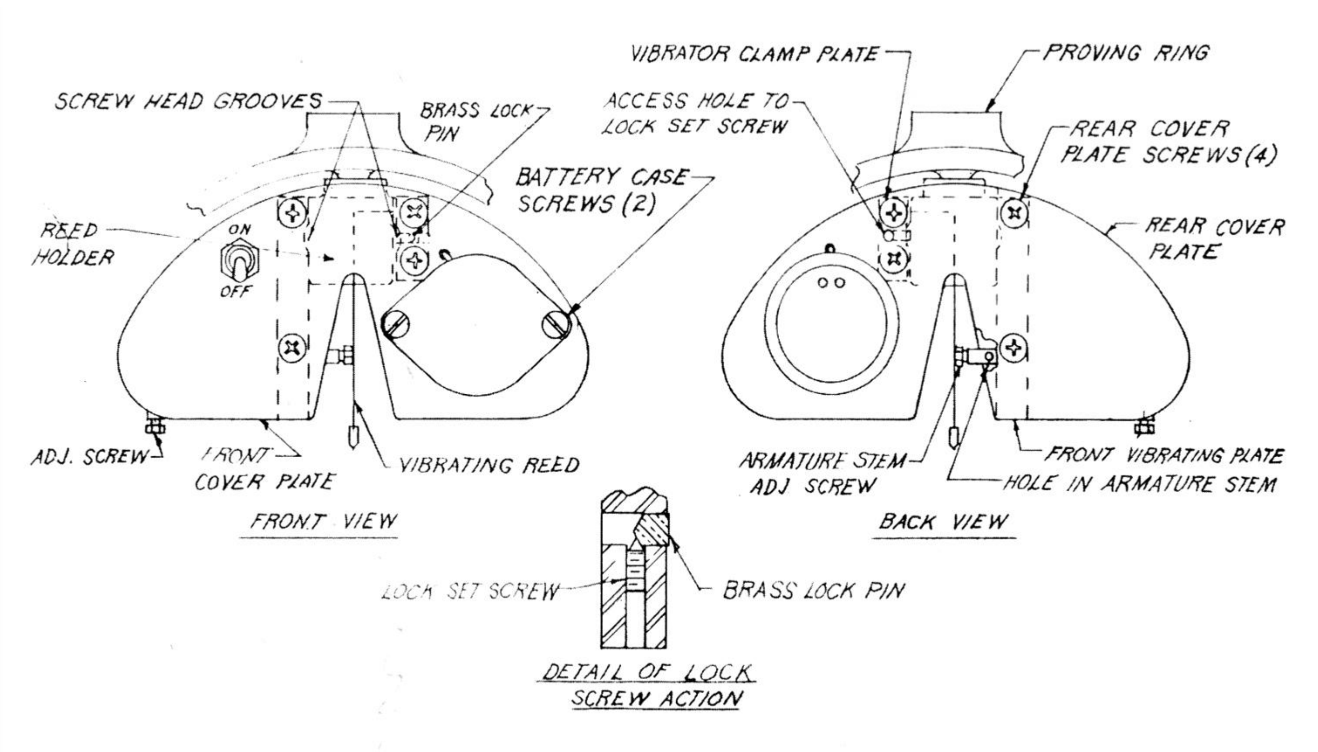

Figure 6-4: *Detail of electric reed vibrator.*

Installation & Use Instructions for Full-Scale Indicator

Use of Full-Scale Indicator

Full-Scale Indicators are standard on Series 1000 Proving Rings, and are an optional accessory on all other analog Proving Rings with a 200-division dial. The full-scale indicator eliminates the necessity of counting the number of revolutions that are made with the Proving Ring dial.

Because of the peculiarities of dial indicators in general, and because it is impossible to manufacture the entire assembly to track the lead of the micrometer screw exactly, full-scale indicators should be relied upon to count the next lowest 100 divisions only as determined by the micrometer dial. This is particularly true when the micrometer dial reading is close to "100" or "0". For example:

1. When the micrometer dial reads 198 and the full-scale indicator reads slightly under 8 (800), read this as 798.

2. When the micrometer dial reads 2 and the full-scale indicator reads slightly more than 8 (800), read this as 802.

Installation

Full-scale indicators attach easily under the dial of any Proving Ring with a 100-division dial. If they were not ordered and installed when the Proving Ring was purchased, they can be installed anytime. The full-scale indicator can be installed without affecting the calibration of the Proving Ring. Since it is an accessory, and not an integral part of the Proving ring, it may be removed leaving the Proving ring completely operable and its calibration unaffected. Following are the instructions for the installation of full-scale indicators:

1. Set the Proving Ring to read 2 or 3 full revolutions away from the actual zero load condition. This is necessary to prevent the micrometer anvil from being accidentally forced into the tip of the reed while the full-scale indicator is being installed.

2. Normally, it is not necessary to remove the vernier (or pointer) to install the full-scale indicator. Tip the full-scale indicator so that the spring-loaded stem is pointed in your direction. Hold it in this position and insert it under the dial. With the spring loaded stem against the wide groove on the bottom of the dial, push up, causing the stem to be depressed. Then bring the full-scale indicator into an upright position with the front tapered portion of the adjustable bridge on the Proving Ring in the T-slot of the full-scale indicator.

3. Depress the spring loaded stem and push the full scale indicator toward the micrometer of the Proving Ring so that its stem bears on the bottom of the dial about 1/8" to 1/4" in from the edge of the wide groove on the dial. The only thing of importance in the positioning of the full-scale indicator is to be certain that there is some clearance between its back and the micrometer assembly. This prevents interference when the micrometer is turned.

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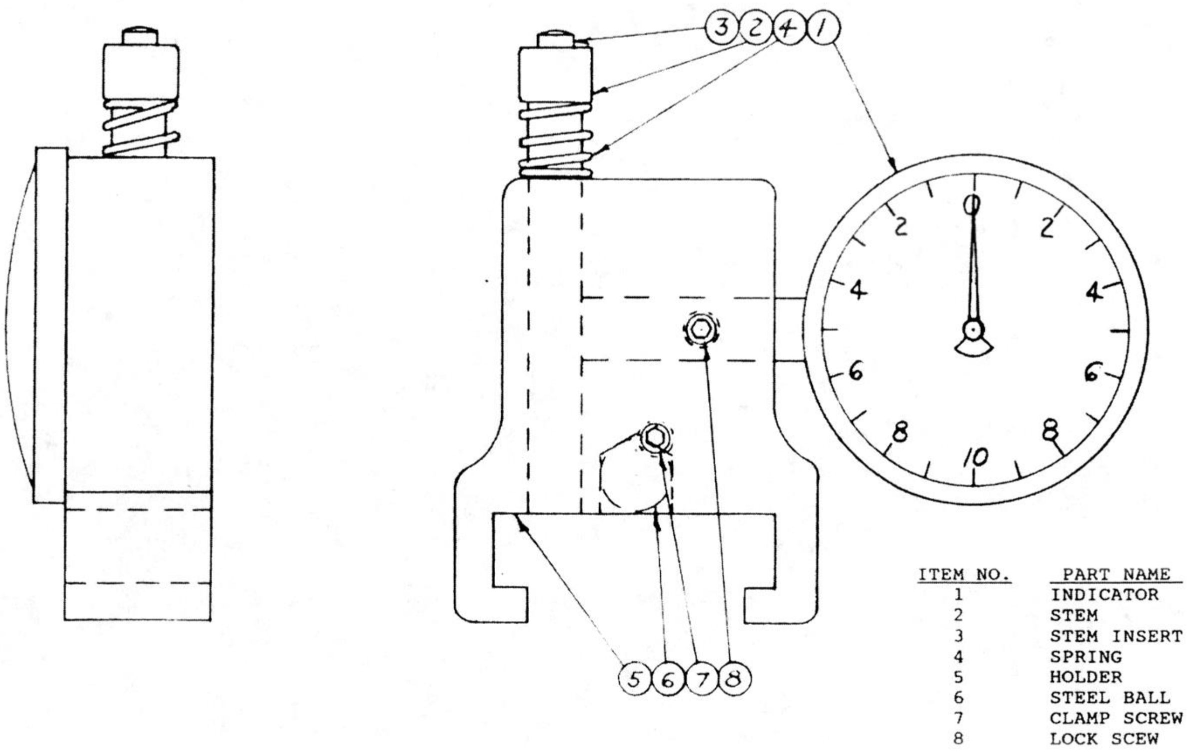
4. Looking at the full-scale indicator from the front of the Proving Ring, center it on the adjustable bridge and then tighten the clamp screw, item 7, Figure 7-1.

5. Set the bezel of the indicator so that the "0" is in the twelve o'clock position. Loosen the lock screw, item 8, Figure 7-1, to free the indicator. Set the Proving Ring dial to the actual zero load condition and position the indicator so that the indicator hand has made at least 1 full revolution and re-tighten the lock screw. While setting the indicator, keep moderate pressure on it with the lock screw. It is not necessary to position the indicator so that the hand reads exactly zero. The bezel of the indicator may be rotated for the exact zero setting.

Maintenance

The operation of the full-scale indicator should occasionally be checked because foreign matter in the assembly may cause erroneous readings. To check, simply observe the revolutions of the dial and compare them with the reading of the indicator. As a person becomes familiar with the use of the full-scale indicator, any malfunction will be immediately discernible.

Figure 7-1: *Full-scale indicator assembly*



Instructions for Replacing Vibrating Reed

Vibrating Reed Repair Kit

Periodically the vibrating reed of the analog Proving Ring may require replacement because of damage or excessive wear. The vibrating reed repair kit contains parts and tools to replace the reed. When ordering a vibrating reed repair kit or replacement for a vibrating reed the serial number of the Proving Ring it is to be used with must be specified.

Replacing The Vibrating Reed

Following are the instructions for replacing the vibrating reed in a Proving Ring. All numbers and letters referenced are identified in Figure 8-1 below.

1. Remove the 2 nuts (1) with wrench (A).

2. Remove the vibrator holder cap (2) from the vibrator holder (3) by placing push screw (B) in center hole of vibrator holder and tighten with back of wrench (A) until vibrator cap is pushed free of holder. Do not attempt to remove screws (4) from vibrator cap. They are held in place by a press fit.

3. Remove the remaining part of the vibrating reed (5) and brass escutcheon pins (6) with a small screwdriver by prying. If the heads of the brass pins are sheared off when removing the damaged reed, grasp them with a pair of long nosed pliers to pull them out.

4. The new vibrating reed (C) that has been supplied with this repair kit has been cut to the length required for the Proving Ring with which it is to be used. Vibrating reeds are not interchangeable. A vibrating reed provided for use with one Proving Ring cannot be used with another.

5. On old Proving Rings, the distance between the two punched holes (C-X) may vary. It will be necessary to elongate one or both of the holes to allow for the variation.

6. Depending on how old the Proving Ring is, the vibrating reed may be larger in width than the rectangular recess in the vibrating reed holder cap (4). If this condition exists, file one side of the new reed so that it will enter the recess with a light push fit. Use a fine stone to remove any sharp edges that may remain on the side of the vibrating reed after it has been filed to fit.

7. Place the new reed into the cap. Be sure that the sides of the reed are as parallel as possible to the sides of the rectangular recess.

8. Insert the brass escutcheon pins (D) and set with the pin punch (E).

9. Replace the cap on the vibrator holder and tighten the nuts uniformly with the thumb (A) until the cap is properly seated on the holder. "Finger tight" is the term we use to describe how tight the nuts should be.

10. The vibrator cap is fit to the holder by a light 3-way press fit. This means, the two screws protruding from the cap fit the holder by a press fit and the rectangular recess on the cap fits the rectangular seat on the holder by a press fit. Do not change this condition to make the cap fit the holder easier. If the nuts cannot be tightened properly realign the cap on the holder.

11. Turn the micrometer dial (7) away from the vibrating reed (5) to allow space for placement of the lapping plate on the micrometer dial. The lapping plate has a round recess for the anvil of the micrometer dial (8). Be sure the bottom of the lapping plate is perfectly parallel to the face of the dial. Place the lapping plate in position carefully so the anvil of the micrometer is not damaged.

12. Place some lapping compound, supplied with the repair kit, on the lapping plate and advance the micrometer until the vibrating reed comes into contact with the lapping plate. Begin the lapping operation by moving the vibrating reed back and forth in an arc approximately 1/2" long across the face of the lapping plate. As metal is removed from the end of the vibrating reed continue to keep light pressure against it by advancing the micrometer.

13. Continue the lapping operation until a flat of approximately 1/64" appears on the vibrating reed. Sometimes it is possible to regain the approximate old zero load reading by checking it periodically during the lapping process. This may be difficult because each 1/10 division on the dial represents approximately 0.00001 linear inch.

14. When the lapping operation has been completed be sure there is no compound remaining on the vibrating reed.

Figure 8-1:
Parts and tools contained in vibrating reed repair.

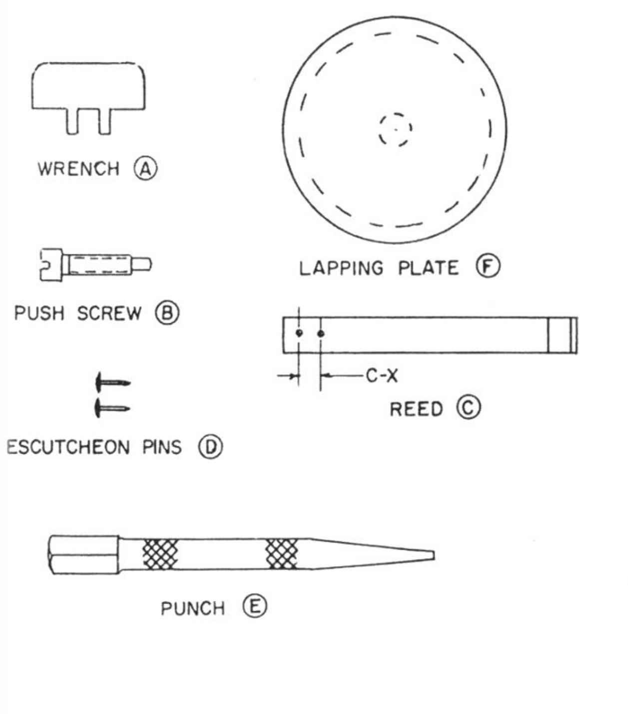
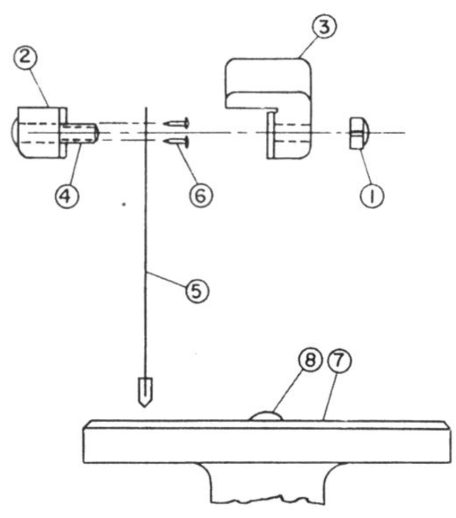


Figure 8-2:
Assembly drawing for vibrating reed.



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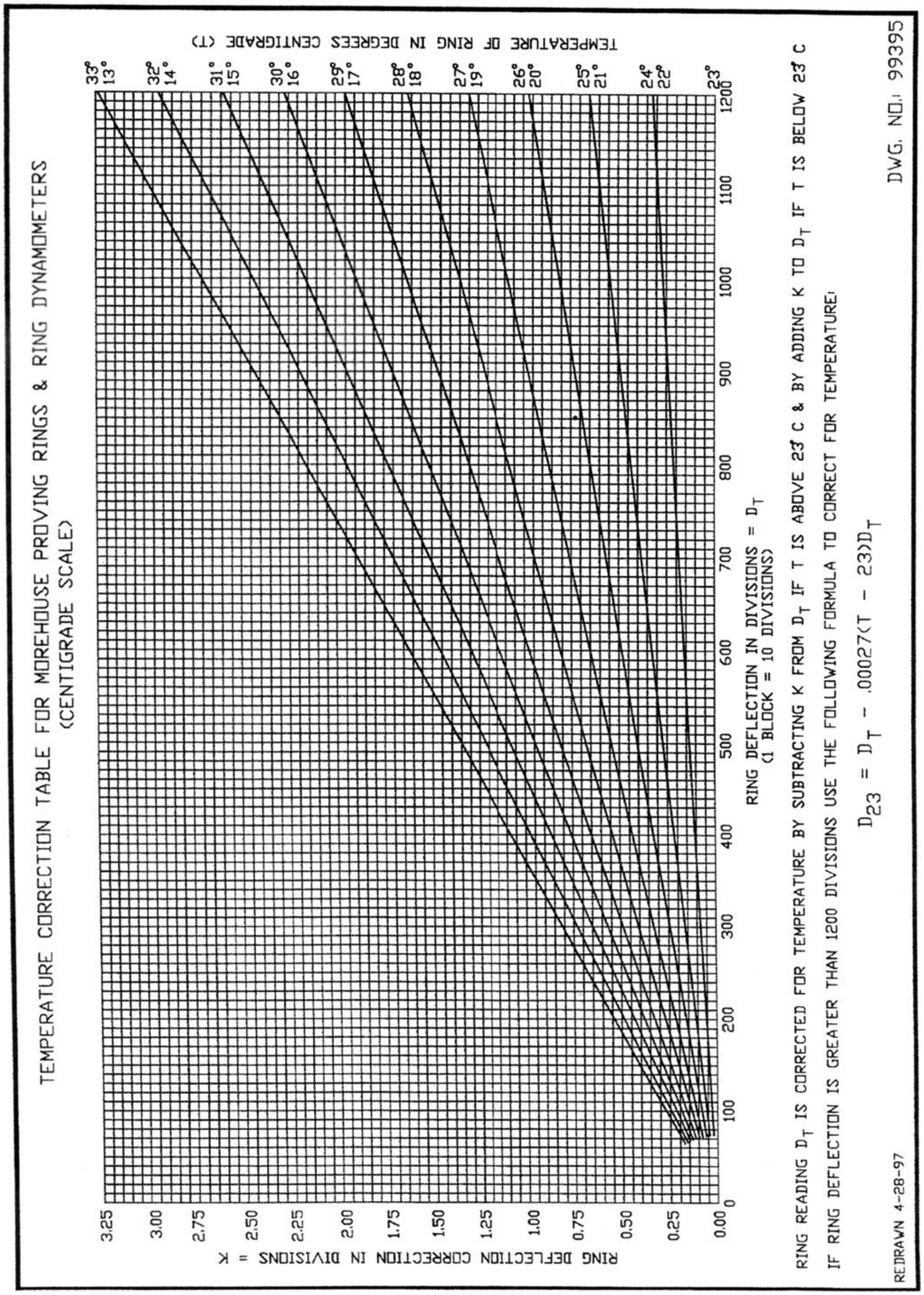
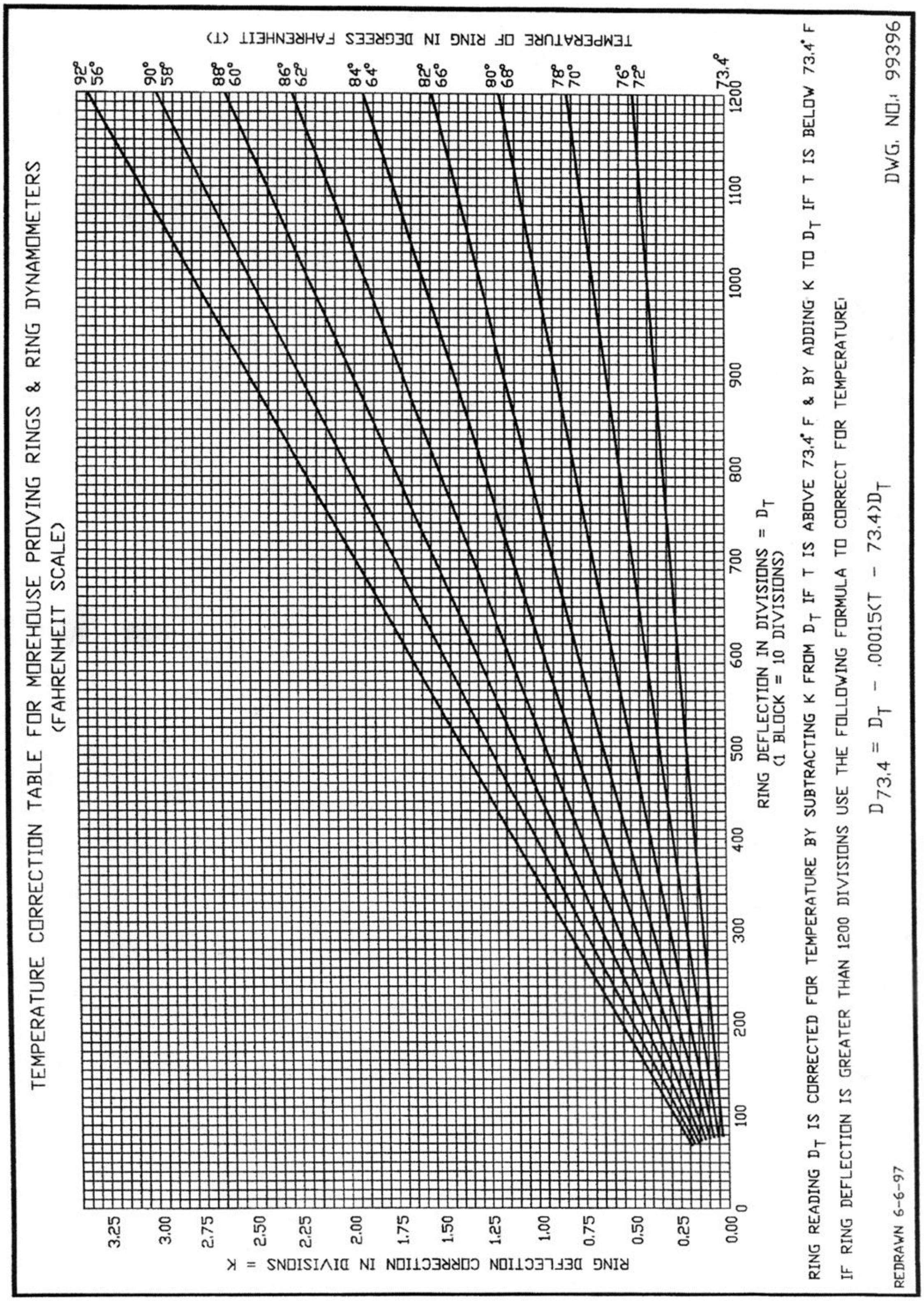

TEMPERATURE CORRECTION TABLE FOR MOREHOUSE PROVING RINGS & RING DYNAMOMETERS
(CENTIGRADE SCALE)
TEMPERATURE OF RING IN DEGREES CENTIGRADE (T)
33° 13°
32° 14°
31° 15°
30° 16°
29° 17°
28° 18°
27° 19°
26° 20°
25° 21°
24° 22°
23°
RING DEFLECTION IN DIVISIONS = D_T
(1 BLOCK = 10 DIVISIONS)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
RING DEFLECTION CORRECTION IN DIVISIONS = K
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
RING READING D_T IS CORRECTED FOR TEMPERATURE BY SUBTRACTING K FROM D_T IF T IS ABOVE 23° C & BY ADDING K TO D_T IF T IS BELOW 23° C
IF RING DEFLECTION IS GREATER THAN 1200 DIVISIONS USE THE FOLLOWING FORMULA TO CORRECT FOR TEMPERATURE:
D_23 = D_T - .00027(T - 23)D_T
DWG. NO.: 99395
REDRAWN 4-28-97



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