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Morehouse
THE FORCE IN CALIBRATION SINCE 1925

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Operation and Instruction Manual

Universal Calibrating Machine (UCM)

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1. Introduction

1.1 Origin and Use

Morehouse Universal Calibrating Machines were originally developed to make use of the inherent high accuracy of Morehouse Proving Rings to calibrate working load cells. Today, calibrating machines are used extensively in industrial, government, and military laboratories not only for the calibration of load cells, but for calibrating force transducers, dynamometers, load rings, force links, and other force measurement devices.

1.2 Functional Operation

The Morehouse Universal Calibrating Machine is a device for simultaneously applying a force to a high accuracy calibration reference standard, and the device to be calibrated (unit under test). The force is produced by a hydraulic jack activated by a manually operated pump, specially designed to perform precise and accurate calibration work. The calibrating machine is used to calibrate compression type and tension type instruments. The calibration reference standard is always loaded in compression, even when calibrating an instrument in tension.

Figure 1: Morehouse Universal Calibrating Machine 1,000,000 lbf Capacity

1.3 Design

The design of the machine has one purpose, ultimate accuracy. The force produced by the calibrating machine is transferred directly to the unit under test without any machine loss or mechanical interference. Friction between the reference standard and the unit under test has been eliminated. This is essential because even slight friction, which is inherent in other types of calibrating machines, frequently results in gross inaccuracies. Non-axial loading, another factor contributing to inaccurate calibration, is also eliminated by the design of the machine and its accessories.

1.4 Reference Standard

While a reference standard, such as a load cell, is essential to the function of calibration, it is not supplied as part of the Universal Calibrating Machine. Only compression reference standards need to be purchased for use with the machine because whether performing a tension or compression calibration, the reference standard is always loaded in compression. Since compression reference standards are less expensive than dual mode tension and compression type standards, the cost of reference standards for use with a Morehouse Universal Calibrating Machines is less than for other types of machines.

Figure 2: Morehouse Ultra-Precision Load Cell

1.5 Overview

This manual contains instructions for the installation, operation, service, and routine maintenance of all Morehouse Universal Calibrating Machines, regardless of capacity. If there are any questions about the use or maintenance of the calibrating machine, please contact us.

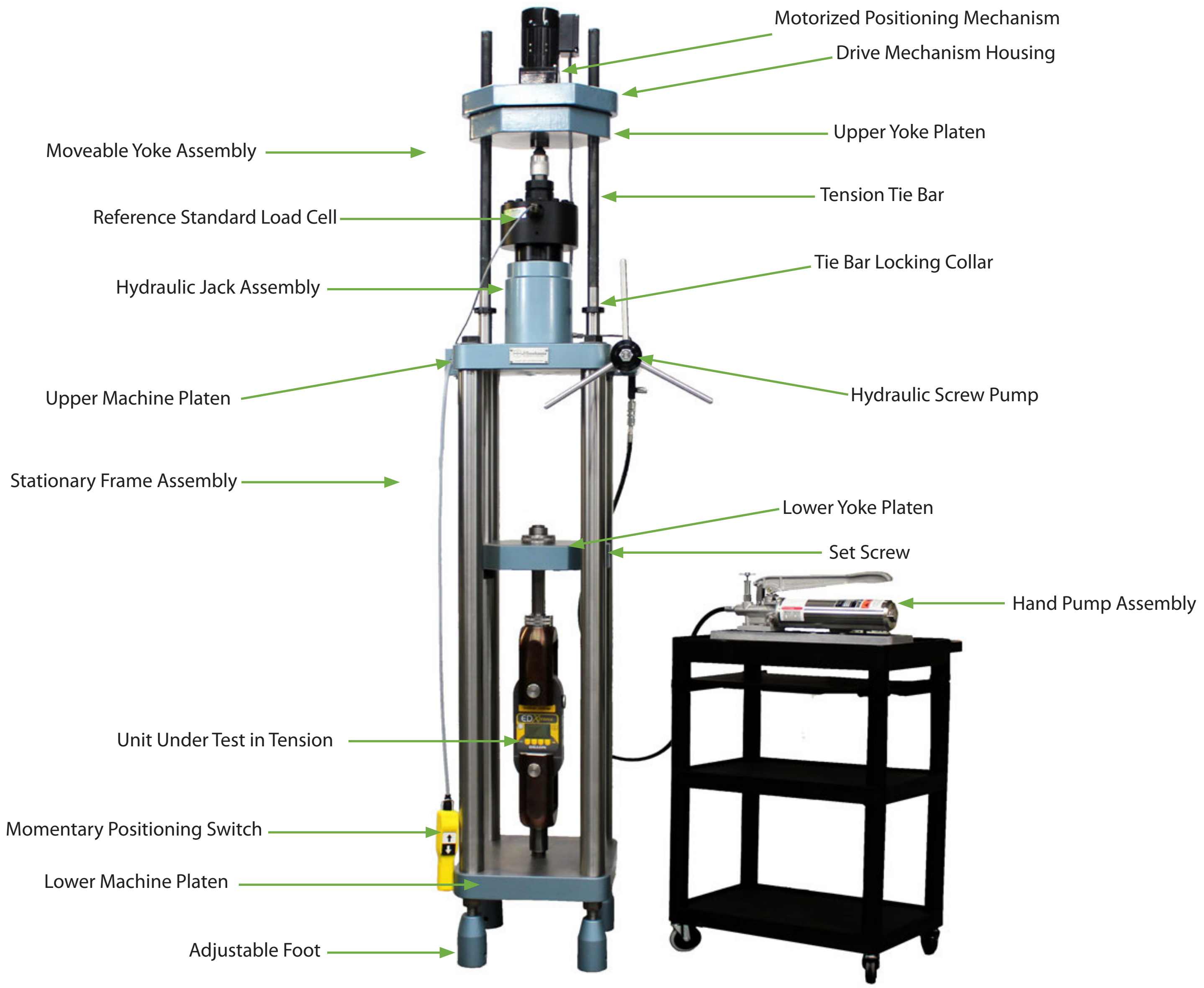


Figure 3: Morehouse Universal Calibrating Machine 100,000 lbf (500 kN) Capacity (with motorized adjustable yoke platen)

2. Description

2.1 General

The Morehouse Universal Calibrating Machine is comprised of three principal assemblies, which are described in this section:
1- Loading Frame
2- Hydraulic Jack
3- Loading Power Supply

2.2 Construction

Overall construction of the calibrating machine is illustrated by the outline drawing shown in Figure 4. Dimensions are indicated for the various standard capacity machines in Table 1 and 2.

Technical Specifications

Capacity required (lbf)	Model designation[1]	Max capacity	A	L Max[2]	L Min[2]	M Max[2]	M Min[2]	Size
10,000	UCM-11xy-01	11,500	TBD	TBD	TBD	TBD	TBD	Standard
10,000	UCM-11xy-02	11,500	48.0	13.5	2.0	12.5	1.5	Compact
30,000	UCM-30xy-01	30,000	96.0	22.0	3.0	43.5	24.5	Standard
30,000	UCM-30xy-02	30,000	75.0	22.0	3.0	22.5	3.0	Compact
60,000	UCM-60xy-01	60,000	105.0	22.5	3.0	46.0	26.5	Standard
60,000	UCM-60xy-02	60,000	81.0	23.5	3.0	22.5	2.0	Compact
100,000	UCM-112xy-01	112,500	112.5	24.0	3.0	46.5	25.5	Standard
100,000	UCM-112xy-02	112,500	92.0	24.5	3.0	26.5	5.0	Compact
200,000	UCM-225xy-01	225,000	120.0	28.5	7.0	36.5	14.5	Standard
300,000	UCM-338xy-01	338,000	132.0	29.5	8.0	41.5	19.5	Standard
500,000	UCM-675xy-01	675,000	158.0	34.5	10.0	50.5	26.0	Standard
600,000	UCM-675xy-01	675,000	158.0	34.5	10.0	50.5	26.0	Standard
1,000,000	UCM-1125xy-01	1,125,000	192.5	40.0	11.0	54.0	25.0	Standard

Table 1: UCM lbf Dimensions (inches)

Capacity required (kN)	Model designation[1]	Max capacity	A	L Max[2]	L Min[2]	M Max[2]	M Min[2]	Size
50	UCM-11xy-01	50	TBD	TBD	TBD	TBD	TBD	Standard
50	UCM-11xy-02	50	1 220	340	50	320	30	Compact
100	UCM-30xy-01	133	2 440	570	80	1 110	620	Standard
100	UCM-30xy-02	133	1 900	570	80	570	80	Compact
250	UCM-60xy-01	266	2 670	580	80	1 160	670	Standard
250	UCM-60xy-02	266	2 060	600	80	570	50	Compact
500	UCM-112xy-01	500	2 860	610	80	1 180	650	Standard
500	UCM-112xy-02	500	2 340	620	80	670	130	Compact
1 000	UCM-225xy-01	1 000	3 040	720	170	920	370	Standard
1 500	UCM-338xy-01	1 500	3 360	750	200	1 050	500	Standard
3 000	UCM-675xy-01	3 000	4 010	880	260	1 280	660	Standard
5 000	UCM-1125xy-01	5 000	4 870	1 020	280	1 370	630	Standard

Table 2: UCM kN Dimensions (mm)

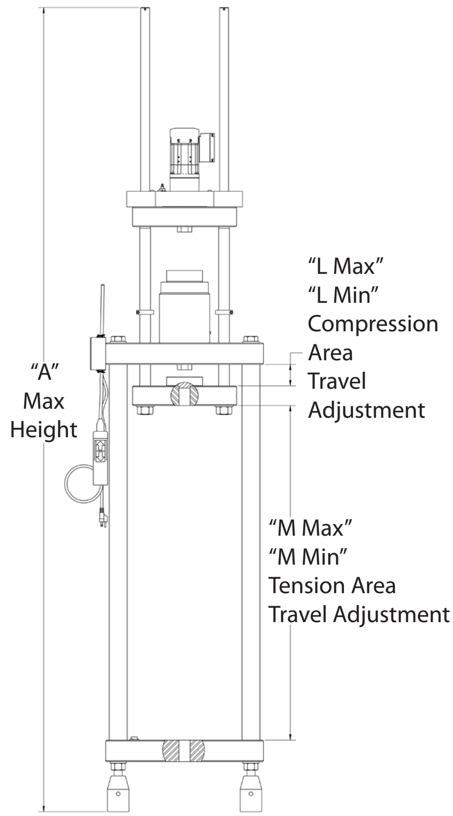


Figure 4: UCM Dimensions

[1] Model designations xy are defined as:

- x = M for manual or A for automated
- y = D for domestic or E for export

[2] Referenced dimensions are configured with the use of Morehouse load cells as the standards.

The Universal Calibrating Machine consists primarily of two load bearing frames:

Moveable Yoke Assembly

Two tension tie bars connect the upper and lower yoke platens. The lower yoke platen is permanently fixed in position by means of the set screws and tension collar nuts. An aperture in the center of the lower yoke platen provides for insertion of either an alignment adapter or a tension member (pulling rod). When positioning the moveable yoke assembly, the tie bar locking collars are used to support it on the upper machine platen. The upper yoke is adjustable to accommodate various calibration configurations, and to minimize necessary jack travel. A motorized positioning mechanism for the upper yoke is standard on all capacity Universal Calibrating Machines.

Stationary Frame Assembly

The stationary frame assembly consists chiefly of two platens connected by tie bars. Adjustable feet, together with a circular level mounted on the lower machine platen, provide the means for leveling the machine. Construction of the stationary frame assembly assures an extremely rigid support with negligible machine deflection, even at capacity load.

2.3 Hydraulic Jack Assembly

The Morehouse hydraulic jack assembly (Figure 5) is specially designed and constructed to be suitable to perform precise calibration work. The jack is attached to the top of the upper machine platen to maintain the vertical axis of the jack precisely in line with that of the calibration standard and test instrument. Ram travel of this jack is 1” (25.4 mm) maximum. Hydraulic pressure at capacity load is approximately 4,500 psi (31 026 kPa).

2.4 Loading Power Supply

A hydraulic power system is required to supply, maintain, and adjust the hydraulic fluid pressure in a UCM hydraulic jack in order to provide various calibration loads. Morehouse provides three optional hydraulic power systems for all UCM models based on the needs and conditions provided by the user:
1- Hydraulic Hand Pump
2- Universal Hydraulic Pump (UHP)
3- Auxiliary Hydraulic Screw Pump

Hydraulic Hand Pump

The basic and low-cost system to provide hydraulic pressure for a UCM is a Morehouse hand pump (Figure 5). When this system is purchased with a UCM, the hydraulic jack is activated by a hand pump assembly that advances the ram quickly, then more slowly until the desired load is achieved. The high/low operation is switched manually, and can be switched at any desired load. The pump is connected to the hydraulic jack by means of a hydraulic hose assembly with a quick-disconnect coupling.

Caution: Before use, check the hose and fittings for any potential leaks.

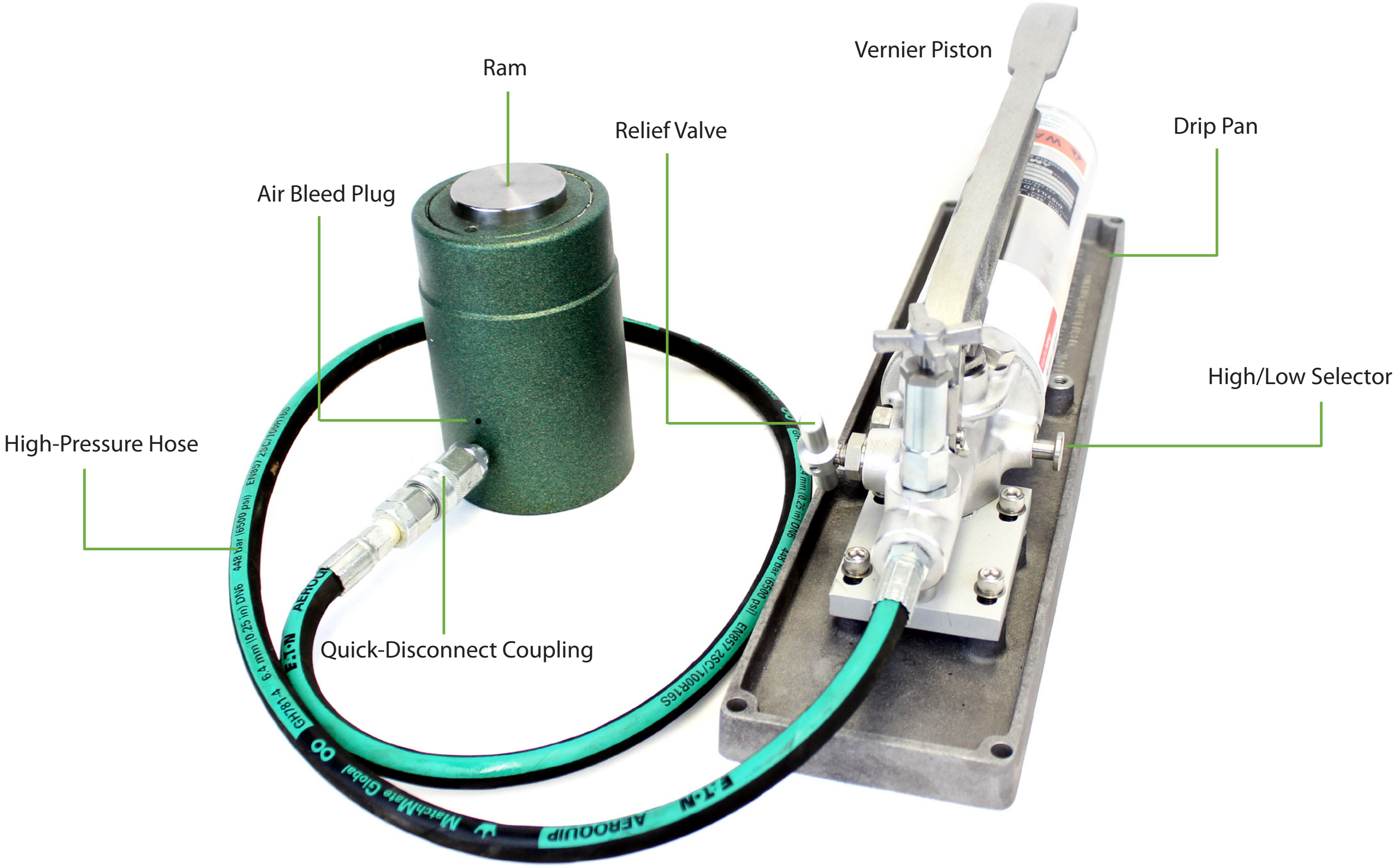


Figure 5: Hydraulic Hand Pump Assembly Connected to Jack Assembly

Universal Hydraulic Pump (UHP)

The Morehouse Universal Hydraulic Pump (UHP) is comprised of an electric motor driven pump that eliminates the effort required to operate the hand pump. It is available for use with calibrating machines of capacities 60,000 lbf (250 kN) and higher. The hydraulic fluid flow for UHP units is adjusted by Morehouse based on the capacity and size of the machine. The operator uses the momentary switch in front of the unit to activate the electric motor and run the hydraulic pump. Universal Hydraulic Pump (UHP) is connected to the hydraulic jack through a hydraulic hose assembly.

Caution: Before use, check the hose and fittings for any potential leaks.

Figure 6: Morehouse Universal Hydraulic Pump

Auxiliary Hydraulic Screw Pump

The Morehouse Auxiliary Hydraulic Screw Pump is a manual hydraulic power system that is specifically designed to adjust and maintain the calibration force in a UCM at very fine level. This optional add-on gives the operator exceptional control over the calibration force and enables accurate calibration at any desired force. The Auxiliary Hydraulic Screw Pump can be installed on the UCM frame directly, or mounted on the body of the Universal Hydraulic Pump unit for easier handling. Figure 7 shows the Auxiliary Hydraulic Screw Pump mounted on both the UCM frame and UHP unit.

(a)

(b)

Figure 7: Auxiliary Hydraulic Screw Pump Mounted on: a) UCM Frame; b) Universal Hydraulic Pump

3. Preparation for Use

3.1 Unpacking

Go to https://bit.ly/3pzWeAW and watch a video on how to unpack the machine.

Each Universal Calibrating Machine is assembled and tested at the factory prior to shipment. The calibrating machine is packed completely assembled, as a unit, in a single crate. The lower yoke platen is bolted to the lower machine platen to form a rigid assembly for shipment, and the hand pump assembly is disconnected from the jack and attached separately to the shipping crate.

The uncrating procedure is straightforward. With the crate in a horizontal position, remove the packing material from the crate, being careful to check for small parts and accessories that may be packed with the calibrating machine, including the hydraulic hose.

Caution: Before lifting, ensure the unit does not exceed the capacity of the lifting equipment.

3.2 Installation

Installation consists of setting the machine in place on a smooth, flat surface, and leveling the machine by means of the adjustable feet, using the circular level as an indicator. The 10,000 lbf (50 kN) capacity machine is normally placed on a bench or sturdy table. Larger machines are usually installed adjacent to a bench or other suitable work surface to which the hand pump can be fastened. Note: Selection of a location where an even temperature prevails will greatly facilitate calibration.

After the machine has been installed in position, remove the bolt that holds the lower yoke to the lower machine platen. Next, operate the hand pump to extend the ram of the hydraulic jack approximately 1/16 to 1/8 inch. Loosen the tie bar locking collars and raise the lower yoke platen until the lower surface of the upper yoke platen is within 1/8 inch of the shoulders of the tension tie bars.

Note: Be careful not to run the upper yoke platen up against the shoulders of the tension tie bars as this may damage the calibrating machine.

Next, slide the locking collars down the tension tie bars to the upper machine platen, and firmly tighten the locking collar set screws. Now raise the upper yoke platen so there is sufficient space to insert the force standard between the hydraulic jack and the upper machine platen.

Note: Be careful not to run the upper yoke platen against the stops near the end of the threads of the tension tie bars as this may damage the calibrating machine.

3.3 Installation of a Reference Standard

A reference standard, which is normally a load cell, must be installed in a Morehouse UCM before the using the machine. The reference standard is used to measure the applied force and calibrate the unit under test. Reference standards need to be calibrated periodically by higher accuracy standards such as those provided by the Morehouse Force Calibration Laboratory. A Morehouse reference standard kit can be utilized to install the reference standard into a UCM. This kit consists of Morehouse reference standards, which are typically load cells and the adapters necessary to ensure proper force application. The kit shown in Figure 8 is typically used for force standards with capacities of 100,000 lbf (500 kN) and lower. This kit contains:

1- Load Pad
2- Load Ball Compression Adapter
3- Reference Load Cell
4- Alignment Plug
5- Jack Compression Block

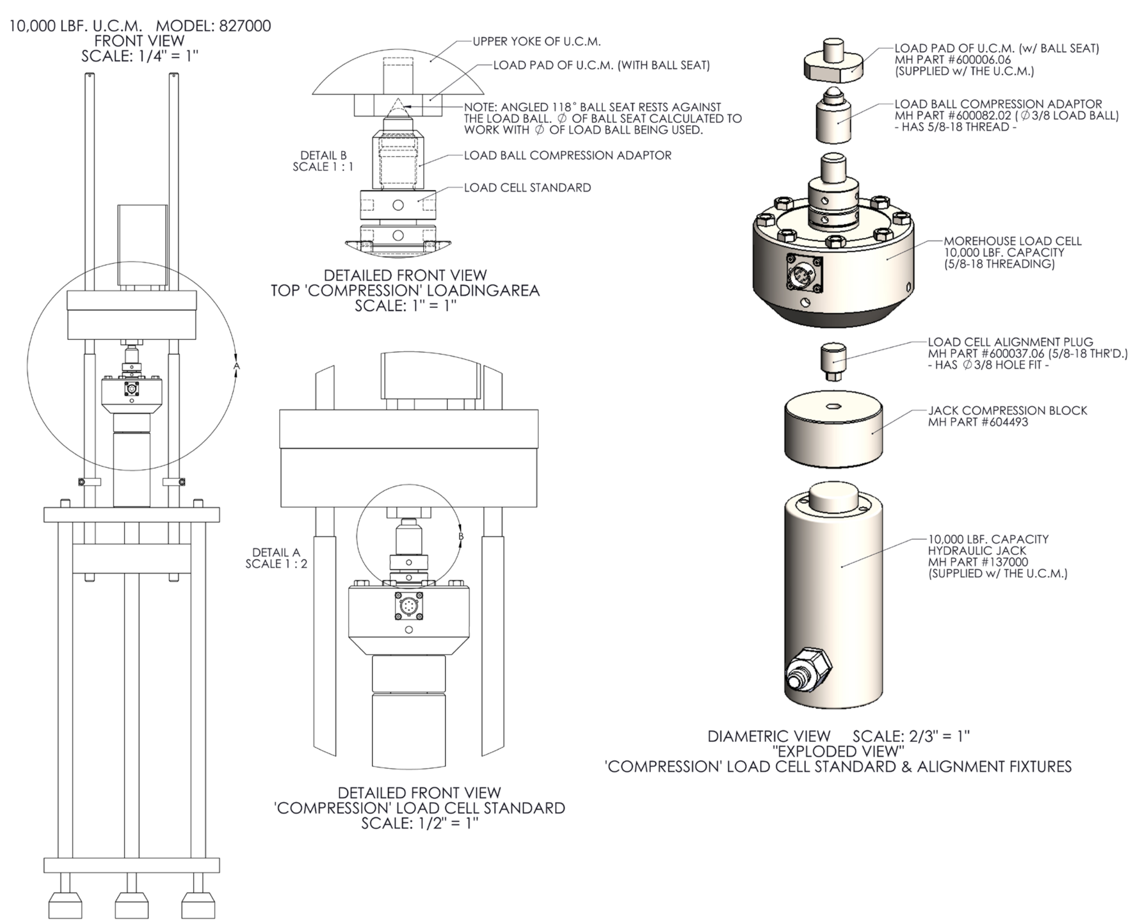


Figure 8: Reference Standard Installation Kit for Load Cells with Capacities of 100,000 lbf (500 kN) or Lower

If the capacity of the reference standard load cell is higher than 100,000 lbf (500 kN), then the kit shown in Figure 9 can be used to install the standard in a UCM. The kit contains the following:

1- Top Block Compression Adapter
2- Reference Load Cell
3- Load Cell Alignment Plug
4- Jack Compression Block

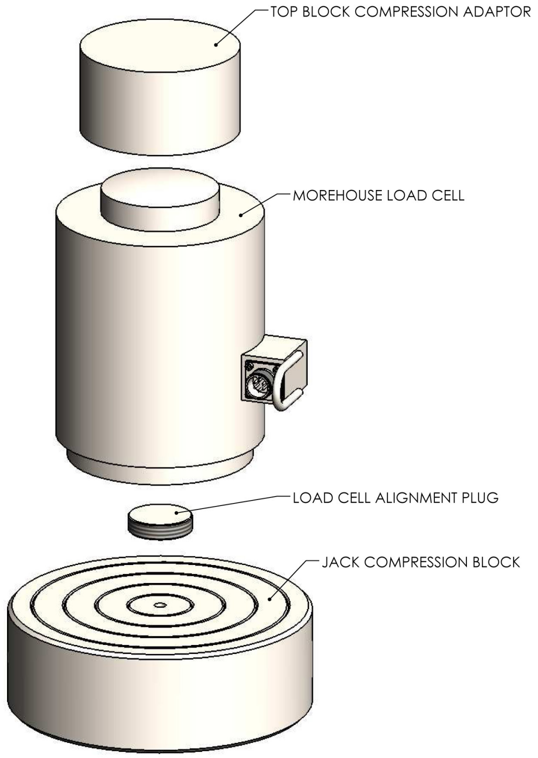


Figure 9: Reference Standard Installation Kit for Load Cells with Capacities Higher than 100,000 lbf (500 kN)

3.4 Preparing the Hand Pump for Use

Before connecting the hand pump assembly to the jack, check the supply of fluid in the pump reservoir by removing the fill plug (item 30 in Figure 15). The fill plug must be left open about two turns during operation to serve as a reservoir vent. If hydraulic fluid must be added, then be sure to use petroleum based anti-wear hydraulic fluid with an ISO Viscosity Grade of 22 or 32. The following hydraulic fluids are recommended, but any equal hydraulic fluid may also be used:

Arco	Dutro AW 32
Conoco	Super Hydraulic 32
Drydene Oil Co	Paradene 22 AW
Exxon	.Nuto H 32
Gulf	Harmony 32 AW
Mobil	DTE 24
Texaco	Rando HD 32
Union	Unax AW 150

In choosing a hydraulic fluid be certain it is equal to one of the above listed recommendations. Many formulations may lack certain additives or are formulated for special reasons, such as lower cost, high detergency, leakage control, etc. Some of these fluids can be used successfully, however, others may prompt malfunctions and high rates of wear.

3.5 Preparing the Jack Assembly for Use

All hydraulic jack assemblies are furnished with a self-sealing hose coupling and are fully bled and checked at the factory prior to shipment. However, if the hand pump and hydraulic jack seem rather “spongy” during use, then there may be air in the system. If this occurs, then the system will need to be bled of the entrapped air. The procedure for bleeding the entrapped air is outlined in Section 6.2.

4. Operation

4.1 Operating Conditions

Calibration is best performed under the standard conditions recommended by the manufacturer of the test instrument. Precision test instruments usually are calibrated in a location where the temperature is maintained within certain prescribed limits, and where the calibration standard and test instrument are not subjected to sudden changes in temperature. It is recommended, therefore, that the Morehouse Universal Calibrating Machine be installed and used where such conditions prevail.

The calibrating machine is designed for calibration of both tension type and compression type test instruments. Figure 10 illustrates the suggested calibration setups for tension and compression.

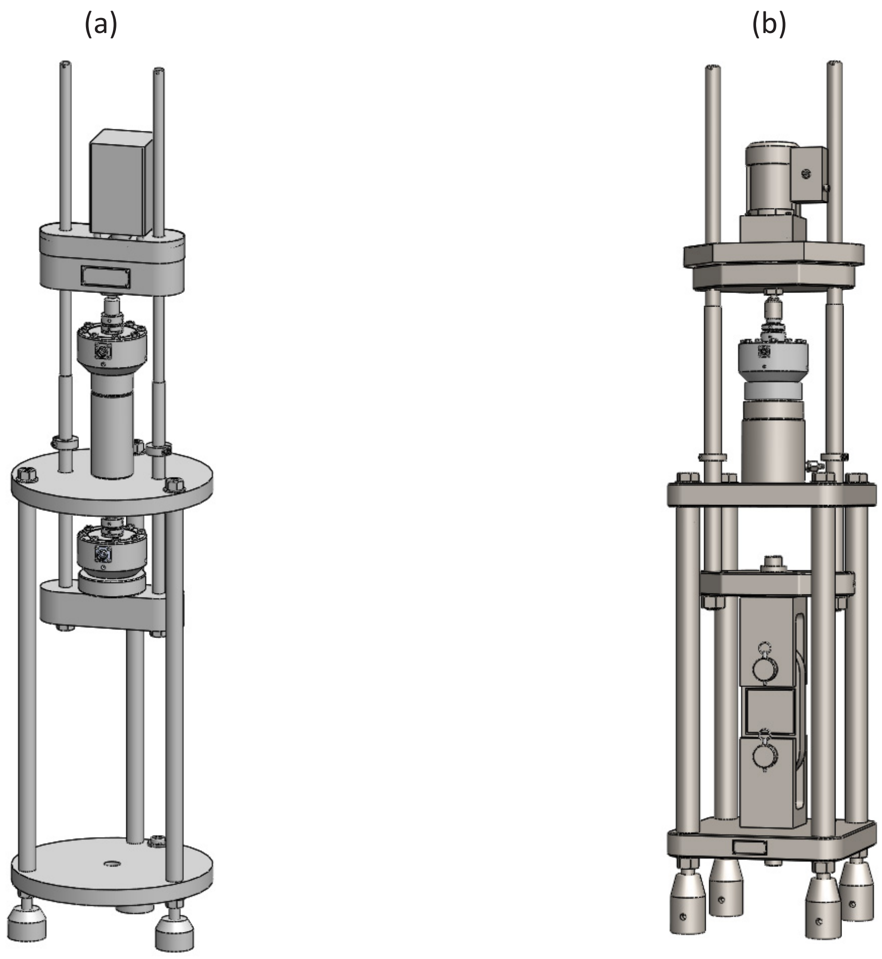


Figure 10: Calibrating Instruments in a) Compression; b) Tension

4.2 Compression Setup

The Morehouse Universal Calibrating Machine is setup for compression calibration in two steps:
1. Positioning the reference standard, such as a Morehouse Proving Ring or Morehouse Load Cell
2. Positioning the unit under test

Prior to use, the machine should be set on a solid surface and leveled by adjusting the feet. Selecting a location where an even temperature prevails will facilitate the calibration.

Operate the hand pump to extend the ram of the hydraulic jack approximately 1/16 to 1/8 inch before making the calibration setup. Verify that the upper yoke platen is positioned so that there is sufficient space between the hydraulic jack and the upper machine platen to insert the reference standard with several inches of thread on the yoke tie bars remaining above the upper yoke platen. Be sure to include an allowance for the height of any accessories or adapters to be used with the reference standard.

If sufficient space cannot be obtained, then adjust the upper yoke platen as follows:

Note: When adjusting the upper yoke platen be careful not to run it against the shoulders or the stops on the tension tie bars as this may damage the calibrating machine.

a) By means of the motor control, lower the upper yoke platen until it rests on the hydraulic jack.

b) Continue to operate the yoke adjusting mechanism until the lower surface of the upper yoke platen is within 1/8 inch of the shoulders of the tension tie bars.

c) Loosen the screws on the tie bar locking collars, lower the locking collars onto the upper machine platen, and tighten the screws firmly.

d) By means of the motor control, raise the upper yoke platen sufficiently to accommodate the reference standard plus any accessories or adapters that will be used with it.

Once the yoke has been positioned to accommodate the reference standard, place the reference standard on the ram of the hydraulic jack. It is advisable to use an adapter to properly align and secure the reference standard (Figure 11, A) on the jack ram (Figure 11, C). A complete list of accessories and adapters for use with Morehouse Universal Calibrating Machines is available at www.mhforce.com.

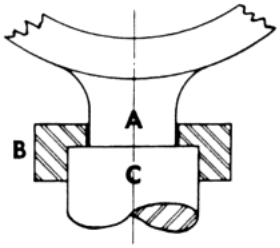


Figure 11:
A) Lower Boss of Reference Standard
B) Ring Alignment Bushing
C) Jack Ram

Next, as shown in Figure 12, place a hardened alloy steel loading ball (B) of the proper size and load rating in the ball seat of the reference standard (C) and lower the upper yoke platen (A) until the ball seat of the platen rests on the ball.

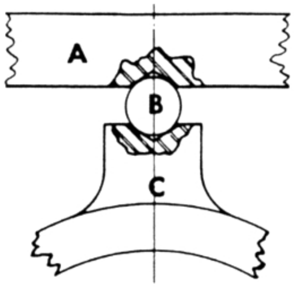


Figure 12:
A) Upper Yoke Platen
B) Hardened Steel Alloy Load Ball
C) Jack Ram Upper Boss of Reference Standard

If the reference standard is not provided with a ball seat, a suitable adapter should be used. Do not confuse a lathe center, often found on instruments, with properly machined ball seats.

Note: Do not interchange hardened alloy steel loading balls, retainer clips with hardened alloy steel loading balls between different reference standards. They should be matched with a reference standard and used only with that standard.

In cases where the reference standard does not have a ball seat, proper axial alignment is difficult to achieve when the proper accessories and adapters are not used. To more easily maintain proper axial alignment, it is recommended that a reference standard with a ball seat be used whenever possible.

With the reference standard in place and the upper yoke platen lowered to rest on the steel loading ball (or other adapter), release the lock collars, and measure the distance between the upper machine platen and the lower yoke platen. This distance should be approximately the height of the test instrument plus any accessories or adapters to be used. If it is not, then raise or lower the lower yoke platen until the correct space is achieved. To raise or lower the lower yoke platen, proceed as follows:

a) Loosen the screws on the tie bar collars and raise them above the upper machine platen.

Caution: Never loosen the screws on the tie bar locking collars unless the reference standard or the hydraulic jack supports the entire weight of the moveable yoke.

b) Using the motorized adjusting switch, push the switch up/down to raise/lower, the lower yoke platen.

c) When the desired adjustment has been achieved, position the tie bar locking collars to allow clearance between them and the upper machine platen. Then firmly tighten the screws to hold them in place.

Next, mount the test instrument on the lower yoke platen as shown in Figure 10a. If the test instrument has a tapped central hole in its base, it should be mounted by an alignment plug to assure proper positioning of the test instrument on the loading axis of the machine. The alignment plug should be threaded far enough into load cell to align, not load on the alignment plug. A test instrument with a circle of tapped mounting holes in its base should be first mounted to an adapter plate that is counter-bored so that all the bolt heads are completely recessed.

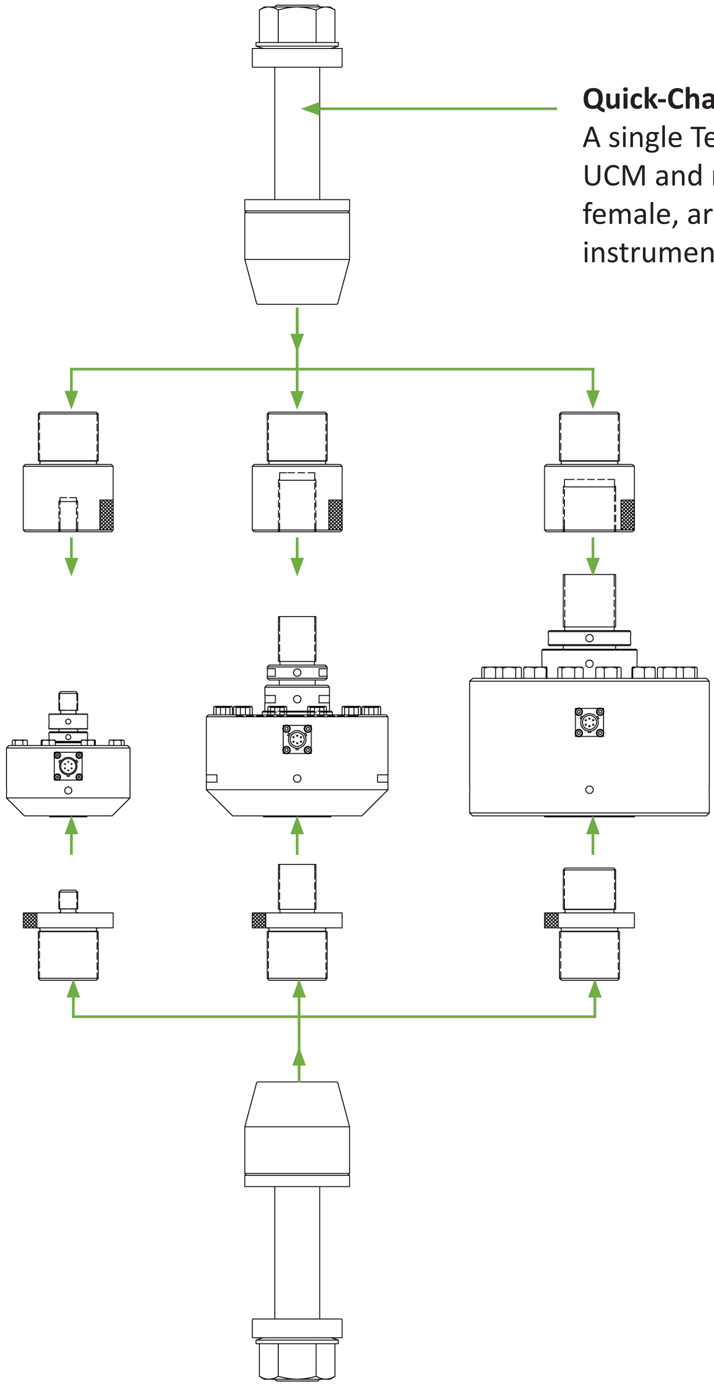
Check for clearance between the adapters used to load against the top of the test instrument and the underside of the upper machine platen. This clearance should be approximately 1/8 inch. If the clearance is greater than 1/8 inch, then raise the lower yoke platen as needed. Always check to be sure there is clearance between the test instrument, its adapters, and the upper machine platen.

Caution: Never load the test instrument directly against the underside of the upper machine platen. Loading directly against the upper machine platen may result in high unit stress and damage the platen. Proper accessories, such as alignment bearing blocks or soft steel pads used with hardened steel bearing plates should be used to decrease the unit stress to safe levels.

4.3 Tension Setup

Preparation for a tension calibration is similar to compression. The principle difference is the manner in which the test instrument is mounted in the machine. For a tension calibration, the test instrument is connected between the lower yoke platen and the lower machine platen by means of tension members (pulling rods), as shown in Figure 10b.

Tension members supplied with the test instrument may suffice for this calibration. Moreover, the Morehouse Quick-Change Tension Members can save your time by making connections easier and more efficient. Faster testing and calibration turn-around can improve the bottom line in your operation. With this system, a set of self-aligning tension members are installed in the tension side of the Universal Calibrating Machine. Then, a pair of Tension Member Adapters, which are included in the kit can be used to quickly mount the unit under test into the machine and prepare for calibration. Figure 13 shows how various adapters can be used for different instruments with the same set of tension members.



Quick-Change Tension Member
A single Tension Member Assembly is installed into the UCM and multiple tension adapters, both male and female, are interchanged to attached the desired size instrument.

A single pair of Tension Members can remain fixed in the machine and by swapping out both male and female tension adapters three different load cell sizes can be calibrated in the UCM by user.

One end of the tension adapter always has the same size thread on it so that any adapter chosen will fit the master size Tension Member Assembly.

Figure 13: Morehouse Quick Change Tension Members

Figure 14 shows the method of connecting a tension member (B) between the test instrument (C) and the lower yoke platen (A). The test instrument is connected to the lower machine platen in a similar fashion.

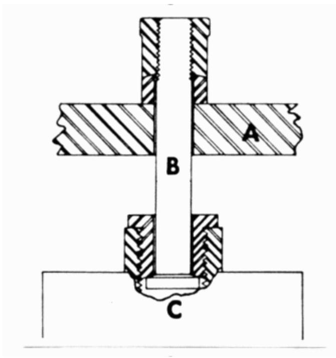


Figure 14:
A) Lower Yoke Platen
B) Tension Member
C) Test Instrument

Check for clearance between the tension member and the underside of the lower machine platen. This clearance should be approximately 1/8 inch. If the clearance is greater than 1/8 inch, then raise the lower yoke platen as needed. Always check to be sure there is clearance between the test instrument and its adapters and the lower machine platen.

Caution: Always be sure any fasteners supplied or used with tension members are fully engaged.

4.4 Hand Pump Operation

The hand pump supplied with the calibrating machine is a dual-volume design based on a double-diameter piston. On the side of the pump is a valve rod (Figure 5) with a round handle. With the rod pulled out, the full diameter of the piston is effective for large volume, low pressure pumping; with the rod pushed in, the reduced diameter is effective for high pressure with a minimum of pumping effort.

Caution: Before pushing the rod in, release any downward pressure applied to the hand lever.

During pump operation, the fill plug on the upper right side of the pump body should be open about two turns to serve as a reservoir vent. Operation of the hand pump is entirely conventional. Operating the hand lever causes oil to be pumped from the reservoir to the outlets. When the relief valve is closed (handle rotated toward the hose connection on the pump body), pressure is developed within the pump. Opening this valve relieves the oil back to the reservoir. In operating the relief valve, use modest pressure on the handle - just enough to prevent leakage.

The auxiliary screw piston (Vernier piston) is a small-displacement precision piston. After pressure has been built up by means of the hand lever to obtain the approximate force desired, rotate the hand wheel to operate the Vernier piston and maintain a precise force. We recommend that the Vernier piston adjustment be kept at its mid-position of travel to allow small increments of force to be increased or decreased. Experience will dictate the best position for individual requirements. A little practice in the use of this pump will enable extremely precise force application by means of the pump and jack.

If the hand pump and hydraulic jack seem rather “spongy” during use there may be air in the system. If this occurs the system will need to be bled of the entrapped air. The procedure for bleeding the entrapped air is outlined in section 6.2.

Caution: Do not attempt to exceed the 1 inch stroke of the ram in the jack cylinder. Considerable damage may result if pressure is applied after the ram has reached its limit of travel.

4.5 Universal Hydraulic Pump

An optional electric motor driven pump is available for use with calibrating machines with capacities of 60,000 lbf (250 kN) and higher. This unit is referred to as the Morehouse Universal Hydraulic Pump. The power control replaces the hand pump, thus eliminating the effort required to operate the hand pump. To use the power control please refer to the operating instructions supplied with it. For detailed information, see the Universal Hydraulic Pump Instruction Manual.

4.6 Calibration

Once the reference standard and the test instrument have been installed into the universal calibrating machine and the operator has become proficient in the use of the hand pump, calibration of the test instrument can be performed.

Caution: Calibration of a test instrument should not be attempted until the personnel concerned are completely familiar with operation of both the reference standard and the test instrument.

Detailed procedures for calibrating the various types of test instruments are beyond the scope of this manual. In general, such calibration consists of applying a series of forces to the calibration system (by means of the hand pump and jack assemblies) and comparing the indication of the calibration standard with that of the test instrument.

Caution: When applying forces, always monitor the force applied by the calibration standard. Never depend on the indicated value of the test instrument to determine the applied force unless the accuracy of the test instrument has been verified. There may be a significant error in the test instrument, which could cause the reference standard and the calibrating machine to be overloaded and damaged.

To apply a load to the reference system, open the reservoir vent and close the relief valve on the hand pump. Apply the load to the test setup by working the pump handle until the desired load is almost reached.

Note: Be sure that the tension tie bars do not touch the sides of the holes in the upper machine platen, because the resulting friction would reduce the accuracy of calibration. If necessary, move the locking collars up the tie bars so that clearance between the tie bars and the upper machine platen can be observed.

Complete the loading to the exact force required by using the auxiliary screw piston (hand wheel). Read and record the force indication of the reference standard and the test instrument. Repeat the procedure at as many loading points as necessary to complete the calibration. To apply forces in descending increments, open the relief valve slightly to achieve the approximate load desired, and make fine adjustments as necessary by means of the auxiliary screw piston.

4.7 Tare Load

The tare weight is a “pre-load” on the reference standard. It is attributable to the weight of the moveable yoke, test instrument, bearing plate(s), load ball(s), and adapter fittings. When calibrating a test instrument whose capacity is approximately equal to that of the calibrating machine, the reading of the calibrating instrument with no force applied to the test instrument may be considered a “no - load” reading with negligible error. In cases where the rated capacity of the test instrument is substantially less than that of the calibrating machine or where it is necessary to obtain the highest possible degree of accuracy, ignoring the tare load effect may introduce significant error into the calibration.

The error introduced by not allowing for the tare load can be determined by treating the deflection of the calibration standard with the tare load applied as the “no - load” reading when calculating the load applied to the test instrument. Comparing the results of this calculation with the results of a calculation taking into account the tare load (as outlined below) will readily show the error introduced.

The tare load can be ascertained by weighing the items (yoke, test instrument, etc.) on a suitable platform scale. However, it may be more convenient to determine the tare load by means of a reference standard. This is done as follows:

a) Use the motor to raise the upper yoke platen to obtain approximately 1/8” (3 mm) clearance between the load ball (or bearing plate) that is used with the reference standard and the upper yoke.

b) Remove the load ball (or bearing plate) from the top of the reference standard, and read the no - load deflection of the reference standard.

c) Replace the load ball (or bearing plate) on top of the reference standard, and lower the upper yoke platen onto the reference standard until the tie bar locking collars are clear of the upper machine platen. Note: Check to see that the test instrument is not under load, and that the tie bars are not touching the upper machine platen.

d) Again, read the indicated deflection of the reference standard.

e) Subtract the deflection reading obtained in step b) from that obtained in step d), and convert this difference to pounds. This is the nominal tare load on the reference standard.

If the nominal tare load, as determined in the above procedure, falls within the range of acceptable accuracy of the calibration standard in use, then this value may be used directly. If it does not, then substitute a lower-capacity reference standard. If possible, use one whose rated capacity only slightly exceeds the nominal tare load. Then repeat steps a) through e). After the force attributable to the tare load (F1) has been determined within acceptable accuracy limits, place the original reference standard into the calibrating machine.

To apply a force (FX) to a test instrument, the reference standard must indicate (F1 + FX). In other words, the force (FX) applied to the test instrument is the difference between the total force (FT) indicated by the reference standard and the tare load (F1). Mathematically, this may be expressed as:

$$FX = FT - F1$$

In some types of calibration, the resulting error may be too small to justify the extra effort of compensating for the tare load. In calibrating test instruments with a rated capacity substantially less than that of the calibrating machine, and with a rated accuracy of 1% or less, the tare load effect usually must be taken into consideration.

5. Service, Inspection, Maintenance, & Lubrication

5.1 Tools

Only those tools normally available in a repair shop are needed for inspection and maintenance of the Morehouse Universal Calibrating Machine.

5.2 Service Inspection

Perform a routine service inspection of the calibrating machine at regular intervals. The frequency of inspection depends on how often and under what circumstances the machine is used. During this inspection, check the equipment for rust, leaking hydraulic fluid, and other visible signs of deterioration or damage. In addition, check the oil level in the pump reservoir, and examine the o-ring seals. Replace any ring that is split, cut, or otherwise damaged. After an extended period of heavy service, it is recommended to disassemble and clean the pump. Cleaning the pump consists of washing or blowing out the body casting and washing the parts. Refer to section 6 for disassembly instructions.

5.3 Maintenance

Routine maintenance of the machine usually is limited to replacing o-ring seals in the pump assembly, adding hydraulic fluid (as recommended in section 3,) if required, removing rust, dirt and corrosion from all assemblies, touching up paint damage, tightening any nuts or set screws which have loosened, and re-leveling the machine, if required.

The numbers in parenthesis in this section refer to items in Figure 15. If the pump and jack assembly fail to develop or hold pressure, corrective maintenance may be necessary. If the hand lever is operated and the pump fails to develop pressure, be sure the relief valve is closed and there is sufficient fluid in the reservoir. If failure continues one or both of the check valves (33 and 38) may be leaking. Replace both o-rings to be sure.

If the pump builds up pressure but the pressure drops, examine all joints for leakage. A very small amount of leakage will result in considerable loss of pressure. As the pressure drops, watch the hand lever. If it rises, the discharge check valve (33) is leaking. Replace the o-ring (29). If the hand lever does not rise as the pressure drops, then the relief valve is leaking. A foreign particle may be lodged on the seat. However, it is more likely that the o-ring (39) has failed and must be replaced. The outlet in the pump body is tapped with 9/16”-18 NF threads and SAE ORB-6 (15). A firm joint will prevent leakage. If leakage develops, do not tighten the fitting excessively. Replace the o-ring seal.

Caution: Do not screw pipe threads directly into the pump body outlet. A special Adapter (53) is provided with pipe threads for making connections.

5.4 Lubrication

Caution: If you jog the chain with the guard removed, keep fingers away from the chain. https://bit.ly/3pA-JM3T

Routine lubrication consists of applying grease to the chain drive on the upper-yoke platen and any grease fittings, and adding oil to the motor-drive gearbox, if necessary. A small amount of grease should be applied to the tension tie bars directly above the upper yoke platen. After applying the grease, move the upper yoke platen to its highest and lowest position to distribute the grease over the threads of the tension tie bars. Also check the calibrating machine for grease fittings on the upper yoke platen and apply grease to these fittings. The grease used should conform to NGLI 2 specifications.

UCM's above 300,000 lb capacity utilize a gearbox which requires maintenance, please refer to manufacturers guidelines for the applicable gearbox used on your machine.

The standard Bodine motors and gear reducers are lubricated by the manufacturer for the service life of the motor. Lubrication of these motors by the user is not required. However, the Boston gear reducers sometimes used with these calibrating machines do require lubrication. In general, for Boston gear reducers the vent filler is at the uppermost plug position, and the drain plug is at the lowermost position. The oil level should be maintained at the centerline of the uppermost gear.

5.5 Rust Prevention

On completion of routine inspection and preventative maintenance procedures, coat all unpainted metal surfaces with some light machine oil.

6. Disassembly, Repair, and Reassembly

6.1 Disassembly and Reassembly

Procedures for disassembly and reassembly of the Morehouse Universal Calibrating Machine are evident from the drawings provided. The parts list and drawing for the hand pump is included with this manual. Parts lists and drawings for Morehouse Universal Calibrating Machines and hydraulic jacks are supplied with the calibrating machine. Recommendations regarding the disassembly and reassembly of the hand pump are included in this section. All numbers in parentheses refer to items in Figure 14.

6.2 Air Bleed Procedure for Hydraulic Jack

If the hand pump and hydraulic jack seem rather “spongy” during use there may be air in the system. If this occurs, bleed the system of the entrapped air. To bleed the hydraulic jack, remove it from the calibrating machine and place it on its side on a bench, or other suitable work surface, then proceed as follows:

a) Check the supply of fluid in the pump reservoir by removing the fill plug (30). The fill plug must be left open about two turns during operation to serve as a reservoir vent. If hydraulic fluid must be added be sure to use petroleum based anti-wear hydraulic fluid with an ISO Viscosity Grade of 22 or 32 as recommended in Section 3.

b) With the hydraulic hose disconnected from the hydraulic jack and connected only to the hand pump, pump the hydraulic hose full of hydraulic fluid. The poppet of the hose half of the self-sealing quick-disconnect coupling must be depressed to accomplish this.

c) Connect the hydraulic hose to the jack cylinder fitting, and pump the jack ram out to full stroke, approximately 25 mm or 1 inch.

d) Roll the jack to bring the air bleed location to the highest point.

e) Alternately open the air bleed and roll the jack back and forth. The ram return spring will keep sufficient pressure on the fluid to purge the air.

f) After the jack has been bled of all entrapped air, tighten the air bleed securely, and replace the jack to its original position on the calibrating machine.

6.3 Service Instructions for Hydraulic Hand Pump

When changing o-rings, always lubricate the o-rings and all contacting metal parts before attempting assembly. For a lubricant, use the same fluid as will be used in the system. The high-pressure valve and retaining parts are held in place by the retaining plug (57). To reassemble, screw the retaining plug (57) into the body until all parts are solid, then back it off about two turns. This provides sufficient travel for the poppet.

The valve rod (41) is held in place by three parts (25, 26, and 27) that must be removed to enable disassembly of the valve rod. Access to these three parts is gained by removing the reservoir (2). Drain the hydraulic fluid before removing the reservoir. The piston and hand lever can be removed as an assembly. Unscrew the cylinder retaining plug (16), disconnect from clevis (19), and pull straight up. At the end of the pressure stroke, the piston should bottom on the body plate (50) before the lever hits the cylinder retaining plug (16). If it does not, or more finger room between the hand lever and reservoir is desired, loosen piston pin (7), insert a small rod in the cross hole provided in the piston, and back off the piston, which is threaded into the piston pin (17) as needed. Re-tighten the setscrew (7).

The cylinder pump (18) must be removed and reassembled from the top. If it is not, the o-ring will be cut by the angular, intersecting body casting bore. To remove the cylinder, detach the body plate (50) and push the cylinder from the bottom. On reassembly, lubricate the o-rings and try to rotate the cylinder, as inserted, to avoid cutting or pinching the o-rings. A tapered piece of wood is helpful in rotating the cylinders.

The precision pressure adjustment mechanism can be unscrewed from the pump body as a unit. The star wheel (21), star wheel pin (22), piston cap (23), and piston (24) make up a sub-assembly, which is removed from the pump body by unscrewing the piston body (24). Note that the star wheel (21) is attached to the Vernier piston (58) by means of a pin (22).

6.4 Repair

All parts of the calibrating machine, except o-rings, are designed to last indefinitely in normal use. If inadvertent misuse or accidental damage occurs, then repair may be accomplished by replacing the damaged parts.

6.5 Drawings & Parts Lists

Figure 15 and the associated parts list, illustrate replacement parts available for the standard hand pump commonly supplied with Morehouse Universal Calibrating Machines. Drawings and parts lists for specific capacity calibrating machines and hydraulic jacks are supplied separately. If copies of drawings and parts lists of a specific capacity calibrating machine or hydraulic jack are required, contact Morehouse to request the the appropriate drawings. When ordering repair parts, please include the serial number and capacity of the calibrating machine (as engraved on the nameplate) and state the part number, name, and quantity required. To order parts, contact info@mhforce.com

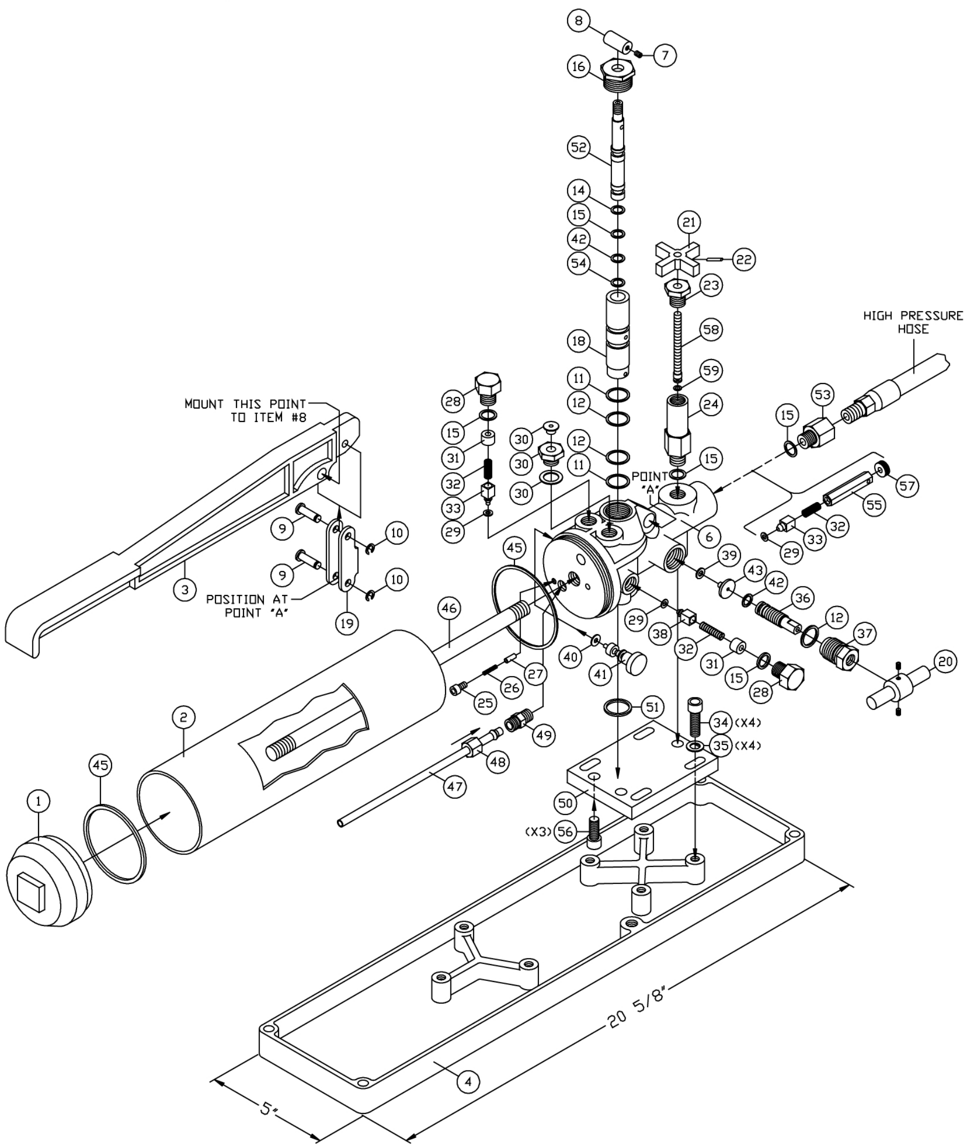


Figure 15: Hand Pump Assembly (Drawing 214000A-01)

Table 2: Parts List for Hand Pump (1-38) - Refer to Figure 15			
Item	Part No.	Nomenclature	Quantity
1	T-575	Reservoir Cap	1
2	T-421	Reservoir Tube	1
3	T-165	Pump Handle	1
4	T-118	Drip Pan	1
6	T-402	Pump Body	1
7	T-160	Piston Pin Screw	1
8	T-161	Piston Pin Shoe	1
9	T-142	Clevis Pin	2
10	T-144	Cotter Hair Pin	2
11	10-90020	Cylinder Back-Up Ring (T-112)	2
12	10-90013	O-Ring (T-153)	3
14	10-90019	Piston Back-Up Ring (T-158)	1
15	10-90027	O-Ring	5
16	T-108	Cylinder Retaining Plug	1
17	T-145	Piston Pin	1
18	T-236	Cylinder Pump	1
19	T-143	Clevis	1
20	T-773	Relief Valve Handle	1
21	P-17-33	Star Wheel	1
22	P-17-32	Star Wheel Pin	1
23	1GT-33	Piston Cap	1
24	1GT-32	Piston Body	1
25	T-405	Screw	1
26	T-116	Valve Rod Spring	1
27	T-133	Valve Rod Detent Pin	1
28	T-117	Pump Body Plug	2
29	10-90001	O-Ring (T-152)	3
30	IGT-302	Fill & Vent Plug	1
31	T-127	Check Valve Spacer	2
32	CV-1-5	Check Valve Spring	3
33	T-147	High Pressure Valve Poppet	2
34	T-406	Drip Pan Attaching Screw	4
35	T-167	Drip Pan Attaching Washer	4
36	T-110	Relief Valve Stem	1
37	T-109	Relief Valve Body	1
38	T-194	Poppet Valve	1

Table 2: Parts List for Hand Pump (39-59) - Refer to Figure 15			
Item	**Part No.**	**Nomenclature**	**Quantity**
39	10-90002	Relief Valve O-Ring (T-175)	1
40	10-90004	Valve Rod O-Ring (T-155)	1
41	T-115	Valve Rod	1
42	10-90005	O-Ring (T-151)	2
43	T-111	Relief Valve Seat	1
45	10-90010	Reservoir O-Ring (T-156)	2
46	T-130	Reservoir Stud	1
47	P-17-29	Inlet Tube	1
48	P-17-7	Inlet Tube Fitting	1
49	T-250	Inlet Tube Nipple	1
50	T-408	Body Plate	1
51	10-90012	Cylinder O-Ring (T-164)	1
52	T-106	Piston	1
53	CV2SS2	Special Adapter	1
54	10-90018	Piston Back-Up Ring (T-159)	1
55	T-107	Guide Rod	1
56	01-90003	Body Attaching Screw	3
57	IGT-10	Retaining Plug	1
58	IGT-34	Vernier Piston	1
59	10-90000	Seal Ring Piston	1

7. Accessories & Adapters for use with Morehouse Universal Calibrating Machines

Because of the physical differences in the many types of test instruments that may be calibrated in the Morehouse Universal Calibrating Machine, many different types of accessories and adapters are available. For more information, see Universal Calibrating Machine Adapters and Accessories.