

Operation and Instruction Manual

Portable Calibrating Machine

Model: PCM-2MD-02

**Calibrate your
force-measuring
instruments, quickly,
accurately, and easily.**





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1. Introduction

The Morehouse Portable Calibrating Machine Model PCM-2MD-02 is a force-calibrating machine designed to calibrate various force-measuring instruments in compression or tension modes. The machine can apply force up to 2000 lbf in both loading modes, providing fine control for the user to apply the test target forces. The machine uses a high-precision load cell as the reference standard. Furthermore, the Portable Calibrating Machine has automatic alignment features to reduce misalignment errors in force calibration.

Depending on the type and capacity of the instruments needed to be calibrated by the user, various standard load cell capacities can be utilized to cover different ranges. The adjustment and force control on the machine is done manually by the user, and the machine does not need any source of electrical power to operate. However, depending on the instrument type, electrical power might be needed to take output readings from standard reference load cells or the unit under test.

Morehouse offers two sets of standard adapters that can be ordered to assist with calibration of a variety of force-measuring instruments:

1. A set of tension member adapters to mount load cells, force gauges, and other similar instruments into the machine for tension force calibration. It should be noted that in any calibrating machine, a tension force cannot be applied accurately without proper tension adapters.
2. A set of L-Brackets explicitly designed for calibrating handheld force gauges in tension and compression. The L-Bracket kit includes multiple pieces with various mounting patterns and offsets to accommodate many hand-held force gauges available on the market.

In addition to the adapters mentioned above, Morehouse offers several types of custom adapters that could be used in conjunction with the Portable Calibrating Machine such as clevises, rod ends, and compression adaptors.

2. Description

2.1 Components

A standard benchtop calibrator includes the following separate components:

1. Main loading frame
2. Force standard reference load cell with an electronic indicator.
3. Compression bearing block
4. Compression ball seat adapter
5. Gray, yellow, and blue/white control springs
6. Custom-cut protective case



2.2 Construction

The Morehouse Portable Calibrating Machine is manufactured from high-quality material and to high-quality standards to provide users with a reliable and accurate force calibration system. The calibration force is generated using a mechanical screw jack which applies force in compression and tension modes. The jack is operated by turning the handwheel on the front side of the machine, and based on the direction of turning the handwheel, compression or tension calibration force is applied.

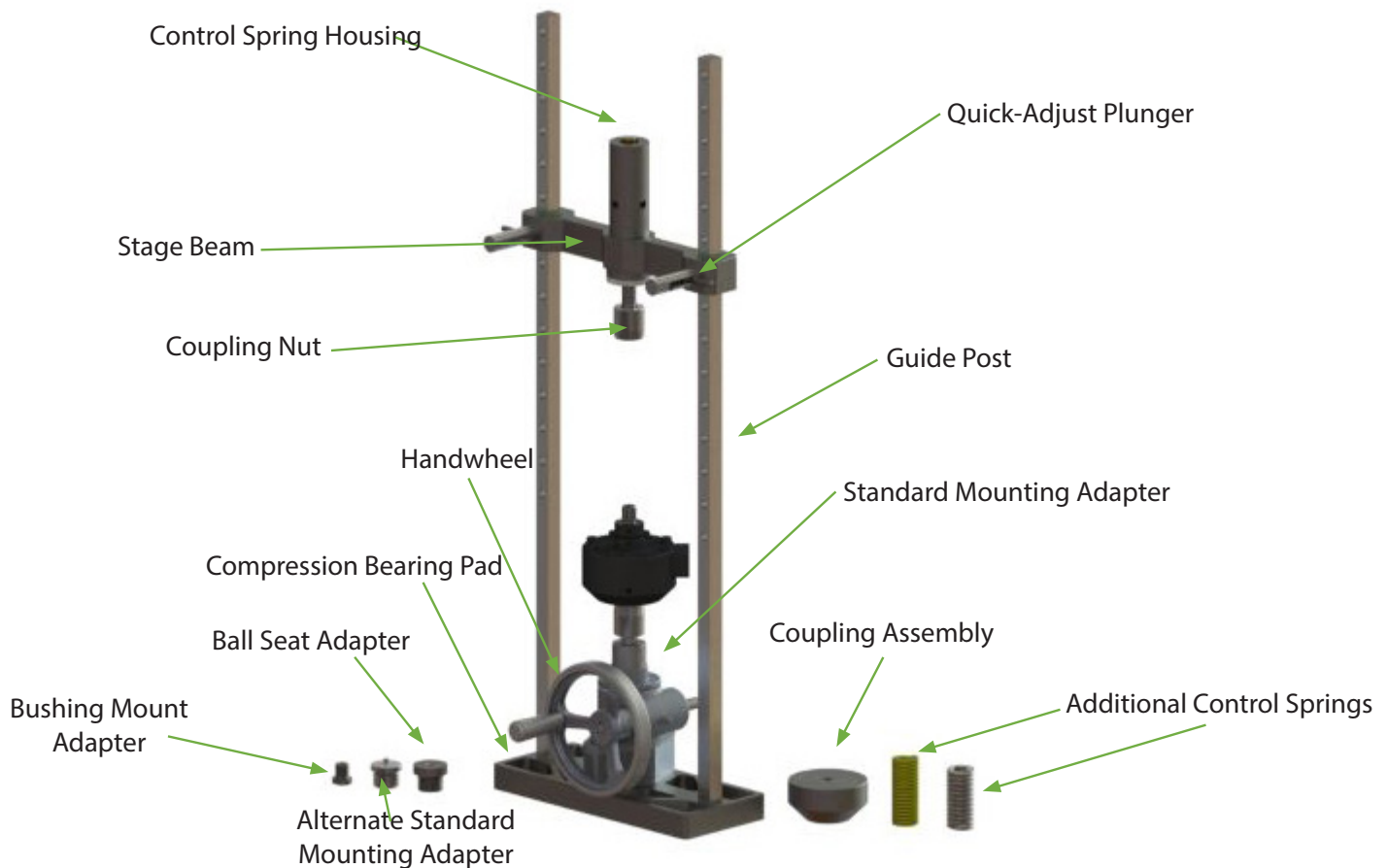


Figure 1: Standard Components of Morehouse Portable Calibrating Machine

The Portable Calibrating Machine is also equipped with a quick-adjust mechanism to change the calibration space based on the size of the equipment. This mechanism adjusts the position of the stage beam quickly and independently of the loading jack. The user can reposition the stage beam at 1.5-in. intervals when the machine is not under any calibration forces.

By default, Portable Calibrating Machines are assembled for right-hand configuration, meaning that the handwheel is located at the right side of the screw jack when standing in front of the machine. You can switch the machine to a left-hand configuration by sliding the stage beam up and off the guideposts, rotating 180°, and sliding it back down onto the guideposts. Then loosen the set screw on the side of the handwheel, and slowly pull the handwheel out, and move the shaft key and handwheel to the other side of the machine, then tighten the set screw.



2.3 Dimensions and Weight

The Morehouse Portable Calibrating Machine weighs 40 lbs. The overall weight may vary depending on the load cell standard, accessories, and cases used with the machine. Morehouse supplies the standard Portable Calibrating Machine model in a protective case with wheels, which provides portability and contains the machine, load cell system component, and some adapters. Figure 2 presents the overall dimensions of the Portable Calibrating Machine.

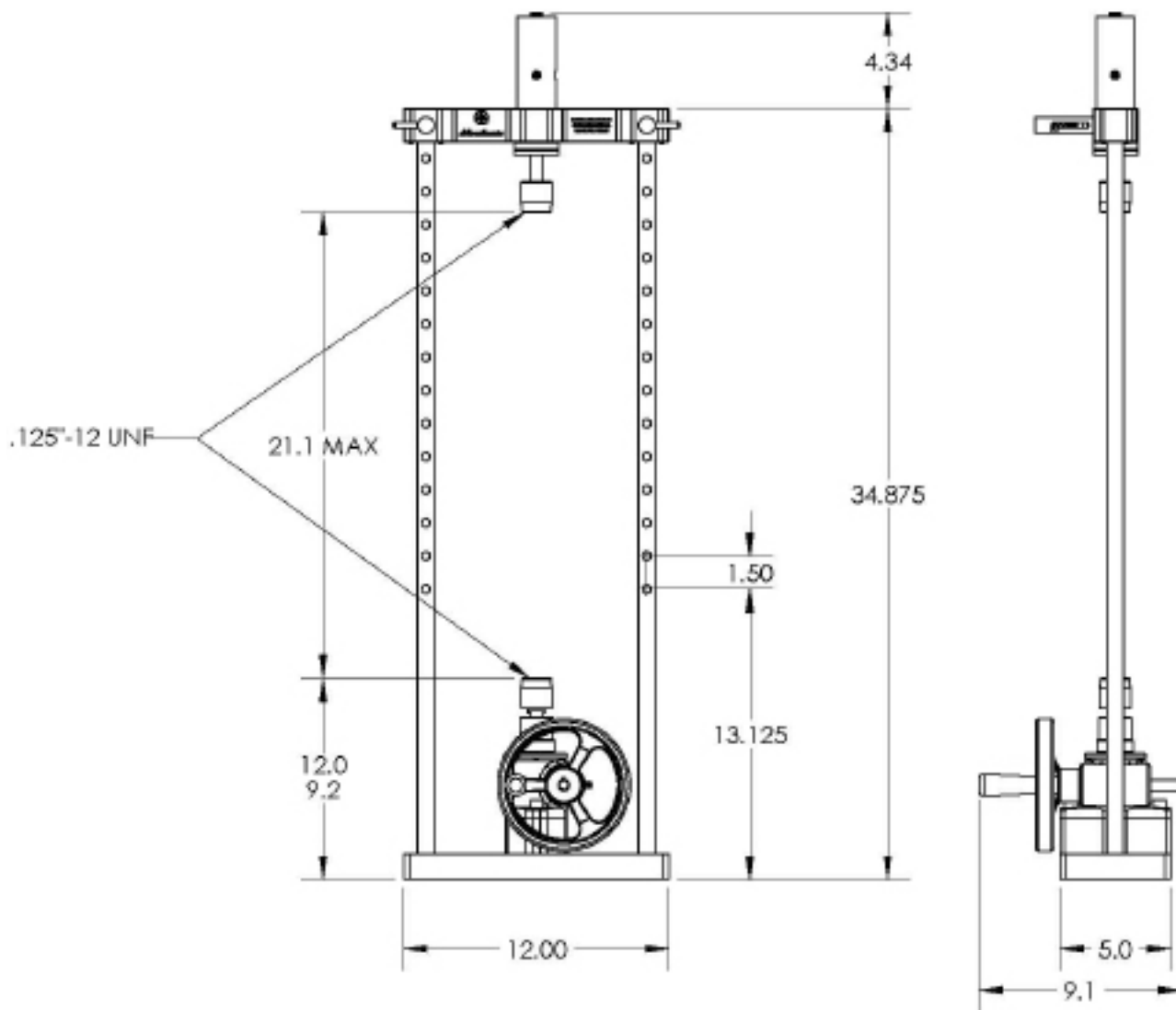


Figure 2: Dimensions of Portable Calibrating Machine (Model: PCM-2MD-02)



3. Operation Instructions

3.1 Installation of Force Standard

The reference standard load cell must be properly installed in the Portable Calibrating Machine before calibrations can be performed. In general, the machine applies the same force to the reference load cell and the unit under test for each test point. The readings from the reference standard are used to adjust and control the force in the machine.

The reference standard load cell is installed on top of the screw jack in the Portable Calibrating Machine. A reference standard mounting adapter is included with each machine. As depicted in Figure 3, this adapter is threaded to the top of the jack. The top side of the adapter with an external thread is then used to install the reference standard. By default, the reference standard mounting adapter has an external 0.625"-18 UNF thread on the top side to accommodate a Morehouse Shear Web load cell for capacities of 2000 lbf. and lower. If a different thread size is needed to mount other load cells, consult Morehouse Sales when placing an order.

When the Morehouse Force Calibration Laboratory calibrates a shear web load cell, the compression force is applied through the bottom shoulder of the cell (unless otherwise specified by the customer). Therefore, applying the compression load through the bottom thread will cause errors in the reported calibration values. Ensure the reference standard load cell is tightened against the mounting adapter before starting a calibration.

IMPORTANT TIP: The standard load cell must be snugly tightened against the mounting adapter before compression calibration. The goal is to have the bottom shoulder of the reference standard in contact with the mounting adapter.



Figure 3: Installation of Reference Load Cell Using the Standard Mounting Adapter

3.2 Compression Setup

Every Portable Calibrating Machine includes a compression bearing block and a ball seat adapter. These adapters can calibrate almost any compression-only force instrument up to 2000 lbf capacity. By default, the compression bearing block is manufactured with an internal 0.625"-18 UNF thread for installation on Morehouse Shear Web standard load cells. If other types of load cells are to be used as the reference standard, consult the Morehouse Sales team with specific requirements when ordering. To set up the Portable Calibration Machine for a compression-only calibration:

1. Using the front handwheel, lower the jack all the way down.
2. Install the compression bearing block on top of the reference standard load cell. Ensure that the thread underneath the bearing block is fully engaged with the threaded rod on the load cell.
3. Install the ball seat adapter to the coupling nut on the upper section of the Portable Calibrating Machine.
4. Place the unit under test on the compression bearing block. The hole at the center of the bearing block can be used with alignment plugs to accurately align the unit under test with the load line. Ensure the unit has an adapter on top with a load ball of diameter 0.438" or less and a force capacity equal to or greater than what will be applied.
5. Release the two latches on the stage beam by pulling the handles out, rotating to the bottom position, and moving the stage beam up or down to have the top of the unit under test 1.5" or less away from the ball seat adapter. Check that the latches are fully engaged without gaps between the handles and their housing slot (see Figure 7).
6. Use the screw jack to raise the test setup until the top is about to touch to the ball seat adapter.

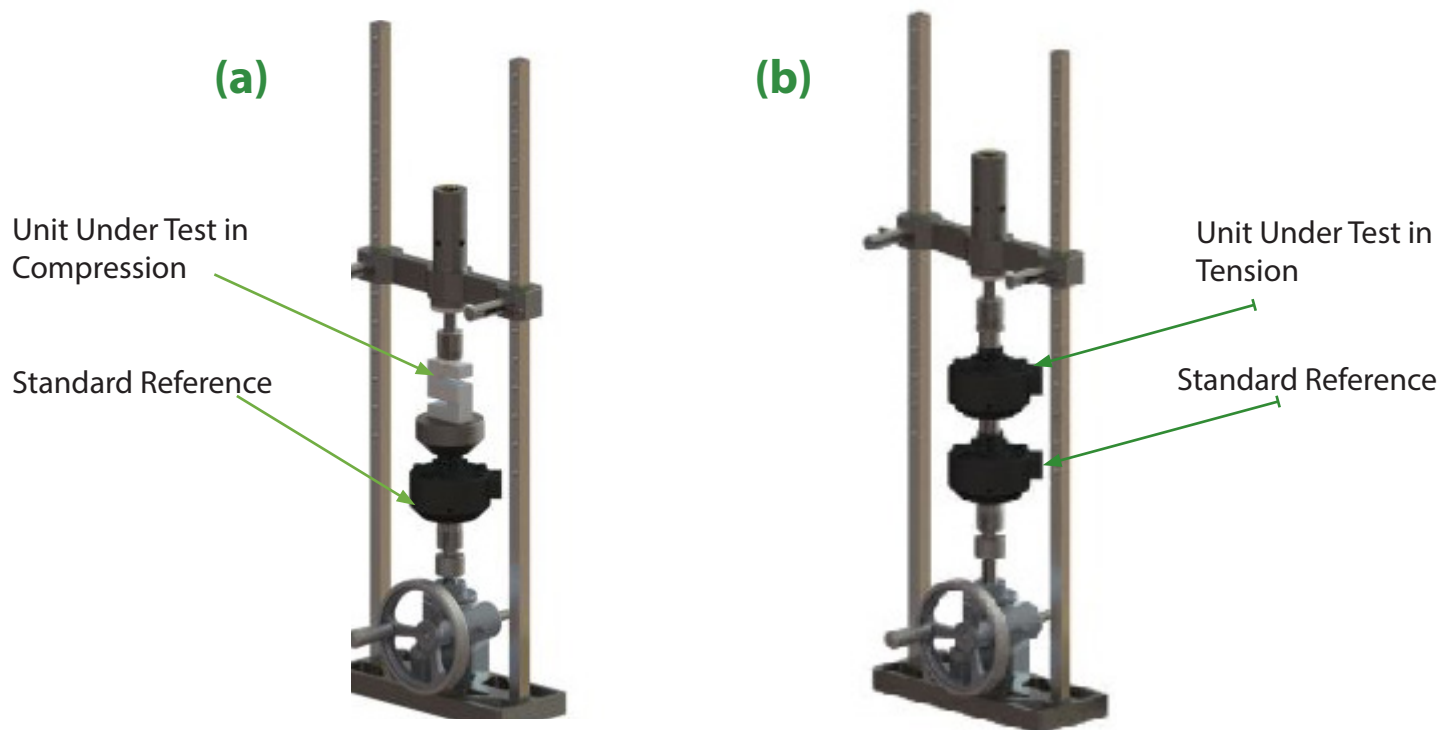


Figure 4: Calibration Setup for: a) Compression-Only Calibration; b) Tension Calibration

3.3 Tension Setup

Before setting up a tension calibration, ensure you have the adapters needed to mount the unit under test and that they are rated for the forces that will be applied. Morehouse manufactures several adapter kits designed for tension calibration in Portable Calibrating Machines. To set up a tension calibration:

1. Using the front-hand wheel, adjust the height of the screw jack so there is about 1" gap between the jack and Standard Mounting Adapter.
2. The tension unit under test is coupled directly to the top of the load cell using adapters. If the unit under test has an internal threaded hole with 0.625"-18 thread size, it can be directly installed on the threaded stud supplied with Morehouse Shear Web standard load cells.
3. Release the two latches on the stage beam by pulling the handles out and rotating to the bottom (see Figure 7) position. Then, move the stage beam up or down to have the top of the unit under test close to the swiveling coupling nut underneath the stage beam. Check the latches to ensure they are fully engaged without gaps between the handles and their housing slot.
4. The coupling nut has an internal thread of 1.125"-12 UNF thread. Use another adapter to connect the top part of the unit under test to the coupling nut.
5. Use the combination of adjustments provided by the stage beam and screw jack to ensure at least 1" but no more than 2.75" gap between the jack and Standard Mounting Adapter after the initial force is applied.

Some instruments may have special calibration requirements. Check the specifications and calibration instructions of the unit under test before calibration setup to ensure that the correct type of adapters and setup is available for calibration.

4. Calibration

4.1 Applying Calibration Forces

After the initial setup, the system is ready to start the calibration test. Compression or tension force is applied by turning the handwheel clockwise or counterclockwise, based upon the lefthand or righthand configuration of the machine. Compression force is applied when the jack screw moves up, and tension force is generated when the jack screw moves down. For calibrating digital instruments such as load cells, typically after exercising the instrument, a small contact force is applied, and the indicators for both standard and unit under test are tared to zero.

To apply a predetermined amount of force, start turning the handwheel in the appropriate direction while watching the output of the reference load cell. Once a certain amount of force is reached, if the user stops the movement of the jack, the creep in the force instrument and the machine might cause some changes in the force value. However, the user can continuously adjust the position of the mechanical jack to keep the force near the target force. Morehouse offers various types of load cell indicators that can be used to monitor the reference load cell output in ratiometric mV/V or direct force values in engineering units based on the user's preferences.

The force applied to the calibration setup is generated by the movement of the mechanical screw jack. In other words, the jack converts the rotation applied to the handwheel by the user into unidirectional force. Therefore, the force applied by the jack depends on the number of turns on the handwheel, with higher levels of force requiring a higher amount of torque to turn the handwheel. As the applied force increases, the handwheel feels tighter to turn. This is normal if the applied force stays within the rated capacity of the machine and the control spring used.

4.2 Force Control

Morehouse Portable Calibrating Machine offers an exceptional capability in controlling the calibration force compared to the other commercially available calibration systems on the market. The machine uses an innovative and simplistic system to achieve this exceptional control capability. However, the capability of controlling the force can change to some extent based on the user's experience, the quality of the force reference standards, and the indicator system. Tests have shown that a user can control the calibration force in a Portable Calibrating Machine within ± 0.001 % of the reference standard capacity, or 0.001 lbf, whichever is greater when a Morehouse Ultra-Precision Shear Web load cell is used as the standard reference with a high accuracy indicator. For example, if a 1000 lbf Ultra-Precision load cell is used, an experienced user can control the test forces within ± 0.01 lbf.

4.3 Changing Control Springs

A special mechanism is designed in the Portable Calibrating Machines stage beam, which helps the calibrator improve force control and load line alignment. This mechanism is inside the housing threaded at the stage beam's top. This mechanism includes a die spring, and each machine is supplied with one, two, or three springs with different properties based on the user's requirements. The springs are color-coded and designed for various loading ranges as follows:

- Gray: 1–2000 lbf compression or tension calibration
- Yellow: 1–750 lbf compression or tension calibration
- Blue: 1–250 lbf compression or tension calibration

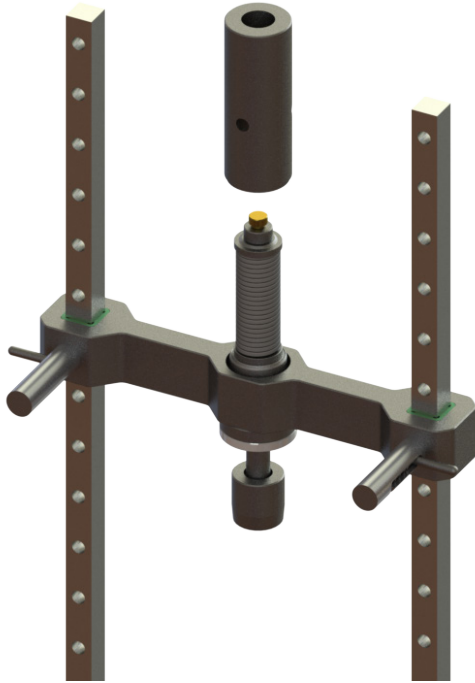
In general, the gray spring (up to 2000 lbf loading) can be used for any calibration with test points up to the machine's capacity. However, if all the test points in a calibration are under 1000 lbf, the yellow spring can be used to gain better control over the applied force. In other words, springs with lower ratings provides better force control but with lower capacities. There is a hole cut in the housing that contains the control improvement mechanism through which the color of the existing spring in the machine is always visible. The user can identify which spring is already installed into the machine and decide whether to change the spring.

1. Open the mechanism housing by turning it counterclockwise.
2. Remove the thumb screw on the top of the loading rod.
3. Remove the nut from the top of the loading rod assembly. The nut is hand tightened and should not need a wrench to open. Be aware that once the nut comes out, the loading rod assembly will come apart and fall out of the machine. Hold your hand underneath the coupling nut to keep the assembly in place.
4. Save the alignment bushings on top and at the bottom of the spring. Replace the spring with the desired one. The springs can be installed from either end.
5. Use the alignment bushings while installing the new control spring, and put them in the same order that they came out. The alignment bushings are marked on the side for easier identification.
6. Use the spherical nut to put the assembly together. Ensure the loading rod extends beyond the nut when installed. Tighten the nut until there is no free play between the spring and the alignment bushing. Then, back nut off 1/16 of a turn to ensure the spring is not being compressed.
7. Install the thumb screw on top of the loading rod, finger-tight.
8. Put the mechanism housing back on the stage beam by turning it on the beam in a clockwise direction. Ensure to have the housing completely threaded in with full engagement. The housing is load bearing in compression and needs to have full engagement, but not tightened beyond hand-tightening.

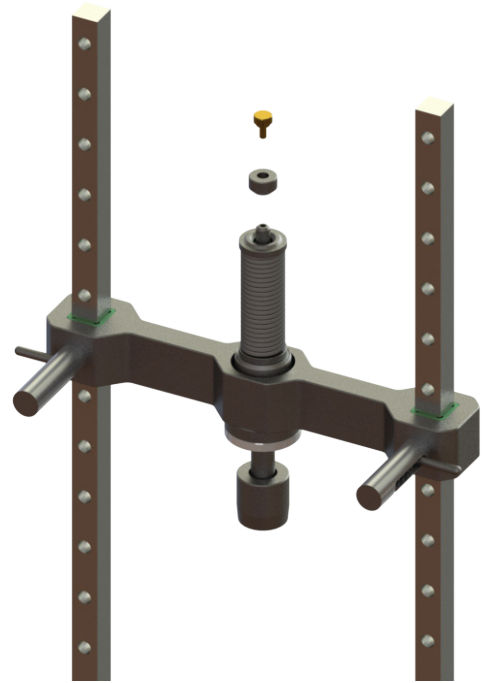
IMPORTANT TIP: The alignment bushings' orientation and placement at the spring's top and bottom are very important. Pay attention to the markings on the bushings to see which goes on top and which goes to the bottom of the spring. Pay attention to the configuration of the bushings (Figure 6) and how they are assembled with the spring when you open the control spring assembly.



a)



b)



c)

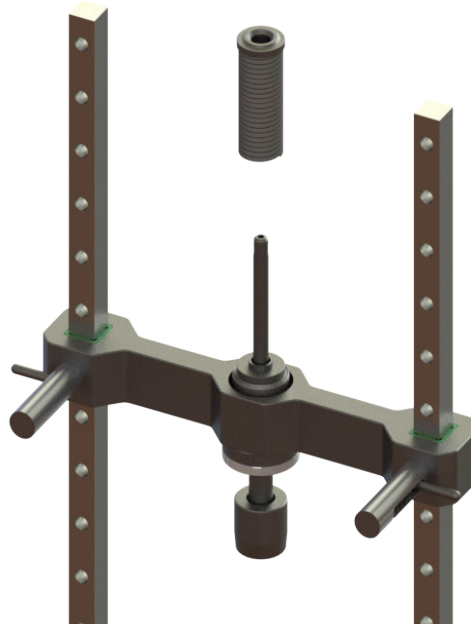


Figure 5: Changing the Control Spring: a) Removing the Housing, b) Removing the Thumb Screw and Spherical Nut; c) Removing the Control Spring

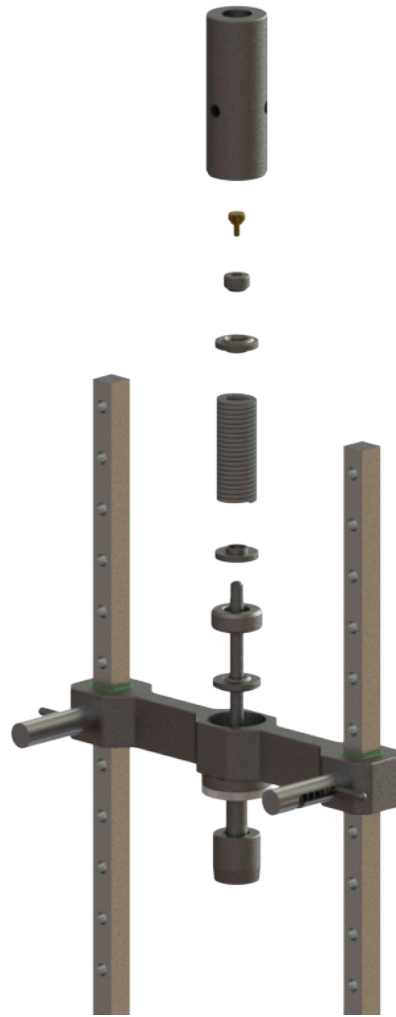


Figure 6: Assembly of the Control Spring Mechanism

5. Maintenance

The mechanical jacks in Morehouse Portable Calibrating Machines are lubricated before leaving the manufacturing plant. For regular operation, jacks should be greased about once per month. Under extended use, grease twice monthly or as conditions dictate. Grease through the fitting on the jack with hand or power-operated equipment. Grease with No. 1 Consistency Grease. Do not allow the jack to operate unlubricated. It is the user's responsibility to maintain sufficient lubrication of the jack and the lifting screw.

The products listed below are recommended by the lubricant manufacturers to meet the requirements for normal operation. The listing of brand names is solely for the convenience of equipment users and their lubricant suppliers; it does not constitute any endorsement. Morehouse assumes no responsibilities for the quality, performance, or availability of any listed products. The total grease capacity for the screw jack used in the Portable Calibrating Machines is about 1.8 oz. or 5 shots.



Table 1: Recommended Lubricants for the Screw Jack

Company	Brand Name
Mobilgrease	XHP 461
Mobilgrease	XHP 221
Shell Oil Company	Retinax HD NLGI 1
Shell Oil Company	Albina SLC 460
Mobil Oil	Mobilith SHC PM 460

The stage beam of the machine is in contact with the guideposts through a set of self-lubricating nylon bushings to avoid jamming in the stage beam slide. To keep the stage beam slide smooth, the surface area of the guideposts needs to stay clean and debris-free. In addition, once the movement of the stage beam is not smooth enough, applying some oil to the nylon bushings and the guidepost surfaces will smoothen the slide again.

Upon completion of routine inspection and preventative maintenance procedures, coat all unpainted guidepost surfaces with some light machine oil to prevent rusting on these surfaces.

6. Safety

For general guidelines about force calibration safety, refer to the [Morehouse Force Measurement Equipment Safety](#) guide (PG-9000) for general guidelines about force calibration safety. In addition, the following safety practices must be exercised when using a Portable Calibrating Machine. To avoid situations that may always cause personal injuries, wear eye protection when using a Morehouse Portable Calibrating Machine or any other force-calibrating machine.

- Any adapter or accessory you may design, make, or purchase for use with a Portable Calibrating Machine or force measuring instrument must be of proper design and made from steel of the proper strength to withstand the forces to which it is subjected. Adapters and accessories must be test-loaded under safe conditions before using an instrument. Equipment should not be used beyond its maximum rated capacity. Failure to use the proper strength material may result in severe injury or death.
- Inspect all machine parts regularly to ensure all the components are free of defects and assembled properly. Look for any damaged connections or loose bolts. Contact Morehouse with any questions about the assembly of the parts or for ordering new parts.
- The quick-adjust latches on the stage beam play a critical role in the Portable Calibrating Machine's load-bearing capability. Before starting to apply force, check the latches to ensure that they are completely pushed in and the holding pin is fully engaged. Figure 8 demonstrates how to check the engagement of the stage beam latches

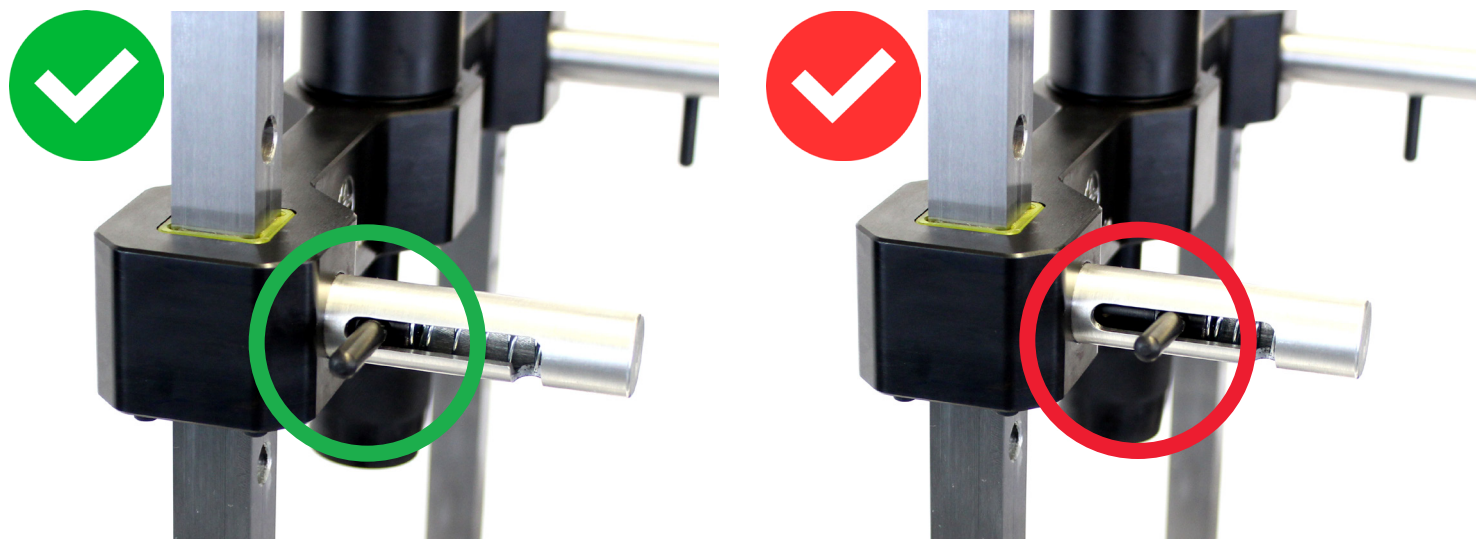


Figure 7: Quick-Change Latch: a) Correct: Fully Engaged, b) Incorrect: Partially Engaged

- The control improvement mechanism on top of the stage beam must be checked regularly and be fully closed before applying any forces. The mechanism's housing cover must be closed and fully threaded into the stage beam before applying forces.
- The spherical nut on top of the control spring and loading rod assembly is also critical in the load-bearing capability of the machine. Regularly check and ensure that the spherical nut has full thread engagement to the threaded portion of the loading rod before using the machine. Make sure the thumb screw is fully threaded onto the loading rod, as this will keep the spherical nut from working loose during use.
- When applying compression calibration force, the loading rod may move, causing the spherical nut to move out of the control spring housing. Do not touch the spherical nut when the machine is under load.
- When the machine is applying force, do not touch the machine's moving parts, such as the jack screw, quick-change latches, loading rod, control spring housing, etc.
- Always operate the machine on a flat and level surface with no risk of falling down or losing sight of it. When the machine is under load, prevent any impact or sudden movements to the machine.
- The Portable Calibrating Machine (Model: PCM-2MD-02) can only be used to generate forces within the rated capacity of the machine. Trying to generate higher forces may cause damage to the machine and result in a dangerous situation for the user. All necessary safety precautions for using manual machinery must be carefully exercised when using Portable Calibrating Machine.
- Read the instruction manual carefully and ensure that anyone who intends to operate the machine has proper training on safe practices of using a Portable Calibrating Machine.

Applying forces to equipment and instruments is inherently dangerous. This document does not, and cannot, foresee all safety considerations in your testing and application environments. It is important to give careful consideration to any application of force.



7. Parts

To order parts and accessories for your Portable Calibrating Machine, contact Morehouse Sales team. Figure 8 and Table 2 demonstrate the parts included in a Portable Calibrating Machine Model PCM-2MD-02.

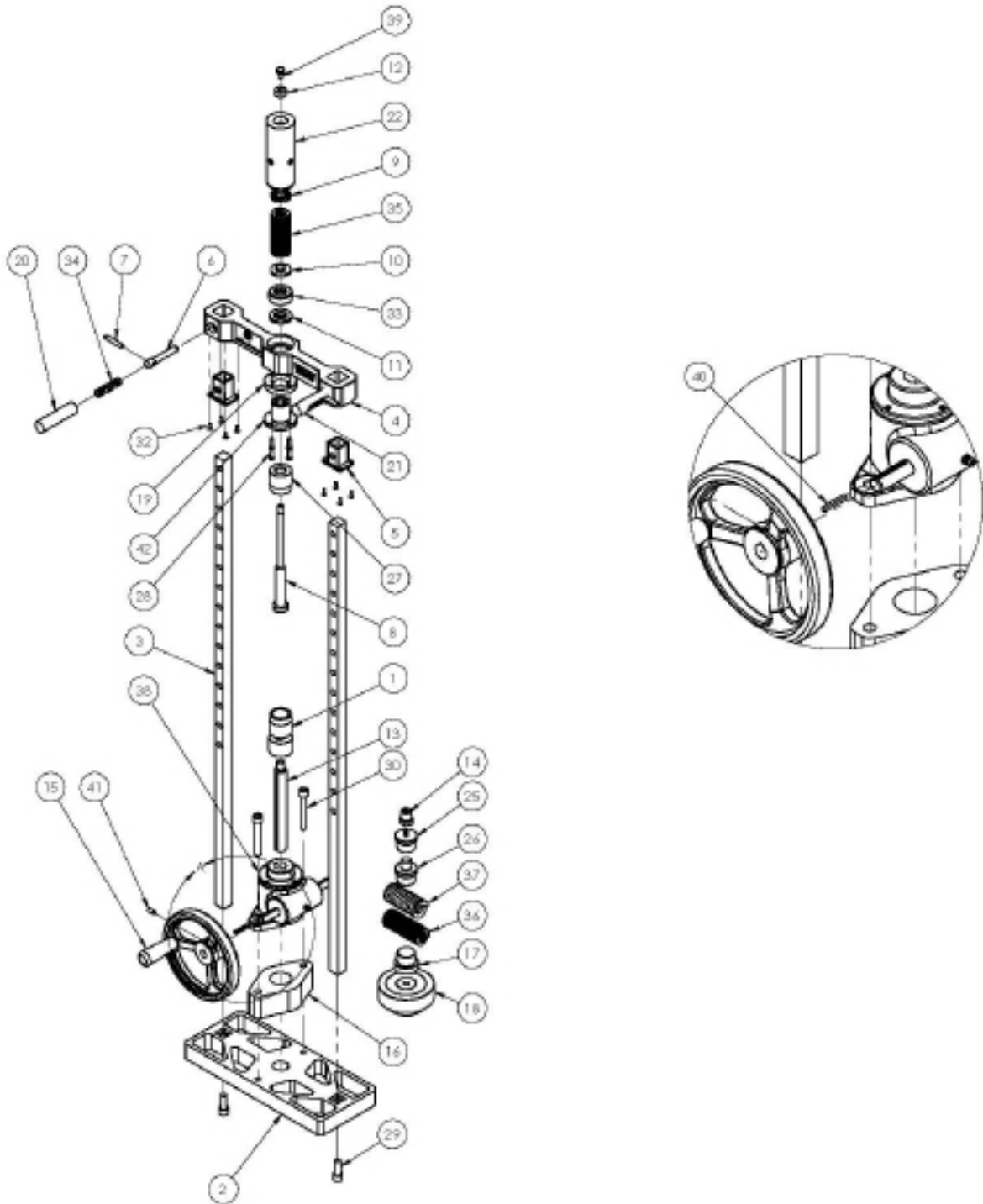




Figure 8: General Assembly of a Portable Calibrating Machine, Model: PCM-2MD-02




Table 2: Parts List for Portable Calibrating Machine, Model: PCM-2MD-02

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	MS-0047	COUPLING ASSEMBLY, PCM	1
2	PC-2-013-01	BASE PLATE	1
3	PC-2-014-02	GUIDE POST	2
4	PC-2-016-01	STAGE BEAM	1
5	PC-2-022-01	NYLON INSERT	2
6	PC-0-024-01	PLUNGER	2
7	PC-2-029-01	PLUNGER HANDLE	2
8	PC-2-038-01	TENSION ROD	1
9	PC-2-040-01	SPRING ALIGN TOP BUSHING	1
10	PC-2-042-01	SPRING ALIGN MIDDLE BUSHING	1
11	PC-2-044-01	SPRING ALIGN BOTTOM BUSHING	1
12	PC-2-046-01	SPHERICAL NUT	1
13	PC-2-052-01	LEAD SCREW	1
14	PC-2-054-01	STANDARD MOUNTING ADAPTER	1
15	PC-2-054-03	STANDARD MOUNTING ADAPTER	1
16	PC-2-055-01	BUSHING (MOUNT ADAPTER)	1
17	PC-0-056-01	HANDWHEEL	1
18	PC-2-060-01	JACK SPACER BLOCK	1
19	PC-2-062-01	COMP BALL SEAT ADAPTER	1
20	PC-2-064-01	COMP BASE PLATE	1
21	PC-2-071-01	SPACER FLANGE	1
22	PC-2-072-01	PLUNGER COVER, LEFT	1
23	PC-2-072-02	PLUNGER COVER, RIGHT	1
24	PC-2-100A-01	DIE SPRING	1
27	TC-12	TENSION COUPLING NUT	1
28	ZF-36-2018-ALLOY	# 8-32 x 0.625", SOCKET HEAD CAP SCREW	4
29	ZF-26-2636-ALLOY	3/8"-16 X 1.000", SOCKET HEAD CAP SCREW	2
30	F-36-4436-ALLOY	3/8"-16 X 2.500", SOCKET HEAD CAP SCREW	2
32	ZF-51-1614-ALLOY	# 6-32 X 0.375", BUTTON HEAD CAP SCREW	8
33	ZM-14-003	THRUST BEARING	1
34	ZM-17-004	SPRING	2
35	ZM-18-001	DIE SPRING, GRAY	1
36	ZM-18-002	DIE SPRING, YELLOW	1
37	ZM-18-003	DIE SPRING, BLUE	1
38	ZM-23-001	SCREW JACK	1
39	ZZ-0341	THUMB SCREW	1
40	ZZ-0396-00120-STEEL	MACHINE KEY	1
41	ZZ-0405-182801-ALLOY	SET SCREW	1
42	ZZ-0411	LINEAR BEARING	1

 **WARNING:** Morehouse Instrument Company products are precision instruments for specific force or torque calibration applications. Improper use, exceeding stated capacities, or unauthorized modifications can result in severe injury, death, machine damage, and warranty voiding. Always ensure proper installation, alignment, and use within specified limits. Do not use damaged or visibly compromised components. Refer to your product manual for proper use and specifications. If you have questions about a Morehouse Instrument Company product's capabilities or limitations or to access a manual, please contact your sales representative or email info@mhforce.com.

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 Français

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 Deutsch

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 Italiano

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 Norsk

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 Português

AVISO: Os produtos da Morehouse Instrument Company são instrumentos de precisão para aplicações específicas de calibração de força ou torque. O uso inadequado, a superação das capacidades declaradas ou modificações não autorizadas podem resultar em ferimentos graves, morte, danos à máquina e anulação da garantia. Certifique-se sempre da instalação, alinhamento e uso corretos dentro dos limites especificados. Não use componentes danificados ou visivelmente comprometidos. Consulte o manual do seu produto para uso e especificações adequados. Se você tiver dúvidas sobre os recursos ou limitações de um produto da Morehouse Instrument Company, ou para acessar um manual, entre em contato com seu representante de vendas ou envie um e-mail para info@mhforce.com.

 Español

ADVERTENCIA: Los productos de Morehouse Instrument Company son instrumentos de precisión para aplicaciones específicas de calibración de fuerza o par. El uso inadecuado, la superación de las capacidades indicadas o las modificaciones no autorizadas pueden provocar lesiones graves, la muerte, daños en la máquina y la anulación de la garantía. Asegúrese siempre de que la instalación, la alineación y el uso sean correctos dentro de los límites especificados. No utilice componentes dañados o visiblemente comprometidos. Consulte el manual de su producto para conocer el uso y las especificaciones correctas. Si tiene preguntas sobre las capacidades o limitaciones de un producto de Morehouse Instrument Company, o para acceder a un manual, póngase en contacto con su representante de ventas o envíe un correo electrónico a info@mhforce.com.

 Svenska

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