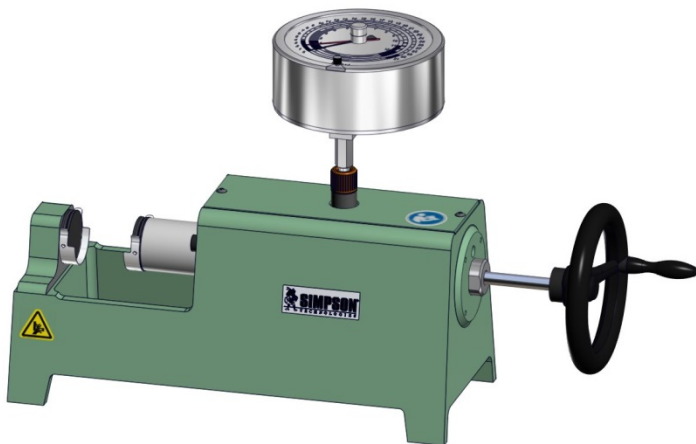


Operating Instructions

Universal Strength Machine

Model PFG



Accessories: Model

Splitting Strength Accessory	PSP
Twin-Transverse Shear Strength Accessory	PQS
Transverse Strength Accessory	PBV
Tensile Strength Accessory	PZV
Low Pressure Gauge	PNM
High Pressure Gauge	PHM

Type:

Universal Strength Machine

Model:

PFG

Part No.:

592-824-600

Serial No.:

Name and address of manufacturer:

Simpson Technologies GmbH
Thomas-Eßer-Str. 86
D - 53879 Euskirchen,
Germany

For other Simpson Technologies offices around the world and for our contact information please visit us on the internet at [simpsongroup.com](https://www.simpsongroup.com) on the Contacts page.

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1 Introduction

Congratulations, you have just purchased an extremely reliable sand testing instrument that is backed by the professional technical support and years of proven sand technology experience of Simpson Technologies.

This laboratory equipment is constructed of quality materials and is the result of unsurpassed craftsmanship. The Universal Strength Machine should be operated only when it is in perfect condition, in accordance with its designed purpose and being aware of possible hazards. Observe the safety instructions in Section 2 and operating instructions in Section 5.

1.1 Application and Designated Use

This device is intended exclusively for measuring the strength of foundry sands mixed with clay and chemical binders. Usage of other materials may be possible upon consultation with the Technical Service of Simpson Technologies.

Any other application outside the intended usage will be regarded as use not in accordance with its purpose, and, therefore, the manufacturer/supplier will not be held liable for any damage that might arise hereunder. The risk in this case will be exclusively that of the user.

1 Introduction

1.2 Organizational Measures

The operating instructions should be readily available at the place of operation. In addition to the operating instructions, the general legal regulations or other mandatory rules for prevention of accidents and environmental protection should be made known and be observed!

The personnel instructed to use this apparatus, before beginning work, should have studied and fully understood these Operating Instructions, in particular the “Safety” chapter.

No modifications, extensions or changes of design of the device that would impact safety requirements should be put into effect without prior consent of the supplier! Spare parts must conform to the technical specifications defined by the manufacturer. This is always guaranteed when using original spares.

2 Safety

NOTICE

Before operating and/or performing maintenance or repair on Simpson Technologies designed and/or manufactured equipment, it is required that all personnel have read and understood the entire Operation Maintenance manual. If any questions exist, you must contact your supervisor or Simpson Technologies before taking further action.

If properly operated and maintained, your Simpson Technologies supplied equipment can provide many years of dependable and safe operation. Please follow all recommended safety, operating, and maintenance instructions. Furthermore, the introduction of any non-Simpson Technologies manufactured and/or approved parts to the equipment may create a hazardous situation. Never alter the equipment without prior consultation with Simpson Technologies .



DO NOT use this machine for purposes other than that for which it is intended. Improper use could result in death or serious injury.

2.1 Safety Signs and Labels

Simpson Technologies has incorporated the ANSI Z535.6/ISO 3864-1-2 safety symbol only label format on all of its laboratory equipment.

The harmonized ANSI Z535.6 format became an established safety label format since it not only fully meets the current ANSI Z535 standards, but also incorporates ISO 3864-2 symbology and hazard severity panel and thus, can be used for both the U.S. and international markets.

2.1.1 Safety Alert Symbols



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. OBEY all safety messages that follow this symbol to avoid possible injury or death.



DANGER! *Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*



The safety alert symbol used without a signal word to call attention to safety messages indicates a potentially hazardous situation which, if not avoided, could or may result in death or minor injury.



NOTICE indicates information used to address practices not related to personal injuries but may result in property damage.



This symbol indicates information containing important instructions concerning the use of the machine or directions for further procedures. Ignoring this information can lead to malfunction of the machine.

2.1.2 Safety Symbol Labels



HAND CRUSH / FORCE FROM RIGHT (STC #217973)

This label is located on the front left side of the machine Base just below the Hydraulic Piston.

When installing the Compression Strength Attachments and other Accessories, ensure that the Hydraulic Piston is adjusted to a fully open position and do not adjust during attachment installation. If the Hydraulic Piston is adjusted during Compression Strength Accessory installation, the Hydraulic Piston can travel and possibly pin your hand / fingers between the moving Compression Insert and the stationary Compression Insert. This may **crush** or **cut** body parts. Follow **Lockout and Tagout** procedures before servicing.



READ AND UNDERSTAND ALL SERVICE MANUAL INSTRUCTIONS (STC #214081)

This label is located on the lower right corner of the top Base Cover Plate.

Before operating and/or performing any maintenance or repair on Simpson Technologies designed and/or manufactured equipment, it is required that all personnel read and understand the entire Operating Instructions manual. All protective guards and covers shall be installed and all doors closed before operating the equipment. If any questions exist, you must contact your Supervisor or Simpson Technologies before taking further action. Follow **Lockout and Tagout** procedures before servicing. Safety System Procedure

NOTICE

*Whenever performing any type of maintenance or repair, whether in the form of cleaning, inspection, adjustment or mechanical maintenance, the equipment must be rendered into **Zero Mechanical State (ZMS)**.*

Prior to maintenance (routine or otherwise) or repair of equipment, a safety procedure should be established and maintained. This procedure should include training of personnel; identification and labeling of all equipment which is interlocked mechanically, through levers, gravity or otherwise; and a listing of the established lockout procedures posted on each equipment.

2.1.3 Glossary:

Authorized Person(s) - Personnel who have been designated by his/her department to perform maintenance or service on a piece(s) of equipment, machinery or system, and are qualified to perform the work through proper training on Safety System Procedures for the equipment, machinery or system.

Lockout - The placement of a lockout device on an energy isolating device, in accordance with an established procedure, to ensure that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout Device - Any device that uses positive methods, such as a lock (either key or combination type), to hold an energy isolating device in a safe position, thereby preventing the energizing of machinery or equipment. When properly installed, a blank flange or bolted slip blind are considered equivalent to lockout devices.

Tagout - The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout Device - Any prominent warning device, such as a tag and a means of attachment, that can be securely fastened to an energy isolating device in accordance with an established procedure. The tag indicates that the machine or equipment to which it is attached is not to be operated until the tagout device is removed in accordance with the energy control procedure.

Zero Mechanical State - The mechanical potential energy of all portions of the equipment or machine is set so that the opening of pipes, tubes or hoses, and the actuation of any valve, lever or button, will not produce a movement which could cause injury.

3 Short Description & Specifications

3 Short Description & Specifications

3.1 Application

The Universal Strength Machine, Model PFG, is used to determine strength properties of clay and/or chemically bonded foundry sand specimens. A test specimen is developed using a Simpson Sand Rammer, Models 42100, 42117, 42160, PRA, or from a variety of the transverse strength sample machines, depending on the desired test. A horizontally-moving Hydraulic Piston applies pressure on a sand specimen until failure. After the maximum force is reached, the machine is manually reset, moving the piston back to the home position. The force data is displayed on an analog pressure gauge.

3.2 Description

The Universal Strength Machine, Model PFG, is capable of running many different sand strength tests with additional fixtures and accessories that are easy to connect to the instrument. These tests include green compression strength, green shear strength, splitting strength, tensile strength and core transverse strengths.

After placing the sand specimen in the strength accessory, the operator turns the Rotary Handle, moving the Hydraulic Piston and placing pressure on the sand specimen until it breaks. The analog display gauge shows the strength value in N/cm². The machine may be manually calibrated by using measuring spring forces and lengths. (See section 6.4).

3.3 Specifications, Dimensions and Weights (Approximate)

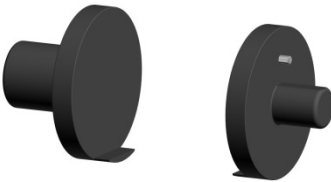
Specifications	Universal Strength Machine (PFG)
Length	613 mm (24.1 in.)
Width	220 mm (8.7 in.)
Height	355 mm (14.0 in.)
Weight	28 kg (62 lbs.)
Power	N/A

Load Capacity		
Test Selection	With PNM	With PHM
Force	640 N	2600 N
Compression Strength	32.6 N/cm ²	132.4 N/cm ²
Twin-Transverse Shear Strength	16.3 N/cm ²	66.2 N/cm ²
Core Tensile Strength	128 N/cm ²	520 N/cm ²
Core Transverse Strength	1280 N/cm ²	5200 N/cm ²
Core Splitting Strength	25.6 N/cm ²	104 N/cm ²

3.4 Accessories

3.4.1 Splitting Strength Accessory (Model PSP)

This accessory is mounted on the Universal Strength Machine, Model PFG, and is used to determine the splitting strength of clay bonded molding sands. A standard sand specimen of 50 mm x 50 mm is placed between the two testing clamps with its radial surface against the face of each clamp. When the sand specimen is compressed through its diameter, a split is formed along its horizontal axis. The splitting strength test is considered an indirect measurement of a molding sand's tensile strength property.



Specifications	Splitting Strength Accessory
Length	ca. 42 mm (1.65 in.)
Width	ca. 55 mm (2.17 in.)
Height	ca. 55 mm (2.17 in.)
Weight	ca. 0.42 kg (0.93 lb.)

3.4.2 Twin-Transverse Shear Strength Accessory (Model PQS)

This accessory is mounted on the Universal Strength Machine, Model PFG, and is used to determine the shear strength of clay bonded molding sands. A standard sand specimen of 50 mm x 50 mm is placed between the two testing clamps with its radial surface against the curved edge of each clamp. The clamp design instigates a shear force at two locations along the horizontal plane.



Specifications	Twin-Transverse Shear Strength Accessory
Length	ca. 50 mm (1.97 in.)
Width	ca. 60 mm (2.36 in.)
Height	ca. 50 mm (1.97 in.)
Weight	ca. 0.61 kg (1.34 lb.)

3.4.3 Transverse Strength Accessory (Model PBV)

This accessory is mounted on the Universal Strength Machine, Model PFG, and is used to determine the transverse strength of standard core sand transverse specimens.

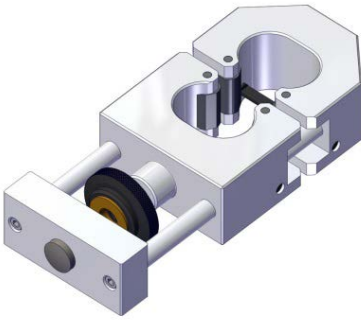


Specifications	Transverse Strength Accessory
Length	ca. 85 mm (3.35 in.)
Width	ca. 190 mm (7.48 in.)
Height	ca. 48 mm (1.89 in.)
Weight	ca. 0.60 kg (1.32 lb.)

3 Short Description & Specifications

3.4.4 Cold Tensile Strength Accessory (Model PZV)

This accessory is mounted on the Universal Strength Machine, Model PFG, and is used to determine the cold tensile strength of standard dog bone specimens prepared from oil, cold box, hot box, and air set sands (no-bake).



Specifications	Transverse Strength Accessory
Length	ca. 233 mm (9.17 in.)
Width	ca. 94 mm (3.70 in.)
Height	ca. 50 mm (1.97 in.)
Weight	ca. 1.4 kg (3.09 lb.)

3.4.5 High/Low Pressure Gauge (Model PHM/PNM)

These accessories are mounted on the top of the Universal Strength Machine, Model PFG, and are used to obtain pressure readings from various sand strength tests. Each of the gauges can measure maximum compression, transverse, shear, splitting, and tensile strength. This is accomplished by means of a Pressure Indicator Pointer and Maximum Pressure Follower. The standard gauge with the Universal Strength Machine is the Low Pressure Gauge, Model PNM, but in some applications it may be necessary to use the accessory High Pressure Gauge, Model PHM. See Section 5.6 of the Universal Strength Machine Operating Instructions for details of both gauges.



Specifications	Transverse Strength Accessory
Length	ca. 160 mm (6.30 in.)
Width	ca. 160 mm (6.30 in.)
Height	ca. 152 mm (5.98 in.)
Weight	ca. 2 kg (4.40 lb.)

4 Unpacking and Installation

4.1 Unpacking

NOTICE

Your new laboratory equipment has been closely inspected before being shipped to your plant. However, damage can occur en route, so it is wise to inspect all equipment on arrival. Notify both the carrier and Simpson Technologies of any damage at once. Damage should be noted on the shipper's receipt before signing for receipt of the shipment.

The Universal Strength Machine, Model PFG, is shipped in one piece with a detached pressure gauge and is intended to be used as received; snapping on the pressure gauge is the only additional assembly required. No lifting equipment is required for handling. The Model PFG machine weighs approximately 28 kg (62 lbs.). Due to its bulky dimensions and tight fitting shipping crate, it is recommended that two people remove the equipment from the crate. Whenever positioning or relocating this instrument, two people should be utilized. The approximate instrument dimensions are 668 mm (26.3 in.) x 220 mm (8.7 in.) x 355 mm (14.0 in.). Its shipping weight (in a crate) is 32 kg (70.5 lbs.).



ONLY authorized personnel may unload and install this equipment. Two people may be required to unpack this instrument due to the bulky dimensions and tight fitting packing crate.

1. Remove any loose accessories/parts within the shipping crate and place in a location away from any packaging material to ensure that these items are not misplaced.
2. Carefully remove the tester from the packaging crate and place on stable bench.
3. Once removed from the crate, proceed by taking off any protective wrap and packaging from the tester and included accessories.
4. The packaging remains the property of the customer and may be used for returning the apparatus if some repair is required.

4.2 Components

Included in your new Universal Strength Machine are the following:

- Universal Strength Machine Base Unit
- Operating Instructions Manual
- Compression Strength Accessories
- Pressure Gauge (Model PNM)
- Connecting Pin for oil fill

If any of the above components are missing, contact your local Simpson Technologies office. See Figure 7.1 for apparatus layout and components.

NOTICE

Do not store the device in the open and unprotected from atmospheric conditions. If this instruction is not followed, claims under guarantee will no longer be considered.

4.3 Installation

The installation of the apparatus is the responsibility of the client to include procuring and preparing the material required for this purpose.

It is recommended that the Universal Strength Machine be installed in close proximity to the Sand Rammer or other desired test specimen production equipment.

The Universal Strength Machine should be placed on a stable bench free of vibrations. Although it is not required, the machine should be placed in a level condition.

The Universal Strength Machine would likely be occupied by one operator at a time. It is used in a foundry sand laboratory. The machine should be placed at an ergonomically correct position and height to allow the operator to comfortably handle the sand sample, turn the Rotary Handle, and clearly read the pressure gauge.

4 Unpacking and Installation

4.4 Checking the Oil Level

1. Turn the Rotary Handle backwards (counterclockwise) until the Hydraulic Piston (Item 3, Figure 7.1) is in the end position on the right.
2. Insert the Connecting Pin (Item 8, Figure 7.1) into the Plug Coupling (Item 5, Figure 7.1).
3. Check the oil level of the apparatus. The oil level should be level with the top of the Plug Coupling. (This will be below the top surface of the inserted Connecting Pin.)
4. If the oil level is below top of the Plug Coupling, fill with specified oil (See Section 6.1). The oil should be filled while slowly rotating the Rotary Handle (Item 6, Figure 7.1) backwards (counterclockwise) until the Spindle (Item 7, Figure 7.7) is in the end position on the right.

NOTICE

Never pull on the Hydraulic Piston (Item 3, Figure 7.1) while the Connecting Pin is inserted. This will draw air into the machine and the machine will not function properly.

5. Remove the Connecting Pin from the Plug Coupling by turning the ring on the Plug Coupling.

4.5 Assembling the Pressure Gauge

1. Ensure that the oil level is correct before assembling the pressure gauge.

NOTICE

Once the oil level is correct, do not allow the oil level to move before installing the pressure gauge. Allowing the oil to rise and spill over the Plug Coupling, or allowing the oil level to drop below the Plug Coupling (by pulling on the Hydraulic Piston) will allow air into the machine. This will cause the pressure gauge to not function properly.

2. Place the stem of the pressure gauge (Item 4, Figure 7.1 shown as Low Pressure Gauge) onto the Plug Coupling. The gauge will simply snap into place.

3. Insert the Compression Strength Accessories (Item 2, Figure 7.1) onto the Universal Strength Machine (see section 5.1.2).
4. Place a piece of wood or metal with the same dimensions of a standard test specimen (50mm x 50mm) between the Compression Attachments. Load the machine to the maximum gauge value and stop. Ensure that the pressure only decreases very slowly and that the gauge indicates immediate changes in the Hydraulic Piston.

4.6 Airborne Noise Emission

Regarding airborne noise emission by the Universal Strength Machine, Model PFG, there is no motor or other noise emitted by this machinery. As such, the equivalent continuous A-weighted sound pressure level at the workstation does not exceed 70dB(A).

5 Operating Instructions



For more information on how to use and care for your Simpson Analytics equipment and accessories visit our Simpson Technologies channel on YouTube and search our library of videos. Subscribe to our channel to keep updated on new releases.

5.1 Compression Strength Testing with Standard Compression Strength Accessories (Clay Bonded Molding Sands)

5.1.1 Description

The standard Compression Strength Accessories consist of two clamps, included with the machine, which are used to measure the compression strength of molding sand. These standard clamps mount directly onto the Universal Strength Machine, Model PFG.

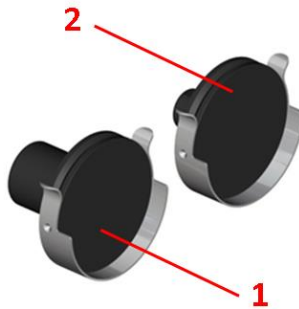


Figure 5.1.1

Item	Description
1	24 mm dia. Compression Strength Accessory
2	15 mm dia. Compression Strength Accessory

5.1.2 Preparing the Molding Sand Specimens for Compression Strength Testing

The Universal Strength Machine, Model PFG, requires a standard 50 mm x 50 mm sand specimen to test for compression, splitting, and shear strength testing. Manufacture a sand specimen using a standard Sand Rammer (Simpson Models 42100, 42117, 42160, or PRA).



Detailed sand specimen preparation instructions can be found in the operation manual for the Sand Rammer being used. Follow the step by step procedure in the operation manual to prepare the proper sand specimen.

5.1.3 Installation of the Standard Compression Strength Accessories

1. The Universal Strength Machine, Model PFG, includes the required attachments to measure the compression strength of molding sand. The attachments required to perform this test are shown in Figure 5.1.1.
2. Install the two Compression Strength Attachments. First, align each of the pins located on the back side of the clamps with the holes located on the Base and Hydraulic Piston of the Universal Strength Machine. Then, gently slide the 24 mm attachment (Item 1, Figure 5.1.1) and 15 mm attachment (Item 2, Figure 5.1.1) into the Base and Hydraulic Piston, respectively. See Figure 5.1.2.

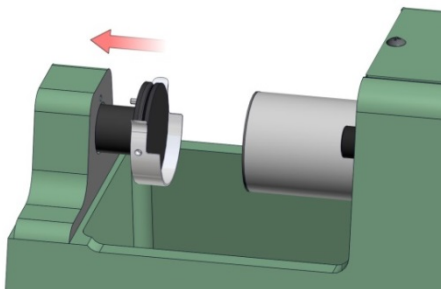


Figure 5.1.2



Refer to Figure 5.1.3, showing a detailed photo of Compression Attachments correctly installed on the Universal Strength Machine.

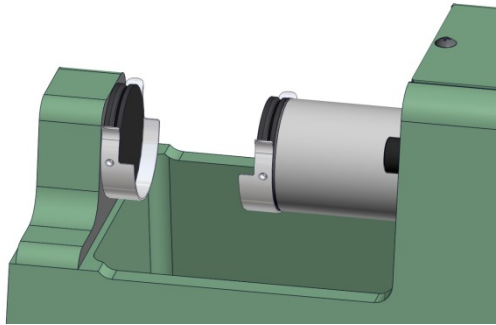


Figure 5.1.3

5.1.4 Operation

1. Manually set the red Pressure Indicator Follower (Item 2, Figure 5.6.1) on the pressure gauge to zero.
2. Place the standard test specimen between the two surfaces of the Compression Strength Accessories. The Compression Accessories should be oriented so that they can support the test specimen, but are not yet placing a load on the specimen.
3. Rotate the Rotary Handle clockwise to load the test specimen. Load the specimen increasingly, and consistently. (Clay bonded sand specimen: load approximately 0.25 N/cm^2 per second). Continue to load the specimen until it breaks. (See Figure 5.1.4).



Always transport clay bonded molding sand samples from the shop floor to the sand laboratory in a sealed container to help reduce strength measurement variation that may occur due to water evaporation from the sand sample. Temperature of the prepared molding sand sample should be tested while transporting the sample container from the shop floor to the laboratory. Sand temperature should be recorded with strength data. Prepared clay bonded molding sand of equal compositions with large temperature variations will result in erratic strength properties.

4. After the specimen breaks, the red Pressure Indicator Follower of the pressure gauge will display the maximum compression strength (σ_D in N/cm^2). Remove the specimen from the Universal Strength Machine. If using the Low Pressure Gauge, Model PNM, the indicated value on the outer scale is the compression strength. If using the High Pressure Gauge, Model PHM, the indicated value multiplied by 10 is the compression strength.



Do not run multiple tests of any type on the same test specimen. The sand sample has been destroyed after the test

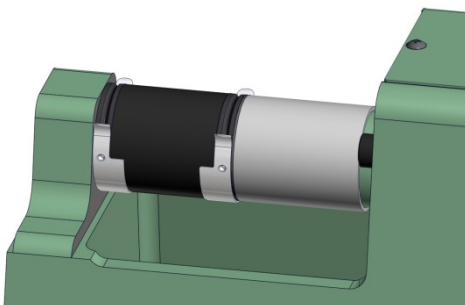


Figure 5.1.4

5.2 Splitting Strength Accessory



Part No. 582-001-602

5 Operating Instructions

5.2.1 Description

The Splitting Strength Accessory, Model PSP, to the Universal Strength Machine, Model PFG, consists of two specially designed clamps mounted to the strength machine to determine the splitting strength of a clay bonded molding sand in green or dry conditions.

In this test a standard cylindrical sand specimen is squeezed between two specially designed compression clamps. As these clamps squeeze the sand specimen, a split is formed that runs parallel to the axis of the specimen.

The values of splitting strength tests have been found to have very low dispersion. The splitting test is easy to execute and the test utilizes the same type of sand specimen used in the standard green compression test.

It has been found that there is a close correlation between splitting strength and tensile strength in clay bonded molding sand. Since the tensile strength test is difficult and delicate, it is preferable to determine tensile strength as a function of splitting strength.

Tensile and splitting strength reflect the degradation and dilution process of bentonites in molding sand better than the compression test.

5.2.2 Preparing the Molding Sand Specimens for Splitting Strength Testing

See Section 5.1.2 for sand specimen preparation.

5.2.3 Installation

1. Install the two Splitting Strength Clamps by first, aligning each of the pins located on the back side of the clamps with the holes located on the Base and Hydraulic Piston of the Universal Strength Machine. Then, gently slide the 24 mm attachment onto the base (left) and 15 mm attachment onto the Hydraulic Piston (right). See Figure 5.2.2 below for installation.

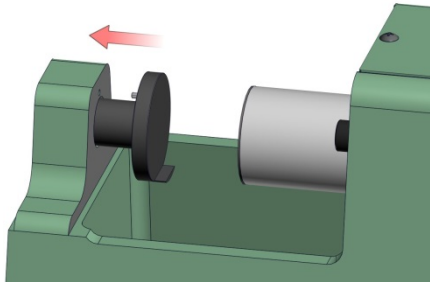


Figure 5.2.2



Refer to Figure 5.2.3, showing detailed photos of the Splitting Strength Clamps correctly installed on the Universal Strength Machine.

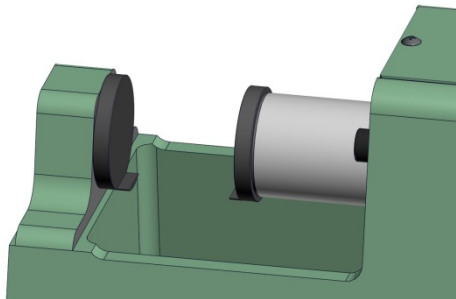


Figure 5.2.3

5 Operating Instructions

5.2.4 Operation

1. Manually set the red Pressure Indicator Follower (Item 2, Figure 5.6.1) on the pressure gauge to zero.
2. Place the standard test specimen vertically between the attachment surfaces (flat surface down), so it is resting on the bottom ledge of the clamps. The Splitting Strength Clamps should be oriented so that they can support the test specimen, but are not yet placing a load on the specimen.
3. Rotate the Rotary Handle clockwise to load the test specimen. Load the specimen increasingly, and consistently. (Clay Bonded sand specimen: load approximately 0.25 N/cm² per second). Continue to load the specimen until it breaks.



Always transport clay bonded molding sand samples from the shop floor to the sand laboratory in a sealed container to help reduce strength measurement variation that may occur due to water evaporation from the sand sample. Temperature of the prepared molding sand sample should be tested while transporting the sample container from the shop floor to the laboratory. Sand temperature should be recorded with strength data. Prepared clay bonded molding sand of equal compositions with large temperature variations will result in erratic strength properties.

4. After the specimen breaks, the red Pressure Indicator Follower of the pressure gauge will display the maximum splitting strength (σ_S in N/cm²). Remove the specimen from the Universal Strength Machine. If using the Low Pressure Gauge, Model PNM, the maximum indicated value on the middle scale is the splitting strength (σ_{SP} in N/cm²). If using the High Pressure Gauge, Model PHM, the maximum indicated value multiplied by 10 is the splitting strength (σ_{SP} in N/cm²). See Figure 5.2.4 for test procedure.



Do not run multiple tests of any type on the same test specimen. The sand sample has been destroyed after the test.

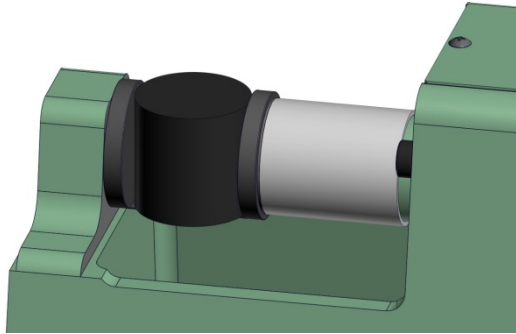
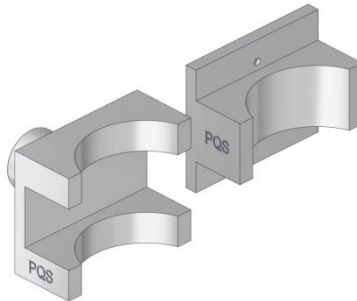


Figure 5.2.4

5.3 Twin-Transverse Shear Strength Accessory



Part No. 582-002-230

5 Operating Instructions

5.3.1 Description

This Twin-Transverse Shear Strength Accessory, Model PQS, consists of two specially designed clamps mounted to the Universal Strength Machine and is used to determine the shear strength of a clay bonded molding sand specimen.

In this test, a standard cylindrical test specimen is squeezed between the two specifically designed shear clamps. As these clamps squeeze, a shear split forms on the sand specimen at the edges of the opposing clamps. The shear test utilizes the same type of sand specimen used in the standard clay bonded sand compression test.

5.3.2 Preparing the Molding Sand Specimens for Shear Strength Testing

See Section 5.1.2 for sand specimen preparation.

5.3.3 Installation

1. Install the two Twin-Transverse Shear Clamps by first, aligning each of the pins located on the back side of the clamps with the holes located on the Base and Hydraulic Piston of the Universal Strength Machine. Then, gently slide the 24 mm attachment onto the base (left) and 15 mm attachment onto the Hydraulic Piston (right). See Figure 5.3.2 below for installation process.

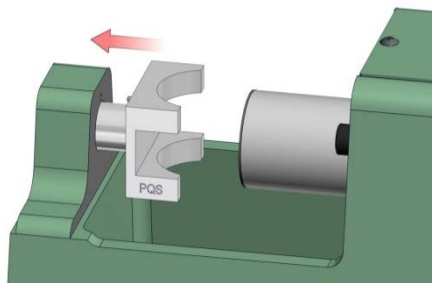


Figure 5.3.2



Refer to Figure 5.3.3, showing detailed photos of the Twin-Transverse Shear Accessory correctly installed on the Universal Strength Machine.

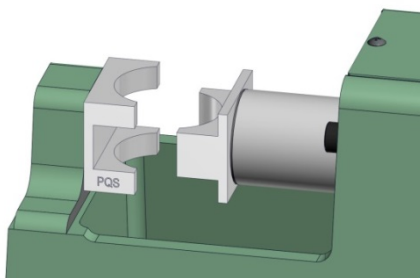


Figure 5.3.3

5.3.4 Operation

1. Manually set the red Pressure Indicator Follower (Item 2, Figure 5.6.1) on the pressure gauge to zero.
2. Place the standard test specimen vertically between the attachment surfaces (flat side down). The Twin-Transverse Shear Clamps should be oriented so that they can support the test specimen, but are not yet placing a load on the specimen.
3. Rotate the Rotary Handle clockwise to load the test specimen. Load the specimen increasingly, and consistently. (Clay bonded sand specimen: load approximately 0.25 N/cm^2 per second). Continue to load the specimen until it breaks.



Always transport clay bonded molding sand samples from the shop floor to the sand laboratory in a sealed container to help reduce strength measurement variation that may occur due to water evaporation from the sand sample. Temperature of the prepared molding sand sample should be tested while transporting the sample container from the shop floor to the laboratory. Sand temperature should be recorded with strength data. Prepared clay bonded molding sand of equal compositions with large temperature variations will result in erratic strength properties.

4. After the specimen breaks, the red Pressure Indicator Follower of the Low Pressure Gauge will display the maximum shear strength (σ_D in N/cm^2). Remove the specimen from the Universal Strength Machine. The maximum indicated value divided by two on the outer scale is the shear strength (σ_S in N/cm^2). See Figure 5.3.4 for test procedure.



Do not run multiple tests of any type on the same test specimen. The sand sample has been destroyed after the test.

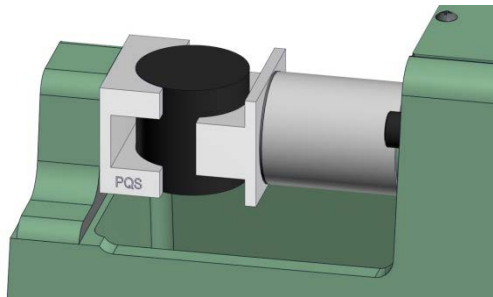


Figure 5.3.4

5.4 Transverse Strength Accessory



Part No. 592-803-033

5.4.1 Description

The Transverse Strength Accessory, Model PBV, is used for transverse strength testing of chemically bonded foundry sand samples. The clamps of this accessory are mounted onto the Universal Strength Machine, Model PFG. The accessory holds the standard 22.4 mm x 22.4 mm x 175 mm rectangular transverse sand specimens.

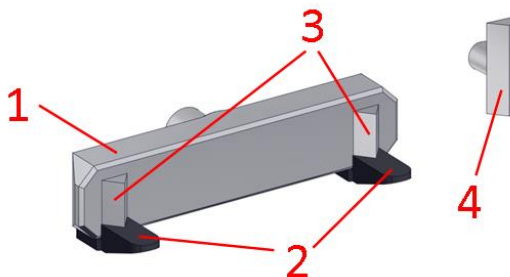


Figure 5.4.1

Item	Description
1	Transverse Support Clamp
2	Specimen Support Pieces
3	Specimen Backing Wedges
4	Pressure Wedge

5.4.2 Installation

1. Install the two Transverse Strength Accessory components by first, aligning each of the pins located on the back side of the components with the holes located on the Base and Hydraulic Piston of the Universal Strength Machine. Then, gently slide the Test Support Clamp (Item 1, Figure 5.4.1) and Pressure Wedge (Item 4, Figure 5.4.1) onto the Base and Hydraulic Piston, respectively. See Figure 5.4.2 for installation procedure.

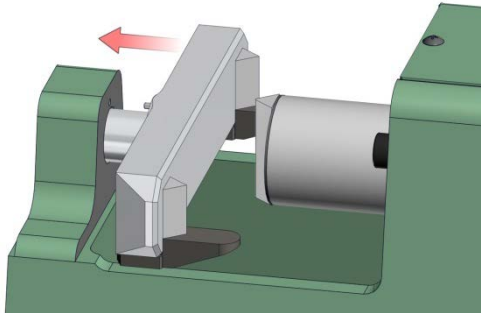


Figure 5.4.2



Refer to Figure 5.4.3, showing detailed photos of the two Transverse Strength Accessory components correctly installed on the Universal Strength Machine.

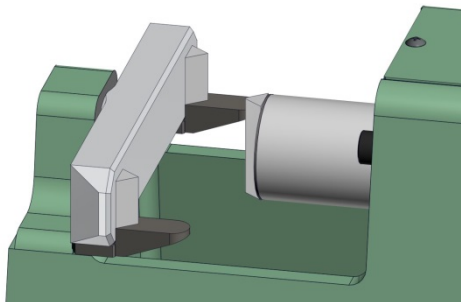


Figure 5.4.3

5.4.3 Operation

1. Manually set the red Pressure Indicator Follower (Item 2, Figure 5.6.1) on the pressure gauge to zero.
2. Gently place a prepared transverse sand specimen onto the two Specimen Support Pieces (Item 2, Figure 5.4.1) located at the bottom of the Test Piece Support Clamp. Position the sand specimen so that it is centered on the Support Clamp and makes contact with both Backing Wedges (Item 3, Figure 5.4.1); however, ensure that the sand specimen is not yet under a load from these components.
3. Rotate the Rotary Handle clockwise to load the test specimen. Load the specimen increasingly, and consistently. (Approximately $10 \text{ N/cm}^2 \sigma_B$ per second). Continue to load the specimen until it breaks. See Figure 5.4.4 for test procedure.
4. After the specimen breaks, the red Pressure Indicator Follower of the Low Pressure Gauge will display the maximum transverse strength, (σ_B in N/cm^2). Remove the specimen from the Universal Strength Machine. The maximum indicated value multiplied by 100 on the inner scale is the transverse strength (σ_B in N/cm^2).

5 Operating Instructions



Do not run multiple tests of any type on the same test specimen. The sand sample has been destroyed after the test.

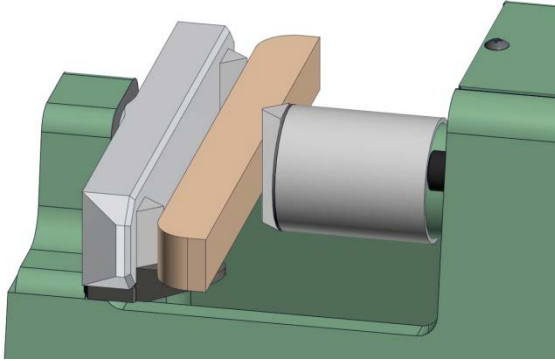
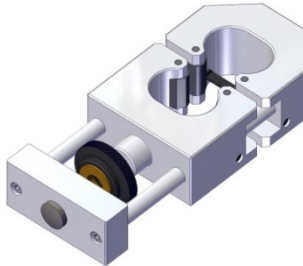


Figure 5.4.4

5.5 Cold Tensile Strength Accessory



Part No. 582-000-505

5.5.1 Description

This Cold Tensile Strength Accessory is used to determine tensile strength of chemically bonded core and molding foundry sands when mounted on the Universal Strength Machine, Model PFG. Tensile strength data can be generated using the standard metric dog bone tensile sand specimens

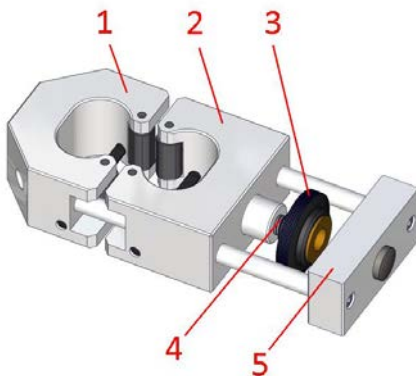


Figure 5.5.1

Item	Description
1	Left Tooling Clamp
2	Right Tooling Clamp
3	Knurled Knob
4	Placement Set Screw
5	Slide Support

5.5.2 Installation

1. Remove the large Knurled Knob (Item 3, Figure 5.5.1) from the large set screw (Item 4, Figure 5.5.1) of the Cold Tensile Strength Accessory.
2. Gently slide the boss and set screw at the rear of the Right Tooling Jaw (Item 2, Figure 5.5.1) through the hole in the Base of the Universal Strength Machine. (See Figure 5.5.2).

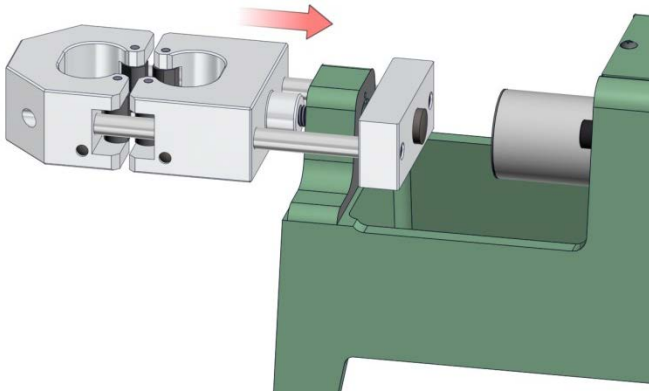


Figure 5.5.2

3. Replace the large Knurled Knob on the large set screw of the Cold Tensile Strength Accessory on the opposite side of the Base extremity. (See Figure 5.5.3).

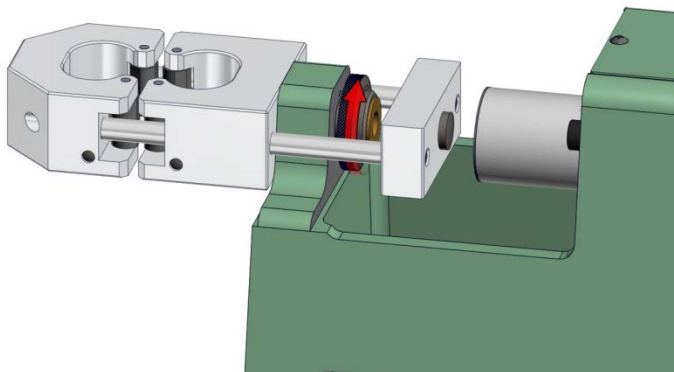


Figure 5.5.3

5.5.3 Operation

1. Manually set the red Pressure Indicator Follower (Item 2, Figure 5.6.1) on the pressure gauge to zero.
2. With the Left and Right Tooling Clamps (Items 1 and 2, Figure 5.5.1) pressed together, insert a standard dog bone tensile sand specimen between the tooling pieces. (See Figure 5.5.4).
3. Once the specimen is in place, manually separate the Left Tooling Clamp from the Right Tooling Clamp, so that both clamps are flush with the specimen side.
4. Rotate the Rotary Handle clockwise to load the test specimen. Load the specimen increasingly, and consistently. (Approximately 10 N/cm² σ_z per second). Continue to load the specimen until it breaks.

5 Operating Instructions

- After the specimen breaks, the red Pressure Indicator Follower of the Low Pressure Gauge will display the maximum tensile strength (σ_z in N/cm^2). Remove the specimen from the Universal Strength Machine. In most cases, the High Pressure Gauge, Model PHM, is appropriate for this test. If using the Low Pressure Gauge, the maximum indicated value multiplied by 10 on the inner scale is the tensile strength (σ_z in N/cm^2). If using the High Pressure Gauge, the maximum indicated value also multiplied by 10 on the inner scale is the tensile strength (σ_z in N/cm^2).



Do not run multiple tests of any type on the same test specimen. The sand sample has been destroyed after the test.

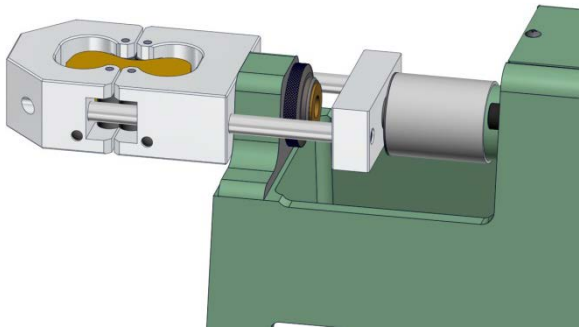


Figure 5.5.4

5.6 High/Low Pressure Gauge



Part Nos. 592-8224-638 and 592-824-637

NOTICE *The pressure gauges are not protected against overloads. Therefore, gauge pointers should be observed during each load operation. Do not allow the load to exceed the pressure scale. The ultimate strength of the test piece is indicated by the red maximum indicator follower.*

5.6.1 Reading the Pressure Gauges

Each pressure gauge has 3 scales:

1. Outer scale for the measurement of compression (σ_D) and shear (σ_S) strength.
2. Middle scale for the measurement of splitting (σ_{SP}) strength.
3. Inner scale for the measurement of transverse (σ_B) and tensile (σ_Z) strength.

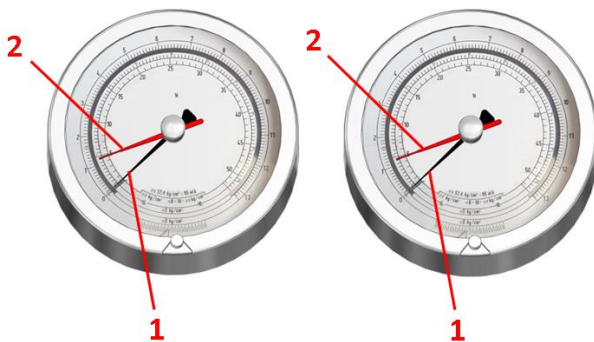


Figure 5.6.1

Item	Description
1	Pressure Indicator Pointer (black)
2	Maximum Indicator Follower (red)

5.6.2 Pressure Gauge Ranges

1. Low Pressure Gauge, Model PNM: Indication range 0-16 bar
 - Outer scale, compression: indication = σ_D = max. 32.6 N/cm²
 - Outer scale, shear: indication / 2 = σ_S = max. = 16.3 N/cm²
 - Middle scale, splitting: indication = σ_{SP} = max. 25.6 N/cm²
 - Inner scale, transverse: indication x100 = σ_B = max. 1280.0 N/cm²
 - Inner scale, tensile: indication x10 = σ_Z = max. 128.0 N/cm²
2. High Pressure Gauge, Model PHM: Indication range 0-65 bar
 - Outer scale, compression: indication x10 = σ_D = max. 132.4 N/cm²
 - Outer scale, shear: indication / 2 = σ_S = max. 66.2 N/cm²
 - Middle scale, splitting: indication x10 = σ_{SP} = max. 104.0 N/cm²
 - Inner scale, transverse: indication x100 = σ_B = max. 5200.0 N/cm²
 - Inner scale, tensile: indication x10 = σ_Z = max. 520.0 N/cm²

6 Maintenance and Calibration



For more information on how to use and care for your Simpson Analytics equipment and accessories visit our Simpson Technologies channel on YouTube and search our library of videos. Subscribe to our channel to keep updated on new releases.

Despite its robust construction, the Universal Strength Machine, Model PFG, is a precise mechanical measurement device and needs appropriate care.

6.1 Hydraulic Oil

The following hydraulic oils are recommended with use of the Universal Strength Machine, Model PFG.

	Mobil NUTO H 32	Mobil NUTO H 46	Shell Tellus T37	Shell Tellus T46
Viscosity, ATSM D445 cSt @ 40° C	32.0	46.0	37.0	46.0
Viscosity Index, ATSM D2270	104	104	154	147

6.2 Daily Maintenance

- Remove and clean any loose sand/dirt from the outside of the strength machine.
- Keep the strength machine accessories clean

6.3 Weekly Maintenance

- Check the oil level as described in Section 4.4.
- Ensure that the pressure gauge is free of air.
- Load the gauge up to the maximum load. Upon returning to zero load, ensure that the gauge once again reaches “zero.” If it does not, correct the position on the front of the pressure gauge.
- Ensure that the gauge pointer moves freely and easily.

6.4 Yearly Maintenance

- Change the hydraulic oil, and flush the system.
1. Take the pressure gauge off of the top of the Universal Strength Machine by simply unsnapping it from the Plug Coupling (Item 5, Figure 7.1).
 2. Snap the Connecting Pin (Item 8, Figure 7.1) into the Plug Coupling where the pressure gauge is normally mounted. Use of a funnel is also recommended.

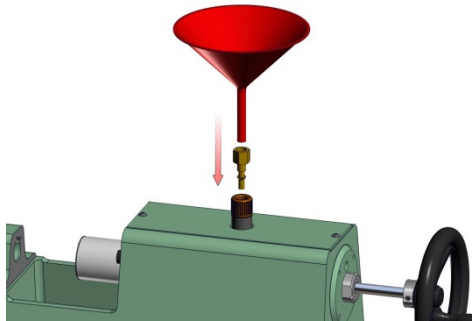


Figure 6.3.1

3. Turn the Rotary Handle forwards (clockwise) until the Hydraulic Piston is in the end position on the left.
4. Manually, remove the Hydraulic Piston to drain the oil. It is recommended to place a tray below.

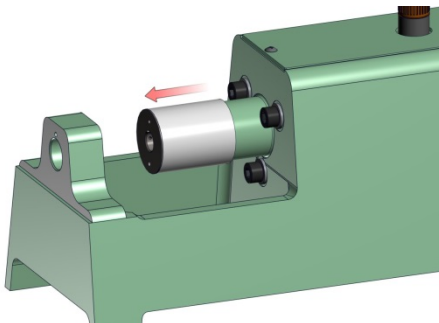


Figure 6.3.2

5. Use a wrench to unscrew the Spindle and Spindle Guide (Item 7, Figure 7.1) from the machine Base (Item 1, Figure 7.1).

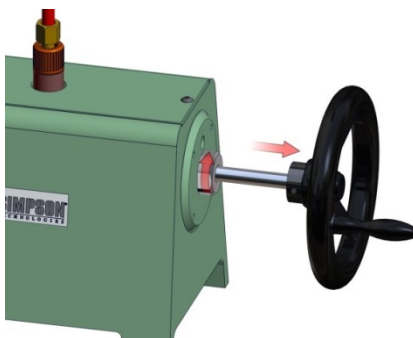


Figure 6.3.3

6. Take the Spindle and Spindle Guide completely out of the Base.
7. Flush the Hydraulic system and the piston with oil. The inside bore and Hydraulic piston must be absolutely clean.

8. Insert the Hydraulic Piston (without tilting) until it is at the end position on the right.

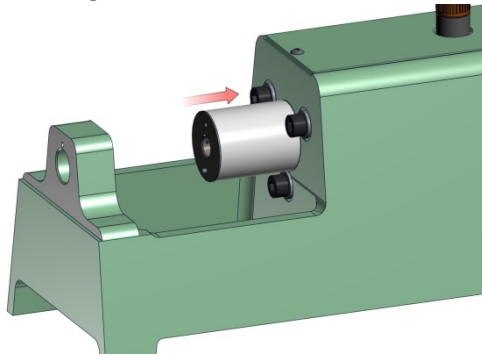


Figure 6.3.4

9. Replace the Spindle by screwing it back into the Spindle bore on the Base of the machine.
10. Crank the Rotary Handle (Item 6, Figure 7.1) all the way in by rotating it clockwise until it will not turn any further. Also, make sure that the disengaged Hydraulic Piston (Item 3, Figure 7.1) is pressed in all the way toward the Base (to the right).
11. Pour oil into the Connecting Pin atop of the machine Base until the oil level becomes even with the top edge of the Plug Coupling.
12. To ventilate, manually and slowly move the Hydraulic Piston about 10 mm to the left. Then manually and slowly move it 10 mm back to the right again.
13. Repeat steps 11-12 until there are no longer air bubbles rising to the top of the oil level when the piston is moved
14. Ensure that the Hydraulic Piston is in the end position on the right and that the Spindle is in the end position all the way to the left. While slowly rotating the Rotary Handle backwards (counterclockwise), fill the Plug Coupling with oil until the Spindle is in the end position on the right. During this procedure, the oil should be filled so that the oil level remains at the top of the Connecting Pin.

15. Manually pull the Hydraulic Piston out *slightly* (to the left), just enough to allow the oil level to decrease from the top of the Connecting Pin to the top of the Plug Coupling below.
16. Remove the Connecting Pin from Plug Coupling by unsnapping it; this will engage the Hydraulic Cylinder. At this point, manually pull on the Hydraulic Piston to ensure that it does not move. If it is loose, there may still be air in the oil. If it is loose, ventilate the system by plugging in the Connecting Pin and rotating the Rotary Handle forwards and backwards several times.
17. Replace the pressure gauge to its original position.
 - Check for pressure losses. Place a piece of wood or metal the same size as a sand specimen (50 mm x 50 mm) between the Compression Strength Accessories and load to maximum. At this point, the pressure losses should not exceed:
 - PNM: 0.3 N/cm² in 10 seconds
 - PHM: 2.0 N/cm² in 10 seconds

6.5 Calibration

To keep the Universal Strength Machine within standard tolerance, the following calibration should be made with the help of the Calibration Accessories. A complete calibration should be executed first after installation and at least every six months thereafter.

6.5.1 Calibration Accessories

The mechanical test springs used for calibration are in the form of a Low Pressure Spring (Part No. 592-820-537) and High Pressure Spring (Part No. 9287-5280). The standard accessory is the Low Pressure Spring: it covers the full range of the Low Pressure Gauge and 25% of the High Pressure Gauge range. These accessories are used to calibrate force on the Universal Strength Machine, Model PFG. (See Figure 6.5.1).



Figure 6.5.1

6.5.2 Calibrating the Universal Strength Machine

The Model PFG should be calibrated once every six months, provided that it is not subjected to abuse. This calibration process is valid for both the Low and High Pressure Gauges, provided the correct spring is being used.

1. Use the calibration certificate delivered with spring to perform the calibration.
2. Take a slide gauge or caliper (not provided) to measure the spring length before you place the spring into the apparatus between the Compression Strength Accessories (Item 2, Figure 7.1). Record the length of the spring.
3. Put the spring in the apparatus between the two Compression Strength Accessories without any pressure applied. To ensure no pressure is applied, turn the Rotary Wheel (Item 6, Figure 7.1) counterclockwise to open the Compression Strength Accessories. (See Figure 6.4.2 below).

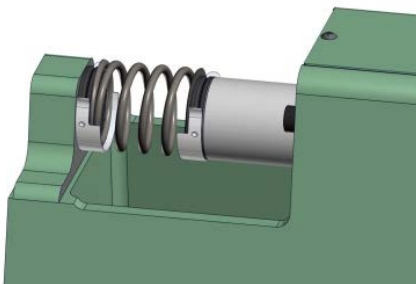


Figure 6.4.2

4. Now, turn the Rotary Handle clockwise until the pointer on the pressure gauge (Item 4, Figure 7.1) reaches 5 N/cm^2 on the outer scale for compression strength. Use a slide gauge to measure the spring distance between the Compression Strength Accessories. Record the measurement in the diagram at 5 N/cm^2 .
5. Load the spring again until the pointer on the pressure gauge reaches 10 N/cm^2 . Once again, use a slide gauge to measure the spring distance between the Compression Strength Accessories. Record the measurement in the diagram at 10 N/cm^2 .
6. Repeat step 5 for pressure gauge readings of 15 N/cm^2 , 20 N/cm^2 , 25 N/cm^2 , and 30 N/cm^2 .
7. Turn the Rotary Handle counterclockwise until the pressure gauge reading returns to 0 N/cm^2 . Take the spring out from between the Compression Strength Accessories.
8. Utilizing the provided calibration certificate, plot recorded spring length measurements vs. pressure. The resulting curve should be linear and decreasing. An example of a successful calibration curve is shown in Figure 6.4.3.



If the calibration points are out of tolerance, it is likely due to friction between the Hydraulic Piston and cylinder. Perform a complete oil change and retry the calibration. If the problem continues, contact Simpson Technologies.

Manometer Pressure	Spring Length
0 N/cm ²	60.6 mm
5 N/cm ²	57.57 mm
10 N/cm ²	54.52 mm
15 N/cm ²	51.51 mm
20 N/cm ²	48.5 mm
25 N/cm ²	45.56 mm
30 N/cm ²	42.57 mm

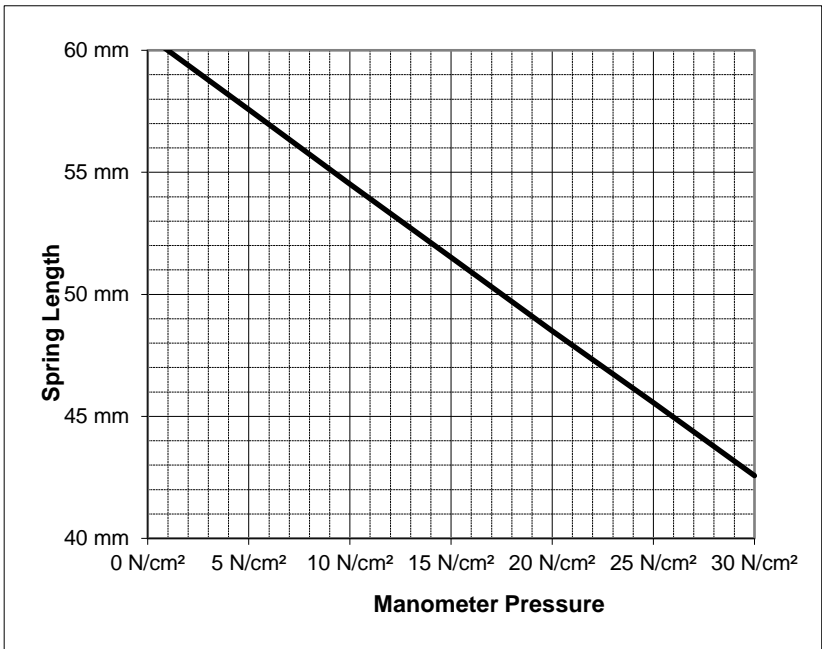


Figure 6.4.3

7 Apparatus Layout

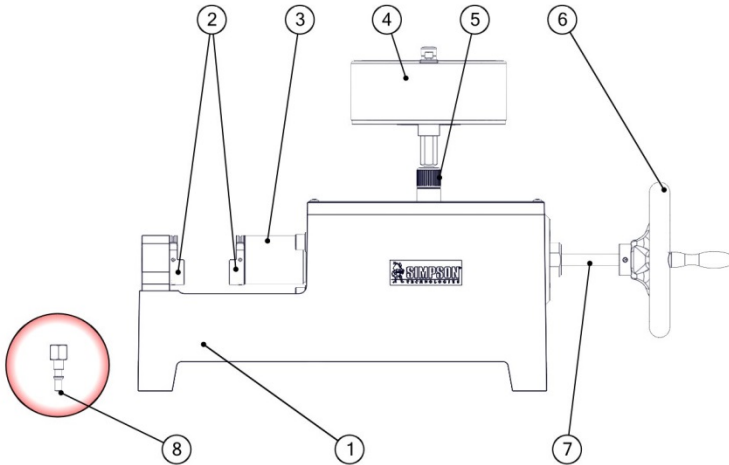


Figure 7.1: Front View

Item	Description
1	Base
2	Compression Strength Accessories
3	Hydraulic Piston
4	Low Pressure Gauge, Model PNM
5	Plug Coupling
6	Rotary Handle
7	Spindle
8	Connecting Pin

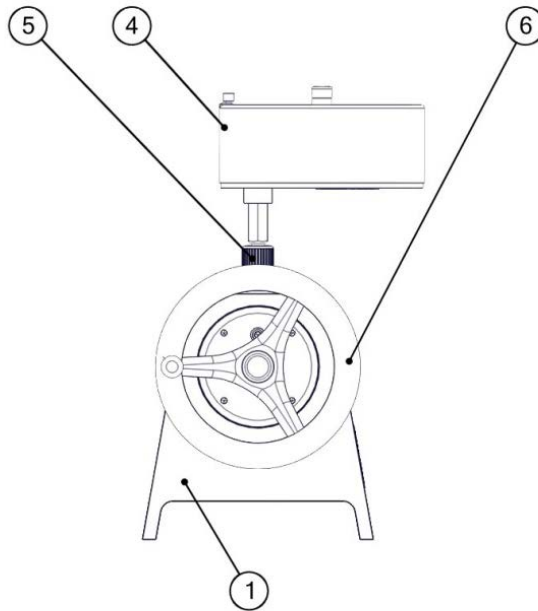


Figure 7.2: Side View

Item	Description
1	Base
4	Low Pressure Gauge, Model PNM
5	Plug Coupling
6	Rotary Handle

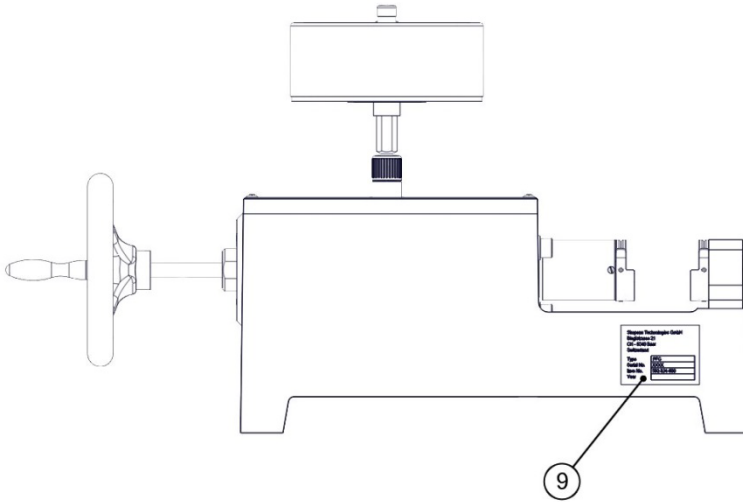


Figure 7.3: Back View

Item	Description
9	Simpson Nameplate

8 Parts List / Ordering Parts / Returns

8.1 Spare Parts List

Simpson maintains a large inventory of common spare parts for all current Simpson Analytics products. The following table provides part numbers for common spare parts for this device. Contact Simpson Technologies with the part number and description when ordering.

Part No.	Description
592-824-637	Low Pressure Gauge, Model PNM
592-824-638	High Pressure Gauge, Model PHM
592-824-614	Plug Coupling
596-459-237	Connecting Pin
582-002-199	Pressure Piston Complete
592-820-560	24 mm dia. Compression Strength Accessory
592-824-616	15 mm dia. Compression Strength Accessory

8.2 Ordering Replacement / Spare Parts

The source of replacement parts for your Simpson Analytics equipment is just as important as the make of the equipment you purchase. ALWAYS order parts for your Simpson Analytics equipment directly from Simpson Technologies. To find the Simpson office closest to you please visit us on the internet at simpsongroup.com on the "Contact" page.

Our sales department to obtain a quotation on replacement parts or service please always include the equipment serial number, the description of the part and the part number. Your Simpson Technologies sales team representative will provide you with a quote on the items with current price and delivery times. When ordering, please always refer to the quote number on your order.

To arrange for calibration support or repair assistance please contact our customer service department at service@simpsongroup.com:

8.3 Return Goods Policy

Simpson Technologies strives to provide their customers with maximum follow up support and, in order to offer the most practical flexibility, the following conditions apply to returned goods. Adherence to these procedures will assure the most prompt and efficient service.

RETURNS WILL BE CONSIDERED IN THE FOLLOWING SITUATIONS:

- Products ordered in error by customer (subject to a restocking charge).
- Incorrect or defective products shipped to customer.
- The return of existing products for factory repair or upgrade.
- Products ordered correctly but which are unwanted or unsuitable (subject to a restocking charge).
- A Safety Data Sheet (SDS) must accompany material that is sent to Simpson Technologies for testing purposes. Simpson Technologies will NOT authorize the return of hazardous materials.

RETURN PROCEDURE:

- **The customer must obtain a Return Material Authorization Number (RMA#) from Simpson Technologies prior to returning the goods.**
- To obtain an RMA#, the customer should contact the Customer Service department by phone, fax, e-mail to service@simpsongroup.com. The material being returned must be identified and the reason for its return clearly specified. Once approved for return, Simpson Technologies will issue the customer an RMA form to be included with the shipment and with instructions on where and how to ship the goods.
- All returned goods are to be shipped with transportation charges PREPAID, unless otherwise agreed when the RMA# is assigned. If it has been predetermined that return goods are to be shipped COLLECT, Simpson Technologies will specify the desired routing.
- All returned shipments will be subject to inspection upon arrival at Simpson Technologies.
- Material returned without an RMA# may be refused and returned at customer's expense.

9 Decommissioning



Before doing any work, review the Safety Procedures in Section 2. Failure to follow safety procedures could result in serious injury.

Use qualified personnel and follow safety procedures, applicable local policies and regulations in decommissioning the Universal Strength Machine and peripheral equipment.

WASTE DISPOSAL

The Machinery and Controls Consists of:

- Iron
- Aluminum
- Copper
- Plastic
- Hydraulic Oil

Dispose of the parts in accordance with the applicable regulations.



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