



Dependable Products From People You Trust



EP (Extreme Pressure) and Lubricity Tester

#112-00-C Complete, 115 Volt

#112-00-1-C Complete, 230 Volt

#112-00-T With Thermocouple, 115 Volt

#112-00-1-T With Thermocouple, 230 Volt

Instruction Manual

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Ver. 11

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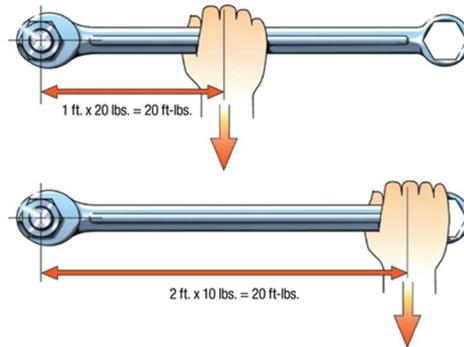
Introduction

When there is relative motion between two contacting bodies, frictional forces that resist motion always come into play. Frictional resistance to rotation of the drill string is called torque, and is especially enhanced when drilling a deviated hole. Serious casing wear occurs in deep and ultra-deep wells. The main influential factor of casing wear is rotation of the drill pipe, horizontal drilling, and tripping in and out of the hole. Many materials, such as Graphite, Fine Mica, and Diesel or Crude Oil, have been used to improve lubricity.

Since evaluation of the various materials cannot realistically be done on the drill string, a lubricity test was designed to simulate the speed of rotation of the drill pipe and the pressure with which the pipe bears against the wall of the bore hole. The OFITE combination EP (Extreme Pressure) and Lubricity Tester is a high-quality instrument used to measure the lubricating quality of drilling fluids, provide data to evaluate the type and quantity of lubricating additives that may be required, and predict wear rates of mechanical parts in known fluid systems.

Inch – Pounds

Torque is defined as the measure of force applied to produce rotational motion (usually measured in foot-pounds). Torque is determined by multiplying the applied force by the distance from the pivot point to the point where the force is applied. Inch-pounds $\times 0.0833 =$ Foot-pounds



Torque is measured in units of distance multiplied by force. A force of ten lb acting through a distance of two feet produces exactly the same torque (20 ft-lb) as a force of twenty lb acting through a distance of one foot.

Description

Lubricity (Surface to Surface Drag) Test

The more common lubricity test measures fluid resistance of various lubricating additives. The standard lubricity coefficient test is run at 60 rpm with 150 in-lb of force (the equivalent of approximately 600 psi (4,137 kPa) pressure of the intermediate fluid) is applied to two hardened steel surfaces, a rotating ring and a stationary block.

Friction is measured as the coefficient of friction (μ). The coefficient of friction between two solids is defined as the frictional force of the load or the force perpendicular to the surfaces. The coefficient of friction is independent of the apparent areas of contact as long as this area is not so small as to break through the film. The force to overcome friction will be the same for a small area as for a larger area. The force, F, required to slide the block and the ring surfaces across each other at a given rate is measured by the power required to turn the test ring shaft at a prescribed rate of revolutions per minute.

The Coefficient of Friction, $\mu = \frac{\text{Meter Reading}}{\text{Load or Force}}$

EP (Extreme Pressure) Test

This test produces an indication of the film strength of the fluid being tested by applying a measured force to a torque-sensitive bearing cup with the torque arm. The EP test is typically run at a high shear rate (1,000 rpm) with fluid pressures ranging from 30,000 to 100,000 psi (206,820 - 689,400 kPa) between the steel surfaces. Increasing pressure in in-lb of force is applied until a seizure or pass is obtained.

Features

Automated Control and Data Acquisition

The unit is designed to run manually via the digital control panel or using Windows PC. An RS232 interface exists between the computer and the machine. Test data is stored in a comma-delimited text file suitable for import into commercially available spreadsheet software if more detailed analysis is required. The bob rotation can be controlled by the personal computer.

Digital Control

- The digital control panel provides more accurate data than older analog models.
- The rotational speed (rpm) is automatically maintained as the torque is increased, resulting in more accurate data collection and is less labor intensive for the technician.

User-Friendly Interface

- The simple, intuitive interface makes testing quick and easy.

Functions include:

- Pre-Set Speeds: 60, 200, 600, and 1000 rpm
- Manual Speed Control
- Zeroing Torque and Time
- Maximum Speed: 1,000 rpm
- Maximum Torque: 600 in-lb
- Belt-Driven Motor: ½ HP, 90 Volt DC, 5.5 Amps
- Size: 19" × 15" × 14" (48.3 × 38.1 × 35.6 cm)
- Weight: 56 lb (25.4 kg)

Components

Included

#111-02-01	Test Ring for Lubricity Test
#111-04-01	Test Block for EP Test
#111-06-01	Test Ring for EP Test
#111-08-01	Test Block for Lubricity Test
#111-09	Sample Cup
#111-10	Torque Wrench
#111-16	Service Wrench, ¾"
#111-17	Service Wrench, 1¼"
#111-18	Combination Wrench, 15/16"
#111-19	Grinding Compound, Silicone
#130-76-03	Thermocouple
#130-79-15	Serial Cable DB9 M/F

Included with #112-00-C and #112-00-1-C:

#111-01	Padded Transport Case
#112-50	Heat Cup Assembly, 115 Volt
#152-59-2	Ultrasonic Cleaner, 115 Volt
#152-59-1	Ultrasonic Cleaner, 230 Volt

Replacement Parts

#111-00-006	Belt, Timing
#111-00-007	Pulley, Timing 36 Teeth
#111-00-016	Motor, ½ HP, 5.5 Volts, Fan Cooled
#111-00-35	Retainer Nut
#111-00-37	Socket Extension
#111-00-38	Test Block Holder
#111-00-54	Assembly, Top Pulley Belt Guard
#111-00-55	Assembly, Cup Holder
#141-18	Thumb Screw
#164-32	Male Connector for Power Cable (230 Volt Only)
#172-09	Fuse, 10 Amp

Optional

#111-01	Padded Transport Case
#111-11	7× Measuring Magnifier with Inch Scale

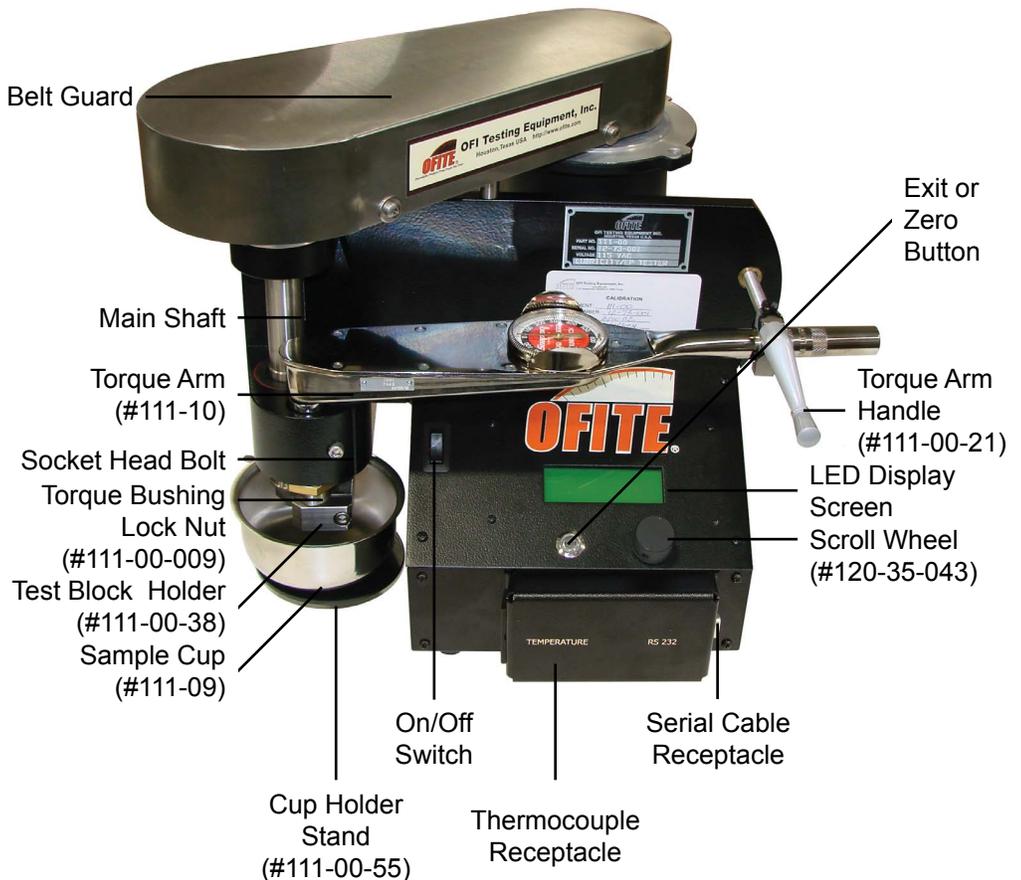


Top Row (Left to Right): Retainer Nut, Lubricity Test Ring, Lubricity Test Block
Bottom Row: EP Test Block (Left), EP Test Ring (Right)

#111-00-SP Spare Parts Kit

Part Number	Description	Quantity
#111-02-01	Test Ring for Lubricity Test	6
#111-04-01	Test Block for EP Test	6
#111-06-01	Test Ring for EP Test	6
#111-08-01	Test Block for Lubricity Test	6
#111-09	Sample Cup, stainless steel	1
#111-11	Measuring Magnifier, 7×, with scale	1
#111-13	Grinding Compound, Grit 280, Fine, 16 oz	1
#111-14	Grinding Compound, Grit 120, Coarse, 16 oz	1

Spare parts listings are intended to be used as a reference for future purchases. Everyone's consumable requirements will be different, and replacement needs will depend on the number of tests performed on a daily and/or weekly basis.



Safety

The safe operation of the EP-Lubricity Tester requires that the technician be thoroughly familiar with the proper operating procedures and the potential hazards that are associated with operating the instrument. Therefore it is important to read the instructions and store the instructions in a place known to all laboratory personnel for frequent consultation.

Mechanical

The large silver colored belt guard protects the V-belt drive which is connected to the main shaft assembly. Be very careful to keep hands, loose clothing, and other objects away from all rotating parts and away from the shielded belt guard. Do not put hands, fingers, or clothing in or near the sample cup and test block while the machine is running.

Temperature

The test ring and test block will become hot due to friction generated during the test. This is especially true when performing the Extreme Pressure (EP) test. The test fluid, stainless steel cup, and the ring and block can cause severe burns if handled immediately after a test.

Clothing and Protective Gear

Wearing loose clothing should be avoided when operating equipment that can potentially snag a loose cuff, collar, or tie. Always wear a lab coat when performing tests and always wear protective eye glasses. Know in advance where the eye-wash station is and the nearest exit from the laboratory and the building in case of a fire.

Electrical

This instrument is powered by 115 or 230 Volts AC. The motor is ½ HP. 90 Volts DC, and as with all electrical components there is a potential for danger. Understanding safe test procedures while practicing a degree of common sense when around electricity is vitally important.

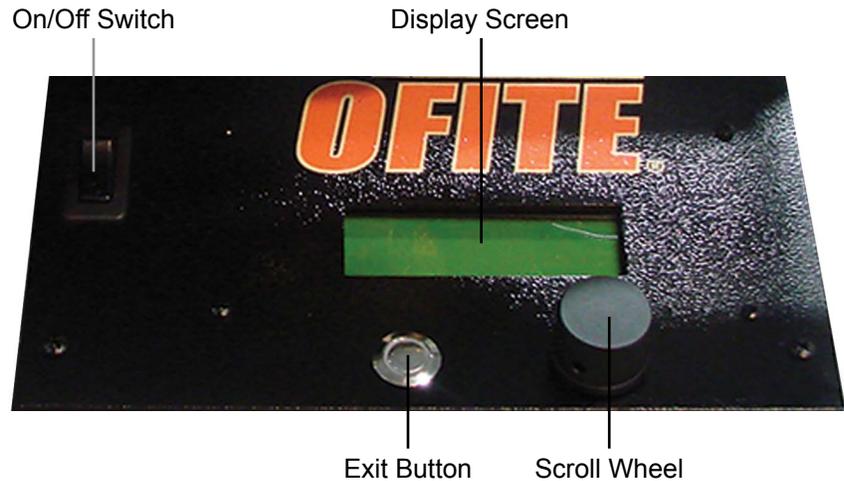
The control panel contains electronic control components. The front panel should never be opened to make repairs. Only a qualified OFITE technician or an OFITE representative should perform repairs on these parts.

As with all electrical assemblies, make sure the machine is unplugged when cleaning and/or moving it. Do not allow the LED panel to get wet. If test fluid or water is spilled on it be sure to wipe it clean immediately with a cloth. Excessive water on the panel could cause the electrical components on the underside of the panel to short out causing an electrical shock hazard.

At the end of the day ALL power cords should be unplugged from the wall outlets, unless a test must be extended overnight.

Control Panel

The instrument control panel consists of a display screen, a Scroll Wheel, and an Exit button.



The Scroll Wheel spins clockwise and counter-clockwise. Spinning the wheel scrolls through the menu and options. Pushing the Scroll Wheel in signals acceptance.

The Exit button cancels any pending input and returns to the Main Menu. Pushing the Exit button while on the Main Menu accesses the Zero Menu. To access the Main Menu, push in the Scroll Wheel while on the home screen. On the Main Menu you can set the motor speed to one of 5 preset values:

1. Set RPM to 0
2. Set RPM to 60
3. Set RPM to 200
4. Set RPM to 600
5. Set RPM to 1000

To access the Manual Speed Select, spin the Scroll Wheel while on the home screen. From here you can increase the motor speed by spinning the wheel clockwise and decrease it by spinning it counter-clockwise. By default, the speed increases by 1 RPM for each increment of wheel spin. By pressing the wheel in, you can increase this increment to 10 or 100 RPM.

SPIN: ADJUST RPM

ENTER: ADJUST RPM BY 1, 10, 100

To access the Zero Menu, press the Exit button while on the home screen. From here you can set the test time and torque values to zero.

1. Zero the Test Time
2. Set Torque = 0.0
3. Restore Last Torque

To stop the motor, press the Scroll Wheel in twice.

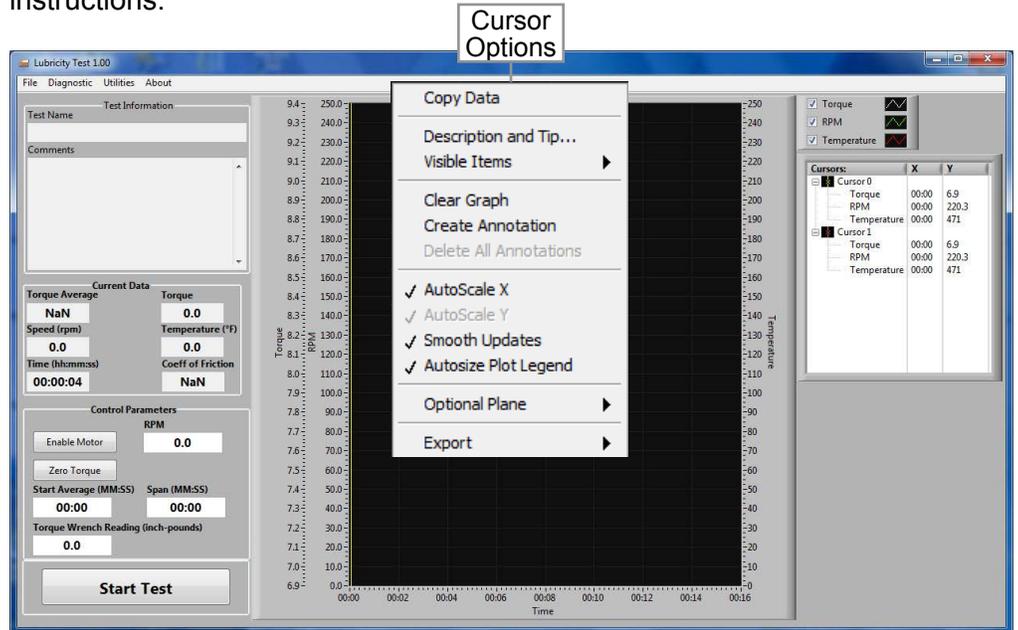
Quick Start

1. Check the instrument calibration. See page 33 for instructions.
2. Thoroughly clean the ring, block, block holder, and sample cup with acetone.
3. Turn on the power and let the machine run for 15 minutes.
4. Place the test block in the holder. Do not let the ring and block touch.
5. Mix the test fluid for at least ten minutes.
6. Set the motor speed to 60 rpm. See page 8 for more information about using the Control Panel.
7. Fill the cup with fluid and place it on the stand.
8. Raise the cup until the ring and block assembly are fully submerged. Tighten the thumb screw.
9. Wait for the torque reading to stabilize. Then zero the torque reading on the control panel.
10. Position the torque arm so it is inside the torque arm clamp.
11. Turn the torque adjust handle so the gauge reads 150 in-lb.
12. Zero the time on the control panel.
13. Let the machine run for 5 minutes.
14. Record the torque reading from the display screen.
15. Release the pressure on the ring and block.
16. Lower the cup and discard the fluid.
17. Thoroughly clean the ring, block, block holder, and sample cup with acetone.
18. Calculate the Lubricity Coefficient = $\frac{\text{Meter Reading} \times \text{Correction Factor}}{100}$
19. See page 19 for more information about calculating the Correction Factor and the Lubricity Coefficient.

Software

Data can be controlled and logged automatically using the software application. Once the computer has been connected to the Lubricity Tester, click on the Lubricity Tester icon to begin logging the test.

If you are using the Serial to USB Converter cable (#130-79-19) to connect to the Lubricity Tester, the PC will require a driver. See page 34 for instructions.



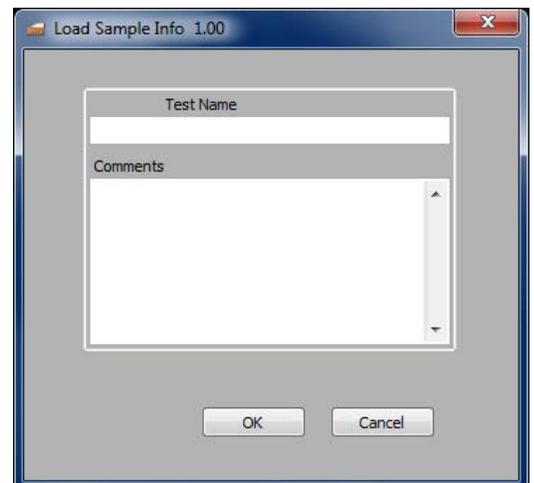
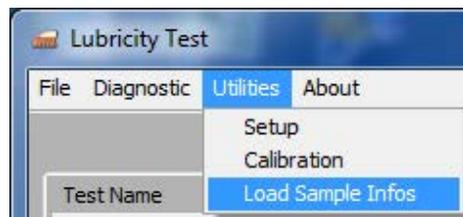
Main Screen

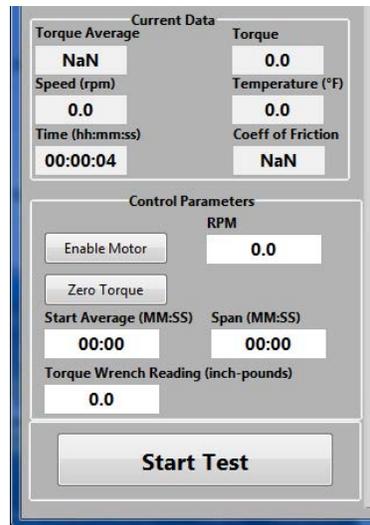
Test Information

This section displays the name of test the user is running. There is also a section which allows the user to add any comments if needed.

To add text into this section:

1. Go to the Utilities tab → Load Sample Infos.
2. Type the information as needed.





Current Data

This section displays the data that is being logged from a test.

Torque Average - Displays the average torque reading through out a specified time span.

Torque - Displays the live torque reading.

RPM - Displays the live RPM reading of the drive shaft.

Temperature - Displays the temperature reading from the thermocouple if the sample is being heated with the Heat Cup Assembly (#112-50).

Elapse Time - Displays how long the current test has been running.

Coeff of Friction - The calculated coefficient of friction. Be sure to enter the torque wrench reading in the field below.

Control Parameters

This section allows the user to Enable/Disable the motor. The user can also control the motor's RPMs.

Press the "Zero Torque" button to zero the torque value as needed.

The user can specify an average log time. Enter the time at the "Start Average" section to specify when to begin logging the average reading. Enter the time in the "Span" section to specify how long the average reading will collect the data. The span can be adjusted manually by placing the cursor on the span bars and clicking and dragging to a desired start time and span.

Torque Wrench Reading (inch-pounds) - Enter the reading on the torque wrench. The software will use this value to calculate the coefficient of friction of the test fluid.



Note

Setup

Initially when connecting the Lubricity Tester to the computer, a communication confirmation must be done. The set up window can be found in the Utilities drop down menu.

Com Port

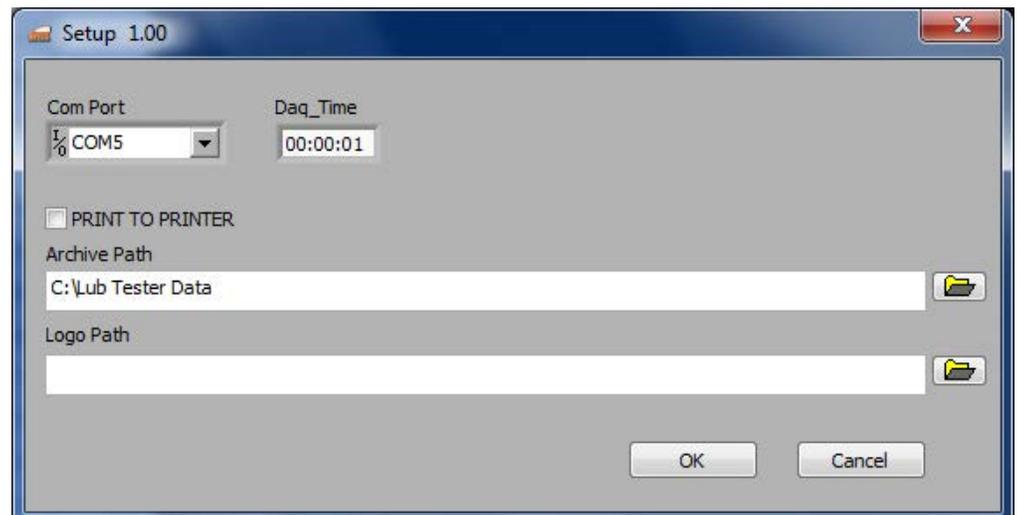
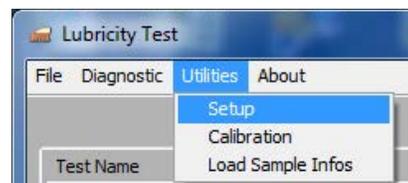
Notice the information in the Com Port field. Make sure the computer is communicating to the Lubricity Tester through the proper port. If the information is not matching, check to make sure the proper software is installed and that it is plugged into the proper port.

DAQ Time: The time interval to collect data.

Archive Path: Select a folder to store test data.

Logo Path: Select a logo file (.jpg) to display on the graph.

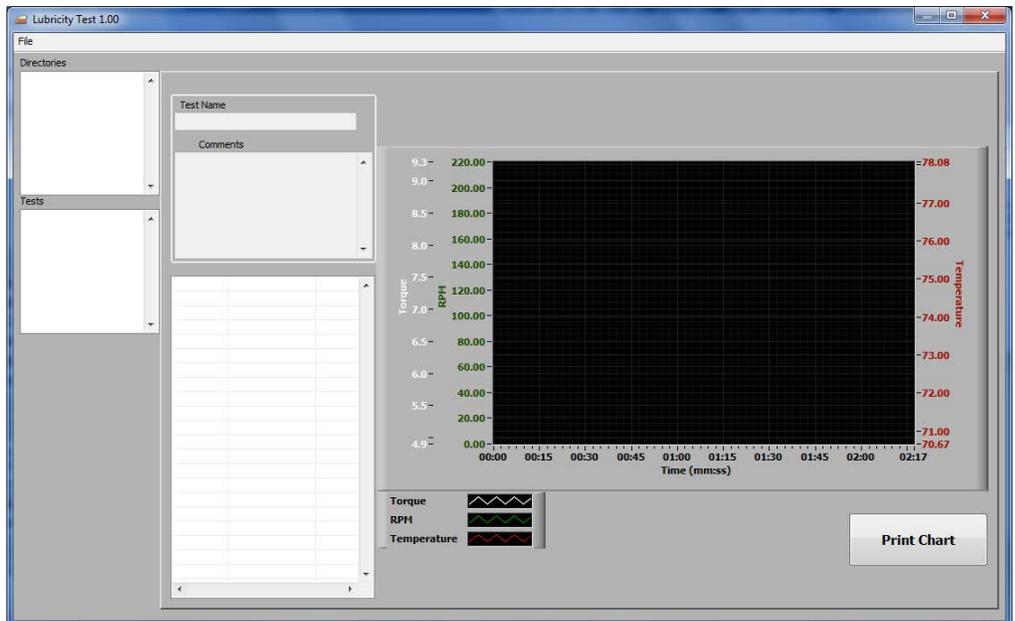
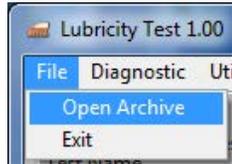
Print to Printer: At the end of a test, the software will automatically save an image file of the test graph. Select this option to also print the graph to the default printer.



Open Archive

The Lubricity Tester software stores all data from previous tests. To view data from a previous test, select “Open Data Archive” from the “File” menu. Select a directory to view available tests. Then choose a test to view the data.

From this screen, the user can view and print the chart. Test information can be modified by zooming in on a portion of the graph to create a new chart.

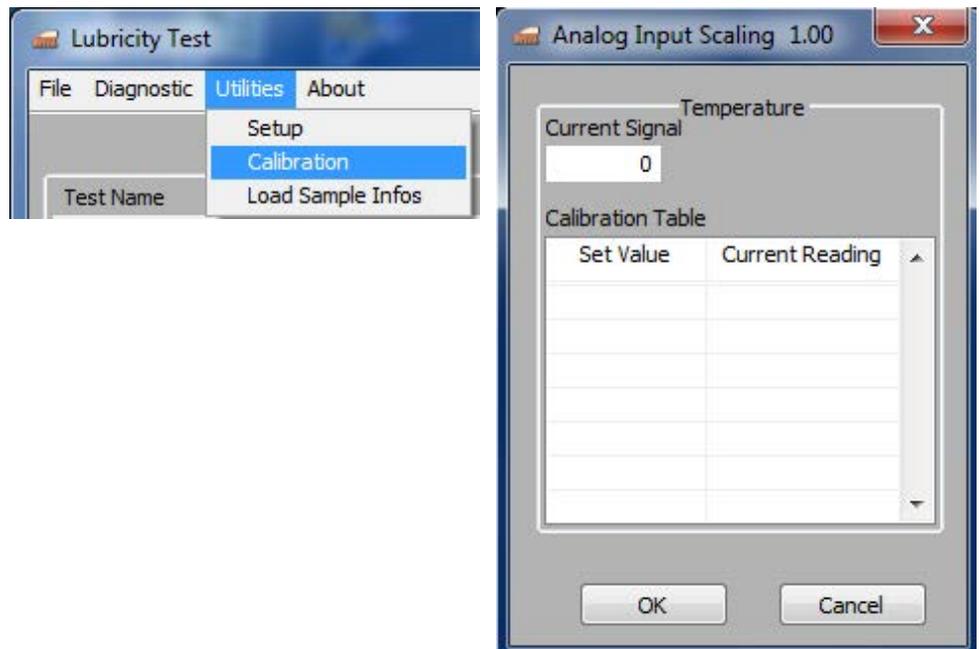


Thermocouple Calibration

The temperature reading from the thermocouple can be calibrated in the Analog Input Scaling window which can be found in the “Calibration” tab in the “Utilities” menu.

Once the thermocouple has been connected to the Lubricity Tester:

1. Place the thermocouple in a dry block calibrator.
2. Set the calibrator to the value displayed on the screen.
3. Scroll to adjust the offset and make the two temperature readings the same. Click “OK” to save the calibration.



Lubricity Test

The Lubricity Test should only be performed when the unit has been successfully calibrated with deionized water and gives a Coefficient of Friction reading of 34 ± 2 . See page 33.

1. Clean the lubricity test ring (#111-02-01 with a flat outer surface) and the lubricity test block (#111-08-01 with a concave groove on one side) with acetone and rinse both thoroughly with deionized water. All parts of the machine in the sample area (block holder and shaft) must be completely clean before starting a test.



Important

Do not touch the metal contact areas with bare hands.

Removing the ring from the main shaft can change the alignment of the contact area with the block. We recommend removing the ring only to replace it (along with the block) or to switch between lubricity and extreme pressure tests.



Note

The Coefficient of Friction for water is 34 ± 2 at 60 rpm and 150 inch-pounds. Since not all metallurgical structures are the same nor is the contact area the same between the metal parts, a variance of ± 2 is allowed. When calculating the Coefficient of Friction, a correction factor of 34 divided by the water reading is used. A test should never be performed if the Coefficient of Friction for water is outside this range.

2. Place the lubricity test ring squarely onto the tapered portion of the main shaft. Secure the test ring retainer nut with a $\frac{1}{16}$ " wrench. Make sure the ring seats squarely on the taper of the shaft.
3. Turn on the power and let the machine run for approximately 15 minutes.
4. Place the lubricity test block in the block holder with the concave side facing out away from the torque shaft. Do not let the ring and block contact each other.





5. Set the motor speed to 60 RPM.

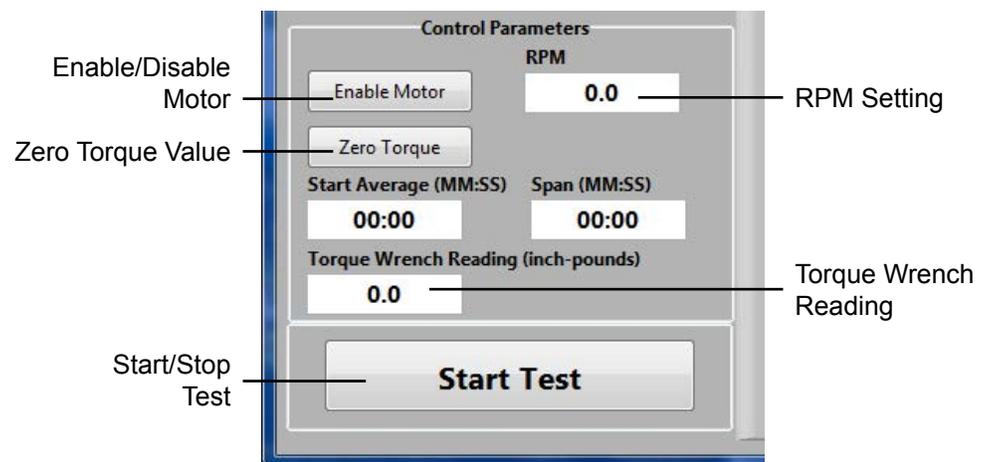
Motor speed can be set via the software in the Control Parameters section in the main home screen. Once the RPMs have been entered, enable the motor.

6. After the unit has been running for 15 minutes, zero the torque reading. Run the unit approximately 5 more minutes and zero the torque again if required.
7. Fill the stainless steel sample cup with the test fluid (260–280 mL) and place it on the lowered cup stand. Raise the cup stand until the test ring, test block, and block holder are fully submerged. Tighten the thumb screw to secure the cup stand.
8. Zero the torque reading.
9. Position the torque arm so that it fits inside the concave portion of the torque arm clamp. Check to make sure the test block has not fallen out of the holder and is lying at the bottom of the cup.
10. Turn the torque adjust handle clockwise until the torque gauge on the arm reads 150 inch-pounds.

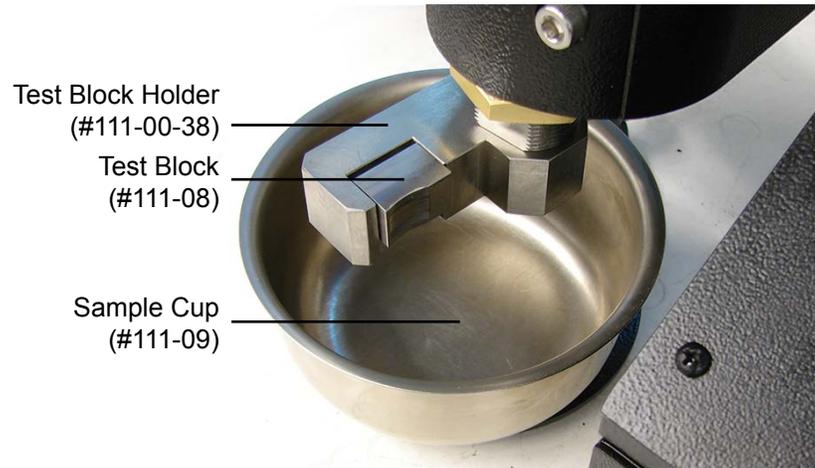


Do not apply torque to the test ring unless it is submerged in fluid.

11. Zero the time.



12. Let the machine run for 5 minutes and then record the torque reading. Release the torque on the arm.



13. Adjust the motor speed back to Zero.
14. Lower the cup stand and discard the fluid. Thoroughly wipe any remaining fluid from the sample cup, block, block holder, and test ring.

Lubricity Test

Calculations - Coefficient of Friction

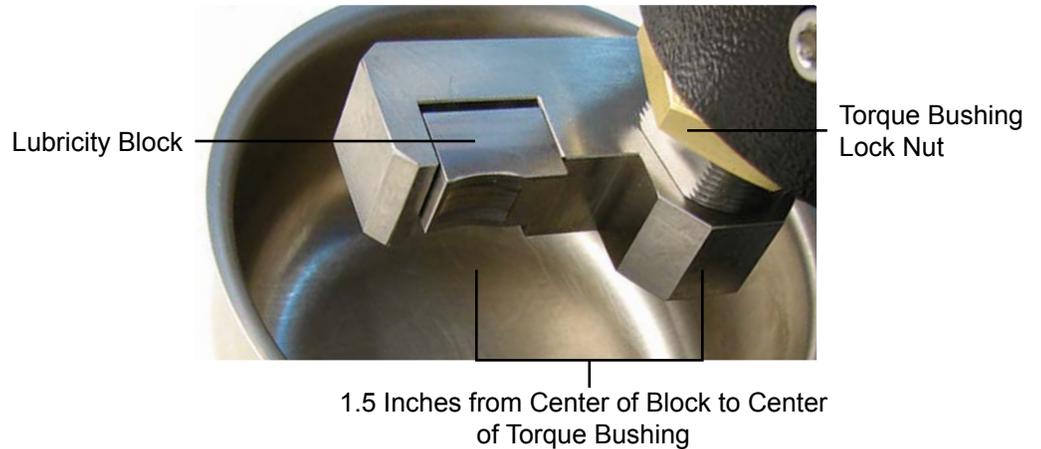
$$\text{Coefficient of Friction} = \frac{F}{W}$$

Where:

F = The frictional force required to slide the block and ring surfaces across each other at a given rate and is measured by the number of amperes required to turn the test ring at a prescribed number of revolutions per minute.

W = The load or force with which the test block is pressed against the test ring through the torque arm. The standard test calls for 150 in-lb of force, but the center of the test block is 1.5 inches from the center of the torque bushing, resulting in an actual force of 100 lb applied.

Torque Shaft Lever Arm



$$\frac{150 \text{ Inch-pounds (Torque Wrench Reading)}}{1.5 \text{ Inches (Torque Shaft Lever Arm)}} = 100 \text{ Pounds}$$

$$\text{Coefficient of Friction} = \frac{F}{W} = \frac{\text{Torque Reading}}{100}$$

Lubricity Test

Calculations - Lubricity Coefficient

The Lubricity Coefficient is a more accurate measure as it considers the variance (Correction Factor) the machine registers when calibrated against deionized water.

$$\text{Lubricity Coefficient} = \frac{\text{Meter Reading} \times \text{Correction Factor}}{100 \text{ Pounds}}$$

Correction Factor

The Coefficient of Friction value for deionized water would be a constant if the metallurgical structures of all rings and test blocks were the same, and the same area between the two objects came into contact each time. At 60 rpm and 150 in-lb of load, the torque meter reading should be 34, resulting in a Coefficient of Friction of 0.34. However since every ring and test block is different a correction factor is required to achieve accurate results. To calculate the correction factor, divide the standard meter reading for water (34) by the actual meter reading, which you recorded in the lubricity test.

Correction Factor =

$$\frac{\text{Standard Meter Reading for Deionized Water}}{\text{Meter Reading Obtained in Deionized Water Calibration}} = \frac{34}{\text{Meter Reading (32 to 36)}}$$

Percent Torque Reduction

The percent of torque reduction is based upon the torque reading of a sample that has been treated with a lubricant, relative to the same sample untreated.

$$\text{Percent (\%)} \text{ Torque Reduction at a Given Load} = \frac{A_L - B_L}{A_L} \times 100$$

Where:

A_L = Torque reading of untreated mud under the same force as B_L

B_L = Torque reading of treated mud under the same force as A_L

EP Test

Before the test can be accurately run, the machine must be in proper adjustment. To test for proper adjustment, or to run a standard test, proceed through the following steps. Refer to page 8 for instructions on using the control panel.

The EP test measures the film strength of the liquid in two ways.

1. A Pass determines the amount of load or pressure the lubricant will hold without a breakdown of film strength.
2. A seizure represents the point where a complete breakdown of the fluid occurs resulting in a metal to metal contact as indicated by tearing or galling of the metal surface on the block.

Procedure

1. Clean the EP test ring (#111-06-01 with a raised narrow surface) and the EP test block (#111-04-01 cube with smooth surface) with acetone and rinse them thoroughly with deionized water. All parts of the machine in the sample area must be clean before starting a test.

Do not touch metal contact areas with bare hands.

Removing the ring from the main shaft can change the alignment of the contact area with the block. We recommend removing the ring only to replace it or to switch between lubricity and extreme pressure tests.

2. Stabilize the main shaft by inserting the shaft lock plunger into the hole in the shaft.
3. Place the EP Test Ring squarely onto the tapered portion of the shaft. Using a $\frac{15}{16}$ " wrench, secure the test ring retainer nut. Make sure the ring seats squarely on the taper of the shaft.
4. Remove the shaft lock plunger from the hole in the shaft.
5. Turn the power on. Let the unit run for 15 minutes.
6. Press the scroll wheel twice to stop rotation. Place the EP Test Block in the block holder.
7. Set the motor speed to 1,000 rpm. Check to make sure the block does NOT fall out of the holder.
8. Zero the torque reading on the display (see page 8 for instructions).
9. Run the machine at 1,000 rpm for approximately 3 minutes, or until the torque zero reading appears to stabilize and no longer drifts appreciably. Zero the torque reading.





10. Position the torque arm so that the arm fits inside the concave portion of the torque arm clamp.
11. Fill the stainless steel sample cup with test fluid (260–280 mL) and place it on the lowered cup stand. Raise the cup stand until the test ring, test block, and block holder are submerged. Tighten the thumbscrew to secure the cup stand.

Never apply torque to the test block until it is submerged in fluid.

12. Rotate the torque adjust handle clockwise so that the reading on the torque wrench increases at a rate of no more than 5 in-lb per second. Continue until the torque wrench reading reaches:
 - a. The desired load (a “PASS”) occurs without seizing or.
 - b. Until a seizure occurs.

If a seizure occurs, quickly record the readings on the torque wrench and on the display screen, then remove the load.



Due to the extreme friction between the ring and the block, the fluid will get very hot and may reach the boiling point.

A seizure is defined as tearing and galling (scarring) of the metal to metal contact between the test ring and the test block surface. This represents a complete breakdown of the extreme pressure lubricating ability of the fluid or mud under the test conditions. A seizure is identified by:

1. The initial and rapid (not slow) rise in the torque reading. It may also appear as a sharp, substantial increase in the torque reading (current), which then drops back to normal. This type of seizure usually occurs at a relatively low torque reading or during tests of highly abrasive muds or muds containing a high solids content.
2. An obvious change in the pitch (sound) of the machine (a rasping sound).
3. The machine begins to vibrate as indicated by rapid fluctuations of the torque gauge needle.

After a seizure, the wear surface on the test block will be very large and will appear rough and scarred.

If it is desirable to know how a fluid behaves at a given torque:

12. Repeat steps 1 through 10 until a “PASS” is obtained. A “PASS” is identified in one of two ways.
 - a. A five minute run at a constant load during which the torque meter reading remains essentially constant and the wear surface is small and polished.

b. A five minute run in which there is a moderate amount of torque meter deflection and the wear surface is moderate, and may either be polished or dull, depending upon the abrasiveness of the test fluid.

13. After removing and cleaning the test block, examine the test block for wear. With the aid of a magnifying glass (#111-11), observe the scar left on the block by the test ring.

If the scar is rectangular, the test block is properly aligned in the holder. Your test is complete. If the scar is triangular or trapezoidal, the alignment is off and must be corrected. Refer to the "Block Positioning" section on page 30 for instructions.



Improperly Positioned Test Block
(Note: Two tests may be performed on each face)



Properly Positioned Test Block

EP Test

Reporting Test Results

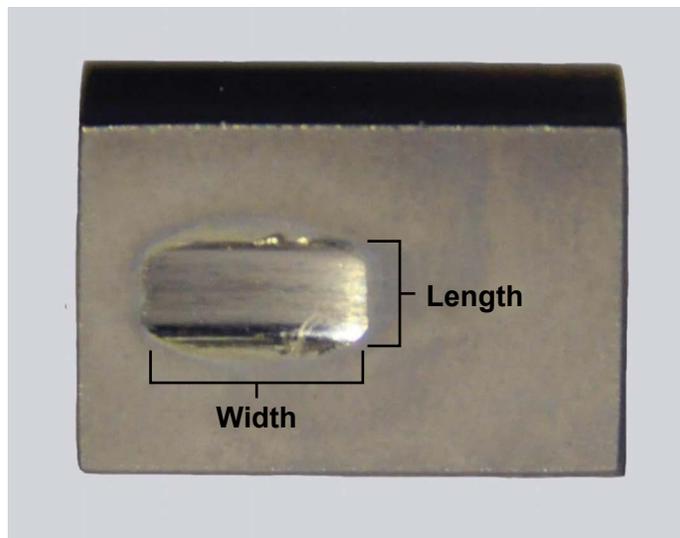
1. Record the lowest torque wrench reading (in in-lb) at which the seizure occurred.
2. Record the average torque reading on the screen at which the seizure occurred.
3. Record the following at the conclusion of a pass or if a 5-minute test does not produce a seizure.
 - a. Torque meter reading in in-lb.
 - b. Scar width in inches.
 - c. Film strength in psi. This value must be calculated.
 - d. Torque reading on the display screen in pounds divided by 10 = Average current in amps.

EP Test

Measurements and Calculations

To calculate the Film Strength of the test fluid:

1. To measure the scar length and width on the block, use a magnifier (#111-11) calibrated to read 0.005" (90.0127 cm). Place the magnifier at the center of the scar parallel to the edges.
 - a. The width of the scar is parallel to the long axis of the block.
 - b. The length of the scar is parallel to the small axis of the block.



2. To calculate the pressure on the block:

- a. Compute the total area of the scar on the block. Multiply the width of the scar (in inches) by the length of the scar (in inches). If the scar is trapezoidal in shape, use the average width of the scar.
- b. Calculate the force acting on the scar area. Divide the torque meter dial reading (in inch pounds) at which a Pass was obtained by 1.5 (1.5 is the travel distance of the arm).
- c. Calculate the pressure on the test block at the time the test was stopped. Divide the force acting on the scar (B above) by the area of the scar (A above). This pressure is the film strength of the fluid. In equation form it is as follows:

$$P = \frac{T \text{ (in-lb)}}{1.5 \times L \text{ (in.)} \times W \text{ (in.)}}$$

Where:

- P = Film Strength (psi)
- T = Torque Meter Dial Reading (in-lb)
- W = Scar Width (inches)
- L = Scar Length (inches)



EP Block – Good Seizure Scarring

Heat Cup

Cup heaters (included with #112-00-C and #112-00-1-C) are designed for controlling the temperature of a mud sample while taking readings with a Lubricity Tester.



1. Do not heat fluid over 200°F.
2. Do not immerse cup heater in water when cleaning.

Procedure:

1. Plug the cord into 115 or 230 volts AC as indicated on the nameplate (#112-50 is 115 V, #112-50-1 is 230 V).
2. Turn the thermostat clockwise to about three-fourths of the range, which will be 185°F, and allow 15 minutes for heat-up. The pilot light will light when the well reaches the set temperature.
3. Plug the Thermocouple (#130-76-03) into the temperature port on the front of the Lubricity Tester and insert the probe into the provided hole on the side of the well to read the temperature. The thermostat should be set about 50°F above desired mud temperature.
4. With the well preheated, place the cup of mud in the well. Stir the mud frequently, checking also with a thermometer. When the mud approaches the desired temperature, cut the thermostat back about ¼ turn to avoid overheating.
5. Place the entire assembly on the base of the Lubricity Tester.
6. Carefully raise the cup stand while swinging the torque arm in place.
7. Raise or lower the instrument to proper depth and stir. Recheck the temperature and take a reading. Thermostat adjustment may be needed if the block and ring are cold.

Disassembly

1. Turn the power off.
2. Lower the cup stand and turn the torque arm clamp up and away.
3. Swing the torque arm back to allow removal of the test block.
4. Remove and thoroughly rinse the test block with deionized water.
5. Remove the cup and discard the test fluid.
6. Remove the retaining nut and test ring.
7. Use acetone, deionized water, and a brush to clean the entire test area, including the test ring, test block, and block holder. To prevent rust, ensure that the entire unit is clean and dry. If the machine is to be stored for a long period of time, coat all components with oil.

Maintenance

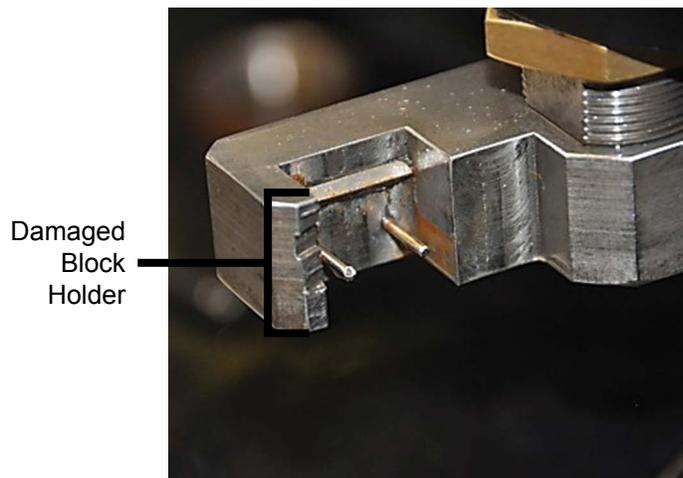
Transportation

The EP Lubricity Tester is intended to remain stationary on a laboratory bench. If it must be transported, the torque arm should be removed from the unit, and not simply tightened down. If it is being shipped, it must be encased inside a wooden crate with the unit bolted to the bottom of the crate. This machine is heavy (56 pounds) and if dropped the frame may warp, which may result in a total replacement of the unit.

Maintenance

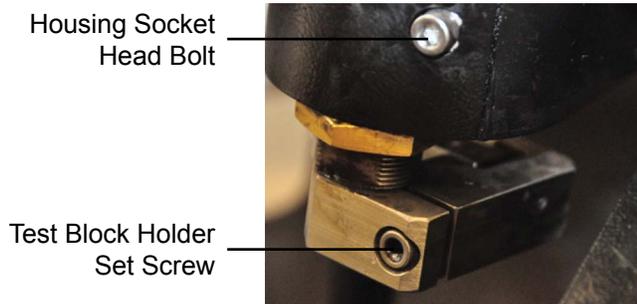
Test Block

After reaching the desired rpm, recheck the test block to make sure it is still inside the holder. Sometimes the vibration of the machine will cause the block to fall out of the Test Block Holder (#111-00-38), ending up in the bottom of the cup. If the technician does not notice the block is out of the holder and the torque arm is depressed the test block holder may become damaged.



To Remove the Test Block Holder:

1. Loosen set screw at the back of the test block holder.
2. Gently tap the test block holder off the torque bushing.
3. If the test block holder does not come loose, it will be necessary to loosen the socket head bolt on the housing so the entire torque bushing comes out.
 - a. Lock the bushing securely on a bench vise.
 - b. Gently tap the test block holder loose from the shaft.



Lubrication

The roller bearing in the main shaft may occasionally need to be greased. If a squeaking noise is coming from the main shaft, add a high-temperature bearing grease (such as Lubricate No. 12601) via the opening located on the lower back of the housing behind the lower main shaft.

Maintenance

Upper Main Shaft Bearing

The upper main shaft bearing is sealed and will need replacement only when the main shaft can be freely moved by hand. This also may be indicated by excessive oscillation in the torque reading.

To replace the bearing:

1. Remove the belt guard.
2. Remove the gear from the main shaft.
3. Unscrew the four screws beneath the gear and remove the plate to reveal the bearing.
4. Press the bearing upward from underneath and slide it up and off the main shaft.
5. Slide the new bearing down the main shaft and into place.
6. Reinstall the plate and secure it tightly in place.
7. Reinstall the gear, belt, and belt guard. Check the belt tension as described below.



Note

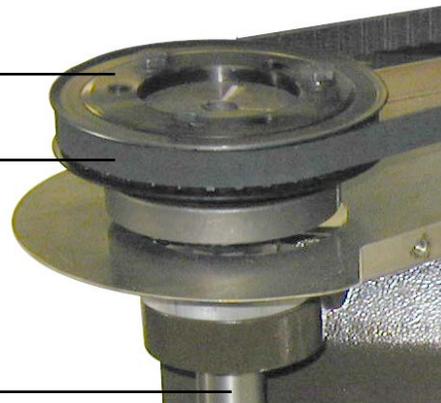
The Lower Main Shaft Bearing (#111-00-012-1) rarely needs replacing.



Timing Pulley
(#111-00-007)

Timing Belt
(#111-00-006)

Main Shaft
(#111-00-33)



Maintenance

Control Panel

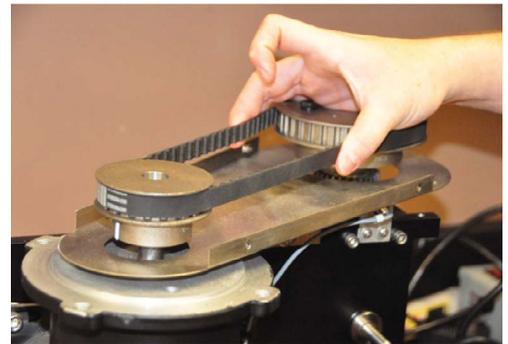
Keep the control panel clean and dry. Fluids on the panel can seep in and around electrical components and cause damage. When running a test, check to make sure that liquid is not being thrown out of the cup and onto the display panel. This becomes particularly important when running an EP Test at 1,000 rpm.

Maintenance

Belt Guard

Periodically remove the belt guard and check the belt tension. Ensure there is sufficient tightness so that when the motor is stalled, the belt will not slip. To increase the belt tension:

1. Loosen the motor mount bolts on the back of the unit.
2. Slide the motor towards the torque adjust handle.
3. Retighten the mounting bolts.
4. Reinstall the belt guard.



Calibration

Block Positioning

Before calibrating the instrument, it is necessary to check the position of the ring and block. The contact area must be centered within the concave portion of the block.

1. Thoroughly clean the ring, block, and block holder with acetone.

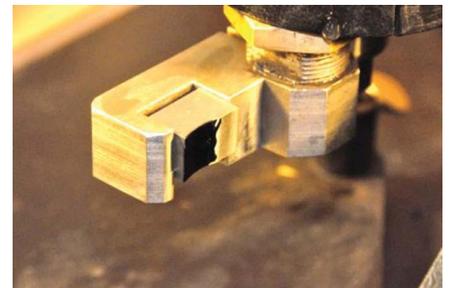
Do not touch the metal contact surfaces with bare hands.



2. Install a new lubricity ring onto the main shaft.
3. Tighten the retainer nut with the $\frac{15}{16}$ " wrench.

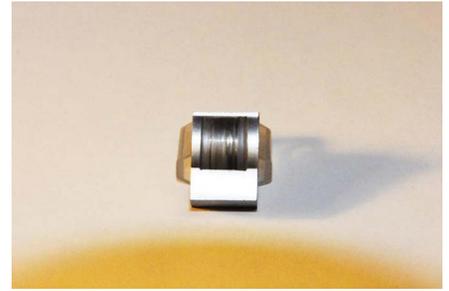


4. Using a black marker, coat the surface of the block.
5. Place the marked block into the block holder.



6. Set the speed to 60 rpm and apply 150 in-lb of force for ten seconds. Do not immerse in water.
7. Release pressure on the block and stop the motor.

8. Examine the block surface for wear. The wear pattern should be centered on the face of the block.



9. If the block needs to be adjusted, loosen the socket head bolt on the housing.
10. To move the block left or right, adjust the torque bushing with the $\frac{3}{4}$ " wrench to tighten the socket head bolt on the housing. To move it up or down, adjust the lock nut with the $1\frac{1}{4}$ " wrench.



Left / Right



Up / Down

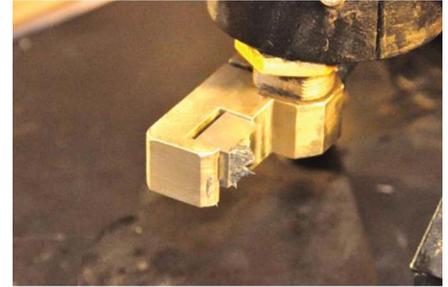
11. Tighten the socket head bolt on the housing.
12. Repeat this process until the wear mark is centered on the concave face of the lubricity block.

Calibration

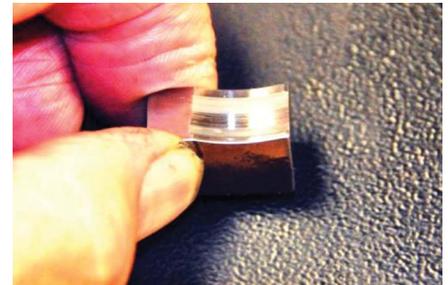
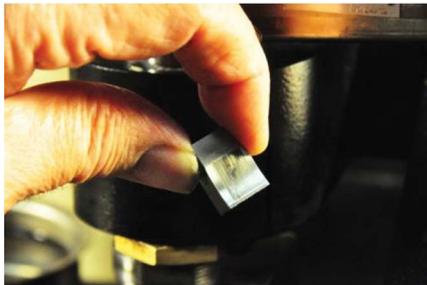
Standardizing the Ring and Block

All new lubricity ring and block sets must be standardized (also called “burning in” or “calibrating”) before running a test. This process ensures complete contact between the ring and the concave surface of the block.

1. Cover the ring and contact area of the block with **coarse** grinding compound.



2. Submerge the ring and block in fresh deionized water.
3. Press the exit button to zero the timer.
4. Set the motor speed to 90 rpm.
5. Apply 150 in-lb of torque.
6. Run for 2 hours, stopping every 30 minutes to redistribute the grinding compound on the surface of the block.
7. Stop the motor and observe the block. The block should show a shiny wear pattern covering 30% to 50% of the surface. If it does not, return to step 1.



8. Cover the ring and contact area of the block with **fine** grinding compound.
9. Submerge the ring and block in fresh deionized water.
10. Press the exit button to zero the timer.
11. Set the motor speed to 100 rpm.

Calibration

Calibration Check

12. Apply 75 in-lb of torque.
13. Run for 2 hours, stopping every 30 minutes to redistribute the grinding compound on the surface of the block.
14. Stop the motor and observe the block. The block should show a shiny wear pattern covering more than 50% of the surface. If it does not, return to step 8.

The EP Lubricity Tester is considered to be in calibration when a reading of 34 ± 2 is obtained in deionized water at a speed of 60 rpm with 150 in-lb of force applied for 5 minutes.

1. Thoroughly clean the ring, block, and block holder with acetone.
2. Submerge the ring and block in a cup of new deionized water.



3. Set the speed to 60 rpm
4. Zero the torque and timer.
5. Apply 150 in-lb of force for five minutes.
6. Wait for the reading to stabilize.
7. After the first run, the reading is usually low. Repeat steps 1 through 6 a total of three times.
8. If the reading is not 34 ± 2 after three runs in deionized water, then additional grinding of the block and ring will be required. Repeat until the instrument reads within the proper range.
 - a. If the reading is below 32: Use coarse compound for one hour at 100 rpm and 90 in-lb. Redistribute the grinding compound every 15 to 30 minutes.
 - b. If the reading is above 38: Use fine compound for one hour at 100 rpm and 75 in-lb. Redistribute the grinding compound every 15 to 30 minutes.

Appendix

Driver Install

If using the included Serial to USB Converter cable (part # 130-79-19) to connect to the Lubricity Tester, the PC will require a driver. This driver is included with the instrument. To install the driver:

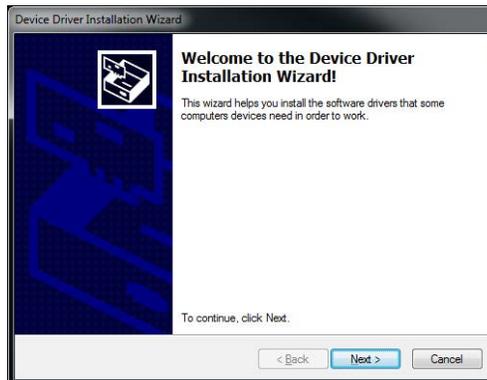
1. Insert the software/driver CD to the computer and select the file labeled: CDM v2 1200 WHQL Certified.exe
2. A prompt will open, asking if you want to run this file. Press Enter or click "Run".



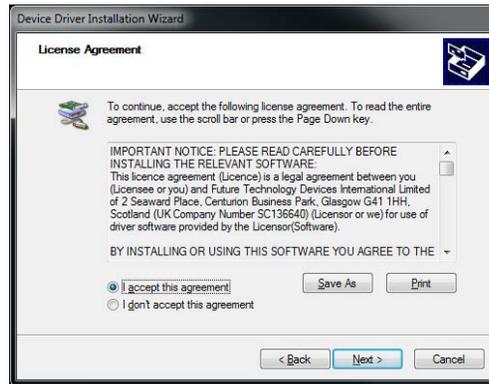
3. The FTDI CDM Driver will open to allow you to extract the driver and launch the installer. Click "Extract".



4. A welcome window will open. Click "Next".



5. Accept the licence agreement and click “Next”.



6. Once the driver installation is complete, Click “Finish”.



7. Plug the USB portion of the USB/RS232 cable (#130-79-19) to the computer.

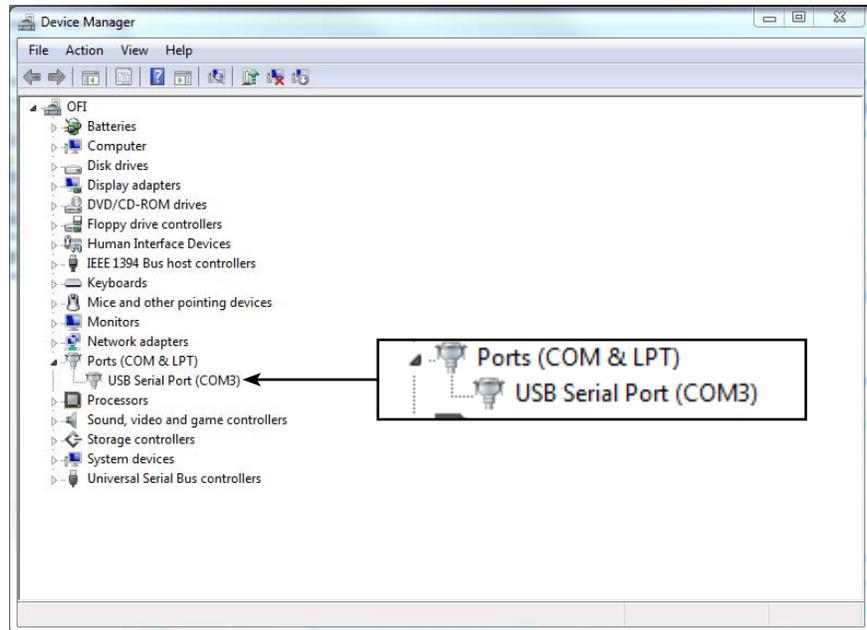


Note

The computer will continue installing the software. Wait for it to finish installing.

8. Once the installation is complete, navigate to the Device Manager: Click the Start Menu. Open the “Control Panel”. Click the “Hardware and Sound” link. Click on the Device Manager link in the “Devices and Printers” options.

9. Confirm which communication port (COM Port) the USB Serial Port is located in. The window below is indicating that this sample port was connected to “COM3” which can be a different COM# depending on the computer and the port it was connected to. This is the COM Port that the driver has been assigned to.



10. Open the Options screen in the ORCADA software. Choose the COM port listed in Device Manager.

Warranty and Return Policy

Warranty:

OFI Testing Equipment, Inc. (OFITE) warrants that the products shall be free from liens and defects in title, and shall conform in all respects to the terms of the sales order and the specifications applicable to the products. All products shall be furnished subject to OFITE's standard manufacturing variations and practices. Unless the warranty period is otherwise extended in writing, the following warranty shall apply: if, at any time prior to twelve (12) months from the date of invoice, the products, or any part thereof, do not conform to these warranties or to the specifications applicable thereto, and OFITE is so notified in writing upon discovery, OFITE shall promptly repair or replace the defective products. Notwithstanding the foregoing, OFITE's warranty obligations shall not extend to any use by the buyer of the products in conditions more severe than OFITE's recommendations, nor to any defects which were visually observable by the buyer but which are not promptly brought to OFITE's attention.

In the event that the buyer has purchased installation and commissioning services on applicable products, the above warranty shall extend for an additional period of twelve (12) months from the date of the original warranty expiration for such products.

In the event that OFITE is requested to provide customized research and development for the buyer, OFITE shall use its best efforts but makes no guarantees to the buyer that any products will be provided.

OFITE makes no other warranties or guarantees to the buyer, either express or implied, and the warranties provided in this clause shall be exclusive of any other warranties including ANY IMPLIED OR STATUTORY WARRANTIES OF FITNESS FOR PURPOSE, MERCHANTABILITY, AND OTHER STATUTORY REMEDIES WHICH ARE WAIVED.

This limited warranty does not cover any losses or damages that occur as a result of:

- Improper installation or maintenance of the products
- Misuse
- Neglect
- Adjustment by non-authorized sources
- Improper environment
- Excessive or inadequate heating or air conditioning or electrical power failures, surges, or other irregularities
- Equipment, products, or material not manufactured by OFITE
- Firmware or hardware that have been modified or altered by a third party
- Consumable parts (bearings, accessories, etc.)

Returns and Repairs:

Items being returned must be carefully packaged to prevent damage in shipment and insured against possible damage or loss. OFITE will not be responsible for equipment damaged due to insufficient packaging.

Any non-defective items returned to OFITE within ninety (90) days of invoice are subject to a 15% restocking fee. Items returned must be received by OFITE in original condition for it to be accepted. Reagents and special order items will not be accepted for return or refund.

OFITE employs experienced personnel to service and repair equipment manufactured by us, as well as other companies. To help expedite the repair process, please include a repair form with all equipment sent to OFITE for repair. Be sure to include your name, company name, phone number, email address, detailed description of work to be done, purchase order number, and a shipping address for returning the equipment. All repairs performed as "repair as needed" are subject to the ninety (90) day limited warranty. All "Certified Repairs" are subject to the twelve (12) month limited warranty.

Returns and potential warranty repairs require a Return Material Authorization (RMA) number. An RMA form is available from your sales or service representative.

Please ship all equipment (with the RMA number for returns or warranty repairs) to the following address:

OFI Testing Equipment, Inc.
Attn: Repair Department
11302 Steeplecrest Dr.
Houston, TX 77065
USA

OFITE also offers competitive service contracts for repairing and/or maintaining your lab equipment, including equipment from other manufacturers. For more information about our technical support and repair services, please contact techservice@ofite.com.