Dependable Products From People You Trust

Dual Cell HTHP Consistometer

#120-05: 25,000 PSI, 400°F
#120-15: 40,000 PSI, 600°F

Instruction Manual

Updated 12/21/2016
Ver. 5.0

OFI Testing Equipment, Inc.
11302 Steeplecrest Dr. · Houston, Texas · 77065 · U.S.A.
Tele: 832.320.7300 · Fax: 713.880.9886 · www.ofite.com

Table of Contents

Intro

During cementing operations, the time required for a cement slurry to set is of primary concern. Under an ideal situation, minimal time would be required to successfully pump the slurry, which immediately upon placement, begins to develop compressive strength. However, if insufficient time is allowed to fully pump the cement, it will be necessary to drill the cement remaining in the casing string. Remedial operations such as this are very costly. Conversely, cements that are successfully placed, but require considerable time to cure, consume valuable rig time, which is also quite costly. Laboratory tests should be conducted under simulated reservoir conditions to examine the actual thickening time of the slurry. The OFITE HTHP Consistometer was specifically engineered to determine the thickening time of well cements under simulated downhole pressures and temperatures.

Description

A cement is mixed and poured into the slurry cup assembly. The slurry cup is placed into the test vessel and pressure is increased via an air-driven hydraulic pump. A PID temperature controller governs an internal heater, which maintains the necessary temperature profile, while a magnetic drive mechanism rotates the slurry cup assembly at 150 RPM. A potentiometer controls an output voltage, which is directly proportional to the amount of torque the cement exerts upon an API-approved paddle. A chart recorder registers cement consistency and temperature as a function of time. Temperature and consistency are digitally displayed via LED indicators.

Features

- Pressure generated via an air-driven hydraulic pump
- Drive table is rotated with a magnetic drive
- External cooling jacket aids cooling of test cell
- Electronic timer with alarm, elapsed 0.1 minute resolution
- Deadweight calibration unit included
- Temperature, pressure, and consistency alarms provide automatic shutdown
- Safety head with rupture disk are provided
- Unit is fully capable of testing cements in strict accordance to the guidelines as stated in API Specification 10

Requirements

- Air/Nitrogen Supply (100 – 150 PSI / 690 – 1,035 kPa)
- Water Supply for Cooling (40 PSI / 276 kPa)
- Water Drain
- 220 Volt, 50/60 Hz, 25 Amp electrical power supply

Specifications

Size	66 × 36 × 32 inches (168 × 92 × 82 cm)
Weight	1,400 lbs (635.6 kg)
Crated Size	51" × 45" × 76" (130 × 114 × 193 cm)
Crated Weight	2250 lbs (1020.6 kg)
Temperature Controller	Digital PID, 1° Resolution
Pressure Indicator	100 PSI (690 kPa) Resolution; High and Low Pressure Alarms
Slurry Cup	150 RPM Rotational Speed; 316 Stainless Steel; Expansion Chamber

Model 100: (120-05)

Maximum Temperature: 400°F (204.4°C)
Maximum Pressure: 25,000 PSI (172,375 kPa)

Model 120: (120-15)

Maximum Temperature: 600°F (315.5°C)
Maximum Pressure: 40,000 PSI (275,800 kPa)

Components

#120-00-5 Graphic Recorder
#120-147 Autoclave Mag Drive
#120-201 Test Cell Thermocouple

#120-628 Potentiometer Assembly:
- #120-602 Calibration Spring
- #120-603 Potentiometer Body
- #120-604 Potentiometer Resistor
- #120-605 Contact Spring
- #120-606 Potentiometer Contact Arm
- #120-607 Contact Strip
- #120-608 Grounding Cable Retaining Screw
- #120-609 Grounding Contact Spring

#120-05 Model 100, 25,000 PSI; 400°F
- #120-001 Mineral Oil; 1 Gallon; Qty: 6
- #120-102 Rupture Disk; 28,000 PSI; Qty: 2
- #120-203 Slurry Cup Thermocouple; Qty: 2
- #120-401 Metal O-rings; Qty: 2
- #120-519 Slurry Cup Assembly

#120-15 Model 120, 40,000 PSI; 600°F
- #120-001 Mineral Oil; 1 Gallon; Qty: 6
- #120-103 Rupture Disk; 45,000 - 50,000 PSI; Prebulged; Qty: 2
- #120-208 Slurry Cup Thermocouple; Qty: 2
- #120-401 Metal O-ring; Qty: 2
- #120-521 Slurry Cup with Extension
- #122-072 1-Amp Fuse, 5 mm × 20 mm, Qty: 10
- #122-073 2-AMP Fuse, 5 mm × 20 mm, Qty: 9

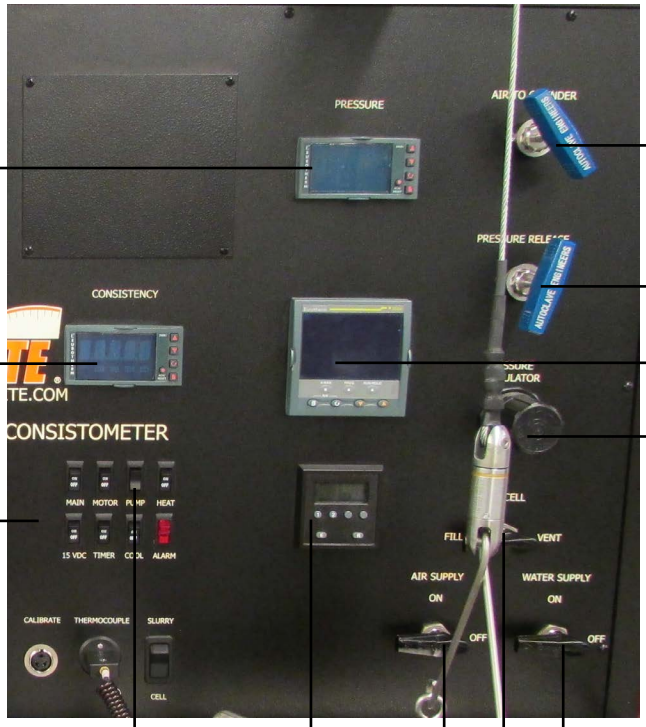
#120-01 Spare Parts for Model 100:

#120-00-1	Consistometer Tool Kit
#120-001	Mineral Oil, 2 Gallons
#120-102	Rupture Disk (28,000 PSI), Qty: 2
#120-202	4,000-Watt Heater
#120-204	Heater Gasket, Qty: 2
#120-208	Slurry Cup Thermocouple, Qty: 2
#120-401	Metal O-ring, Qty: 6
#120-501	Slurry Cup Sleeve
#120-502	Molded Diaphragm, Qty: 25
#120-503	Paddle Pin, Qty: 12
#120-504	Pivot Bearing, Qty: 6
#120-505	Pivot Bearing Gasket, Qty: 5
#120-506	Paddle for Slurry Cup Assembly, Qty: 4
#120-507	Paddle Shaft for Slurry Cup Assembly, 7.75" Long, Qty: 10
#120-508	Diaphragm Retaining Ring, Qty: 2
#120-509	Drive Disk for Slurry Cup Assembly
#120-510	Drive Bar for Slurry Cup Assembly
#120-511	Slurry Cup Shear Pin, Qty: 24
#120-512	Slurry Cup Drive Pin, Qty: 12
#120-513	Slurry Cup Gasket, Qty: 6
#120-514	Drive Disk Set Screw, 6-32 × 3, Stainless Steel, Qty: 10
#120-519	Slurry Cup Assembly, No Expansion Cap
#120-602	Calibration Spring, Qty: 3
#120-604	Potentiometer Resistor, Qty: 4
#120-606	Potentiometer Contact Arm, Qty: 6
#120-607	Contact Strip, Qty: 6
#120-608	Grounding Cable Retaining Screw, 10-32 × ½ SHCS SS
#120-684	Large Bronze Bearing, Qty: 2
#122-072	1-Amp Fuse, 5 mm × 20 mm, Qty: 5
#122-073	2-AMP Fuse, 5 mm × 20 mm, Qty: 5
#130-75-28	1/16" Allen Key, 1.75" Long, Qty: 2

#120-11 Spare Parts for Model 120:

#120-001	Mineral Oil, 2 Gallons
#120-10-1	Consistometer Tool Kit
#120-103	Rupture Disk, 45,000–50,000 PSI, Prebulged, Qty: 2
#120-202	4,000 Watt Heater
#120-203	Slurry Cup Thermocouple, Qty: 2
#120-204	Heater Gaskets, Qty: 2
#120-401	Metal O-rings, Qty: 10
#120-501	Slurry Cup Sleeve
#120-502	Molded Diaphragm, Qty: 25
#120-503	Paddle Pin, Qty: 12
#120-504	Pivot Bearing, Qty: 6
#120-505	Pivot Bearing Gasket, Qty: 5
#120-506	Paddle for Slurry Cup Assembly, Qty: 4
#120-508	Diaphragm Retaining Ring for Slurry Cup Assembly, Qty: 2
#120-509	Drive Disc for Slurry Cup Assembly

#120-510	Drive Bar for Slurry Cup Assembly
#120-511	Slurry Cup Shear Pin, Qty: 24
#120-512	Slurry Cup Drive Pin, Qty: 12
#120-513	Slurry Cup Gasket, Qty: 6
#120-514	Drive Disk Set Screw, 6-32 × 3, Stainless Steel, Qty: 10
#120-520	Paddle Shaft, 9⅛", Qty: 10
#120-521	Slurry Cup with Extension
#120-602	Calibration Spring, Qty: 3
#120-604	Potentiometer Resistor, Qty: 4
#120-606	Potentiometer Contact Arm, Qty: 6
#120-607	Contact Strip, Qty: 6
#120-608	Grounding Cable Retaining Screw, 10–32 × ½ SHCS SS
#120-684	Large Bronze Bearing, Qty: 2
#122-072	1-Amp Fuse, 5 mm × 20 mm, Qty: 5
#122-073	2-Amp Fuse, 5 mm × 20 mm, Qty: 5
#130-75-28	1/16" Allen Key, 1.75" Long, Qty: 2



Pressure Indicator

Air To Cylinder

Pressure Release

Potentiometer Indicator

Temperature and Pressure Controller

Pressure Regulator

Switches

To operate the “Pump” switch:
Up: Manual Mode
Middle: Off
Down: Auto Mode

Timer

Air Supply

Fill Cell

Water Supply

Thermocouple Receptacle

Thread Gland

Cell Cap

Setup

Consistometer

Note

1. Carefully remove the instrument from the wooden crate.

2. Once the unit is in place, lock the casters by depressing the lever on the side. This will prevent the unit from moving.

3. Connect an air or nitrogen (100 – 150 PSI / 690 – 1,035 kPa) supply to the air supply on the back of the instrument.

   This unit uses ¼" NPT female connectors for all supply lines.

4. Connect the drain and coolant supply lines, also on the back of the unit.

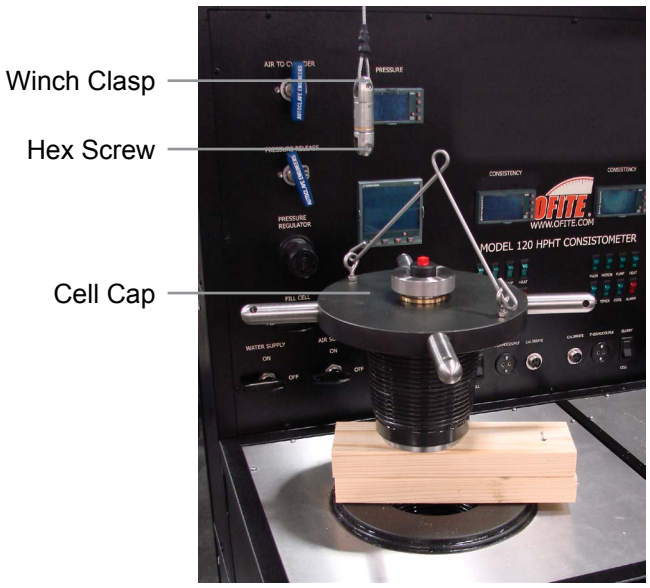
5. Make sure all electrical switches are turned off and the unit is grounded. Make the necessary electrical connections in accordance with local codes.

6. Connect the cell cap to the winch:

   a. With the supplied allen key, unscrew and remove the hex screw from the winch clasp.

   b. Remove the cell cap and support it on blocks above the test cell.

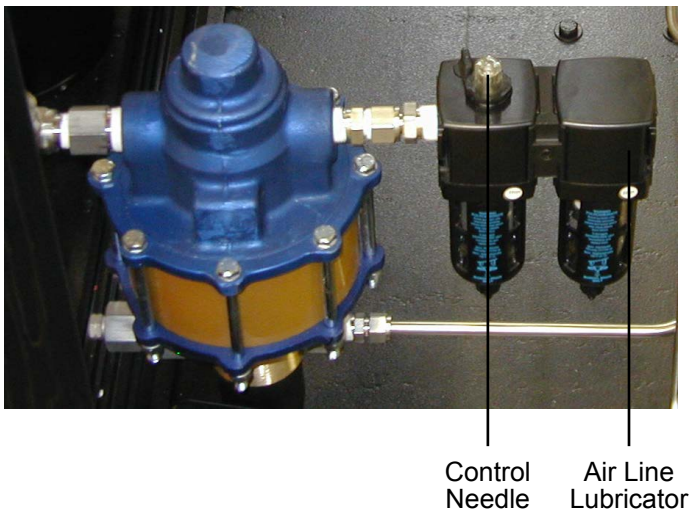
   c. Attach the winch clasp to the cell cap and secure it with the hex screw.



7. To fill the oil reservoir, open the front cabinet door and remove the oil reservoir cap. Using a funnel, pour approximately four liters (or until full) of mineral oil into the reservoir. Replace the cap. Make sure the seal is air tight. Use the sight glass on the side of the reservoir to check the oil level.

8. Periodically inspect the oil level within the air line lubricator. This unit is located just upstream of the air inlet on the hydraulic pump inside the Consistometer cabinet. You can access it by opening the cabinet doors on the back of the unit. If the oil level is low, refill it with mineral oil.

   The lubricator has been adjusted at the factory. Under normal operation, one drop of oil should be discharged into the air stream every 12 to 20 pump strokes. This discharge can be observed through the clear control needle on top of the lubricator. If adjustment is necessary, turn the hex screw on top of the control needle until you observe normal discharge. Rotate the screw clockwise to decrease the oil flow rate and counter clockwise to increase it.



Setup

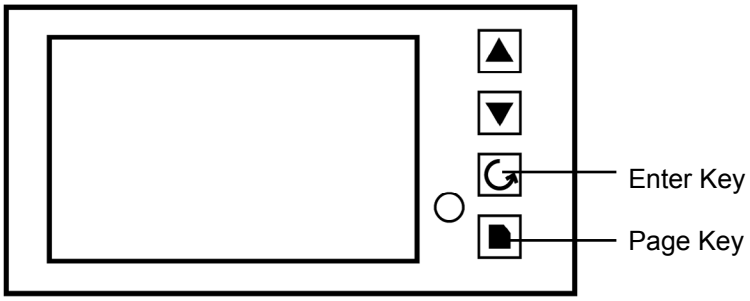
Pressure Indicator

The pressure indicator not only shows you the current pressure, but it also alerts you when the pressure rises above the value you set. During an alarm condition, the heater, pump, and motor will automatically shut down.

The display shows the current pressure in KPSI. This means a reading of 12.501 indicates a pressure of 12,501 PSI.

To set the high-pressure alarm:

1. Press the “Page” button until the display reads “AL”.
2. Press the “Enter” button until the display reads “1FSH”.
3. Press the up and down arrows to set the high-pressure setpoint.



Pressure Indicator

Setup

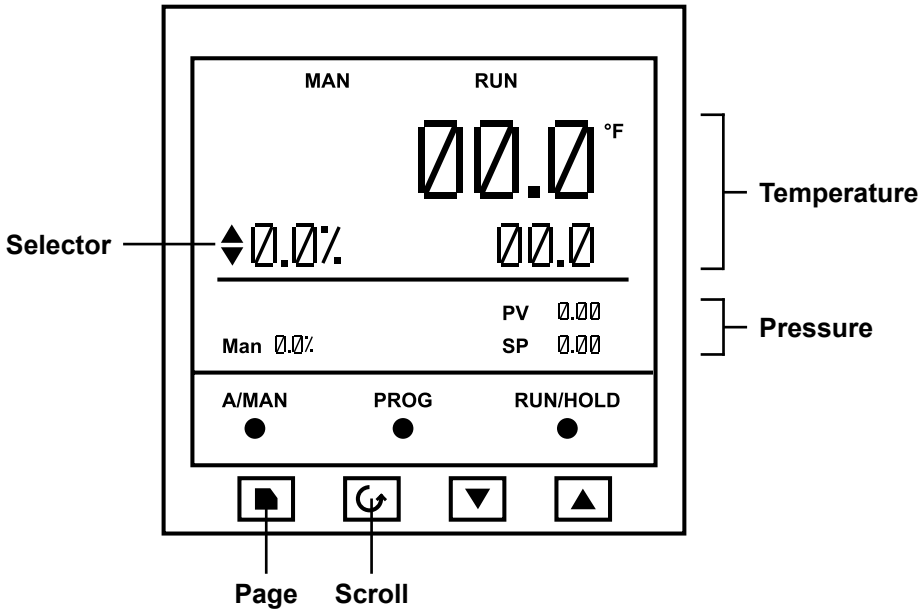
Temperature and Pressure Controller

The Eurotherm Model 3504 controls both temperature and pressure. When running a test with the computer, the software automatically programs the controller. However, when running a test without the computer, the controller must be programmed manually. It is strongly recommended that operators carefully study the Model 3504 instruction manual before attempting to program the controller.

When running a test without the computer, always build the program prior to mixing the slurry and loading the slurry cup.

The Eurotherm 3504 can store up to eight custom programs. Each program consists of multiple segments. In a segment, the temperature or pressure setpoint can be changed or held for a certain amount of time.

Each program also consists of two channels. Channel 1 controls the temperature and Channel 2 controls the pressure. The two channels are programmed separately and have their own set of segments.



To edit a program:

1. Press the “Page” button until the display reads “Program Edit”.
2. Use the up and down arrows to select the program you want to edit.
3. Press the “Scroll” button to move to the Channel parameter.
4. Use the up and down arrows to select the Channel you want to edit.

   Channel 1 controls temperature. Channel 2 controls pressure.

5. Set the parameters for the test:

   Press the “Scroll” button to select a parameter to edit. Then use the up and down arrows to modify the value of that parameter.

   a. Set the following parameters for each test:
      - Ramp Units: Seconds, Minutes, Hours
      - Cycles: The number of times to repeat the test.

   b. You must choose a Segment Type for each segment in the test. The Segment Type will determine the parameters available for that segment:

   Rate: Increase the setpoint by a certain rate (Ramp Rate)
   - Target SP: The end temperature or pressure for the segment
   - Ramp Rate: The rate of increase for the setpoint. For example, if Ramp Units is set to minutes, and Ramp Rate is set to 5, the temperature setpoint will increase by 5° per minute.

   Time: Increase the setpoint over a certain time (Ramp Time)
   - Target SP: The end temperature or pressure for the segment
   - Duration: The amount of time it will take to increase the setpoint to the target.

   Dwell: Hold the current setpoint.
   - Duration: The amount of time to hold the current setpoint.

   Step: Increase the setpoint immediately. No ramp is involved.
   - Target SP: The end temperature or pressure for the segment.

   End: The final segment in every test must be End.
   - End Type: Dwell is recommended. This will hold the current setpoint until the test is stopped.

The display is split into two areas. The top area shows the temperature channel while the bottom shows the pressure channel. Before starting a manual test, both the temperature and pressure channels must be in auto mode:

1. Press the “Scroll” button to move the selector around the screen. When the selector is above the dividing line, the temperature channel is selected. When it is below the dividing line, the pressure channel is selected.

2. Press the “A/MAN” button to toggle the selected channel between auto and manual mode.

   In the temperature channel, the word “MAN” will appear at the top of the display to indicate manual mode. This word will disappear in auto mode.

   In the pressure channel, the word “Man” will appear on the left-hand side of the display. This word will change to “Aut” in auto mode.

Setup

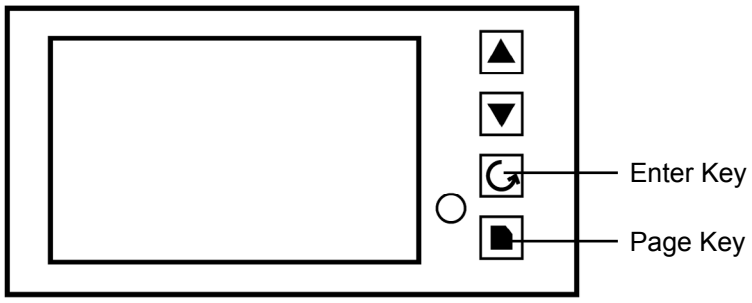
Potentiometer Indicator

The HTHP Consistometer includes a built-in Eurotherm 2408i 15V Potentiometer Indicator. As the slurry cup rotates within the unit, the potentiometer creates a small voltage charge, which is displayed on the indicator. This charge increases as the strength of the slurry increases.

The potentiometer indicator features a high-voltage alarm. When the charge reaches the specified level, an alarm condition is triggered and the heater, pump, and motor are automatically shut off.

To change the alarm setting, perform the following steps:

1. Push the “Page” key twice. The display will read “AL”.
2. Push the “Enter” key. The display will read “IFSH”.
3. Push the up arrow key once to read the current setting.
4. Push the up or down arrow keys to change the setting.
5. After choosing the appropriate setting, press the “Page” key three times to return to the original display.



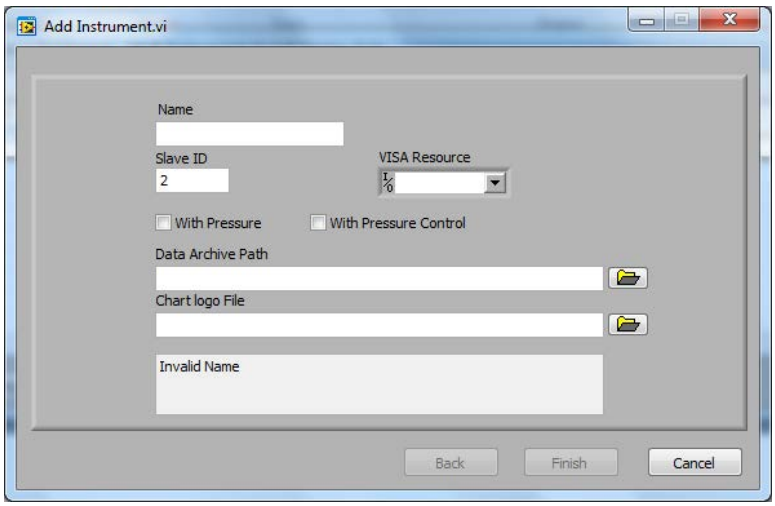
Software

Setup

1. Double-click the “Multi Consistometer” icon on the PC desktop.
2. To add a new unit, click “Add New”.
3. Select “Consistometer” from the list.
4. Enter a name. The name must be different from all other Consistometers connected to this PC.
5. Enter a slave ID. The slave ID must be different from all other Consistometers connected to this PC.
6. Choose the COM port the new Consistometer is connected to.
7. Chose a folder to save the test data. It is recommended that each Consistometer have its own data archive folder.
8. Choose a logo file (.jpg) to display on the printed chart.
9. Select “With Pressure” if you want pressure data to print on your graph.

   This feature is only available on units with a Eurotherm pressure indicator. Units with an AMETEK/Dixson pressure indicator cannot print pressure on the graph.
10. Select “With Pressure Control” if you want to control pressure from the software.

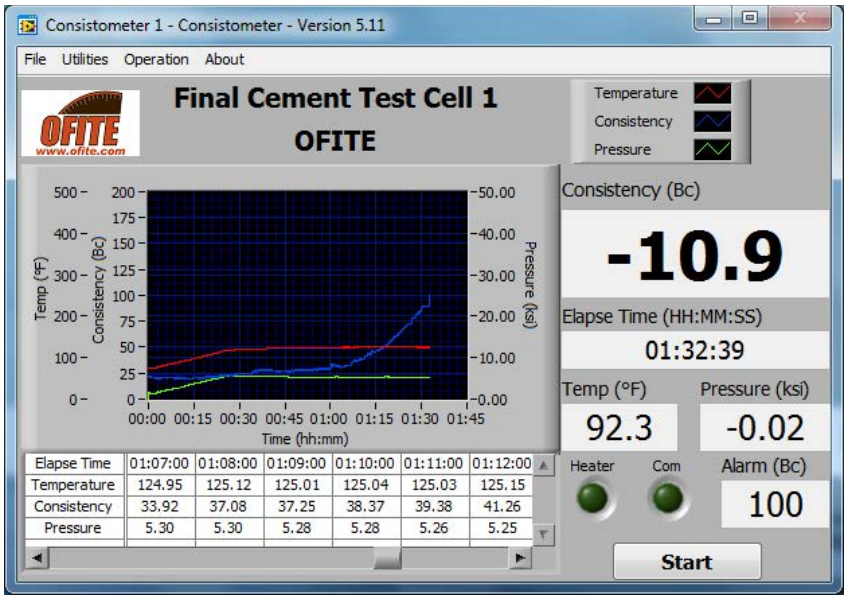
    This feature is not available on all units.



11. Click “Finish” then “Save”.

12. The main screen shows all units added to the PC. For each one it shows the type of equipment, name, slave ID, COM port, and data archive path. Units with “[R]” after their name are currently running a test.

    Right-click on a unit and select “Launch” from the menu.

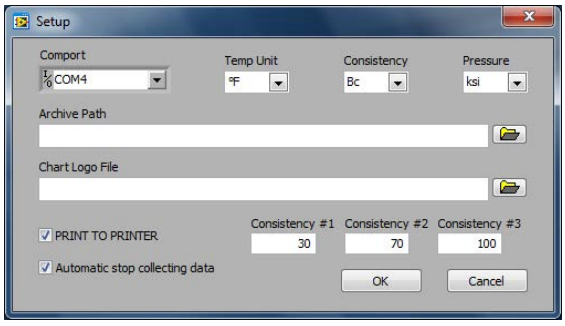


13. Select “Setup” from the “Options” menu.

14. Select a “Temp Unit” (°F or °C), “Consistency” (V or Bc), and “Pressure” (PSI or kPa).

15. Choose an “Archive Path”. This is the folder where all test data will be stored.

16. Choose a “Chart Logo File”. This is the logo that will print on the report at the end of a test. This file must be in .jpg format.



17. Select “Print to Printer” if you want a chart to automatically print when you stop a test. Select “Print to File” if you want a .jpg file to be create automatically when you stop a test.

    Both of these options can be enabled at the same time. It is recommended that “Print to File” always be enabled.

18. Choose values for the “Consistency #1”, “Consistency #2” and “Consistency #3” fields.

    These values tell the software to record the test time when the consistency reaches each point. A note will be made on the chart when the test is finished.

    Make sure that if you select “Bc” for consistency units that you also use Bc for these two fields. Likewise, if you chose “V” for consistency units, you must use voltage for these two fields.

19. Select “Automatic stop collecting data” if you want the Consistometer to stop collecting data during an alarm condition.

    During an alarm condition, the motor, heaters, and pump all stop. By default, when the alarm condition is resolved, everything restarts. However, if the “Automatic stop collecting data” box is checked data collection is also stopped, and only the motor and pump restart. The heaters remain off and no more data is collected.

20. When finished, click “OK”.

21. Select “Set Alarm” from the “Utilities” menu.

22. Enter a value in Bc. If the sample reaches this consistency, the unit will enter alarm condition.

1. Click “Start Test”.

2. Enter the necessary information. The following fields do not affect your test. The information will print on the report when the test is complete:

   - Customer Info
   - Additives
   - Cement Mfr.
   - Test Name
   - Cement Density
   - Cement Class
   - Density Units
   - Job Type

   The following fields do affect your test:

   - DAQ Time (mm:ss): determines how often test data is saved to file
   - Alarm: sets the consistency alarm. Be sure to use the same consistency units set in the “Setup” screen.

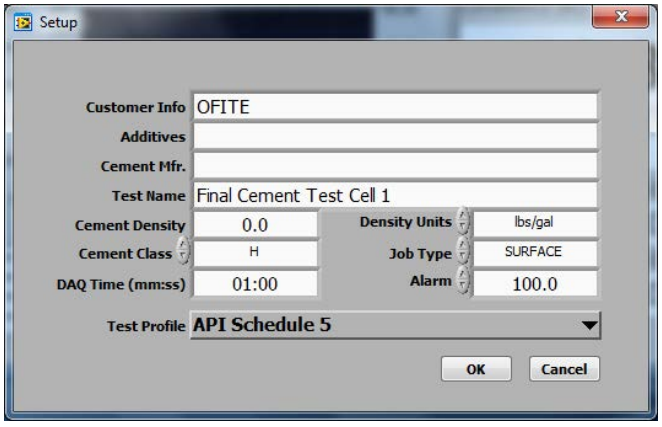
3. Select a “Test Profile”. Test profiles are built in the Test Builder. Refer to page 18 for instructions.

4. Click “OK” to start the test.

   Important

   If the computer is disconnected from the Consistometer or loses power, the test will not stop. Be sure to stop it manually. Refer to page 26 for instructions on stopping a test manually.

5. When the test is complete, click “Stop”.



Software

Test Builder

The Consistometer Software can control both the temperature and pressure during a test. Tests are programmed in the Test Builder.

1. Select “Test Builder” from the “Utilities” menu.

2. Click the “New Test” button to start a new test. Or click the “Copy Test”button to start with an existing test.

3. On the Temperature or Pressure tab click the “Add” button to add a step.

4. Choose a Step Type:

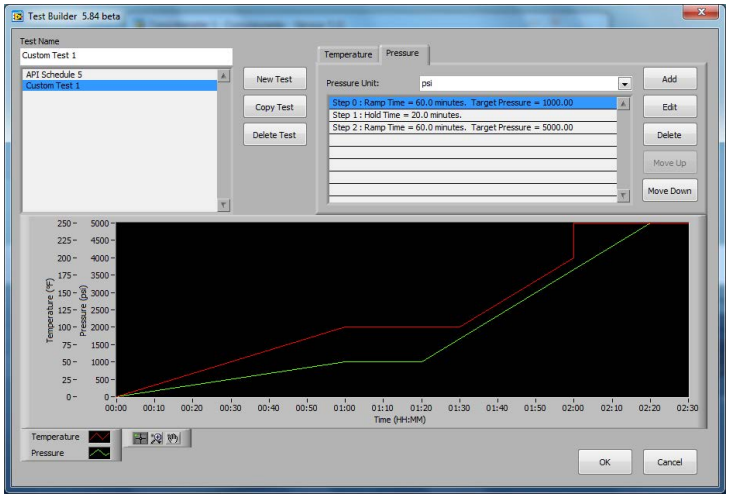
   - Ramp: The software will increase the setpoint up to the target over a specified time period.

   - Step: The software will increase the setpoint to the target immediately.

   - Hold: Maintain the current setpoint for the specified period of time.

5. Once you add a step, you can then go back and edit, delete, or move it up or down in the step list.

6. Click “OK” to save the test. The new test will now be available in the “Start Test” dialog box.



Software

Calibration

A calibration should be performed periodically to make sure the unit is still providing accurate information. Also, be sure to calibrate any time the potentiometer is changed. **Always calibrate with the same potentiometer that will be used during the test.**

1. Select “Calibration” from the “Operations” menu.

2. Prepare the potentiometer for calibration as described on page 29.

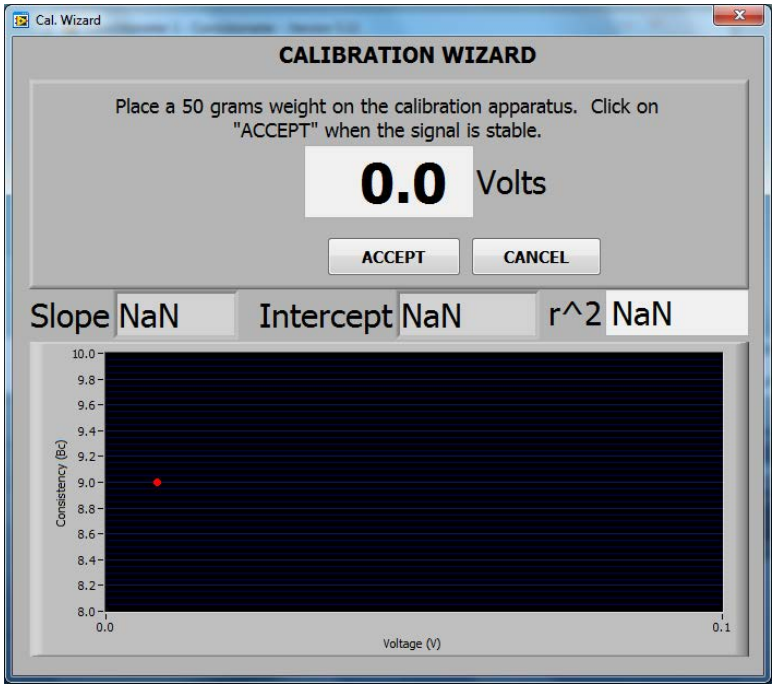
3. Place the weight hanger (with no weights) on the end of the string. The weight hanger is 50 g.

4. Wait for the value on the screen to stabilize and then click “Accept”.

5. The software will prompt you to add weight to the hanger. After adding the weight, wait for the value to stabilize, then click “Accept”.

   The software will graph the calibration points as you enter them. At any time you can click the “Back” button to re-enter a calibration point.

6. Click “Save” to save the calibration data.



Software

Test Data

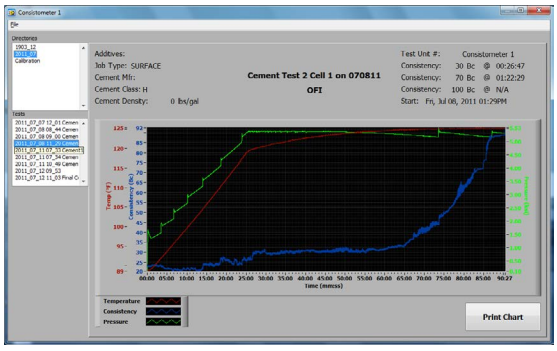
At the end of each test, all test data is saved in the “Data Archive Folder” that was selected in the “Setup” screen. There you can find an image showing the chart for each test as well as a data file that can be opened in MS Excel.

Archived tests and calibrations can also be viewed in the software:

1. Select “Open Data Archive” or “Open Calibration Archive” from the “File” menu.

2. On the left-hand side of the screen, choose a test or calibration to view. The graph will be displayed in the chart area.

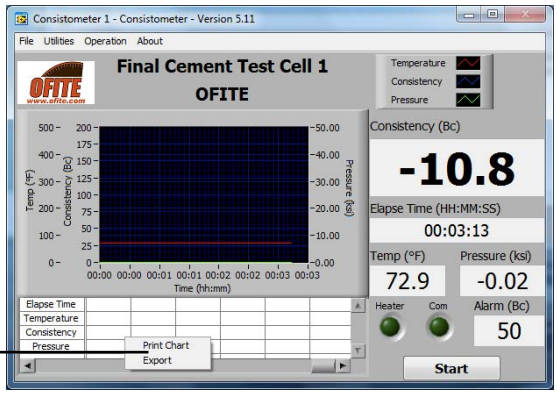
3. To print the chart, click the “Print Chart” button.



You can also print a chart or export test data during a test. Simply right-click on the table at the bottom of the main screen. From the context menu, select either “Print Chart” or “Export”.

a. “Print Chart” - This will print the current chart. If you have selected “Print to Printer” in the options screen, the chart will print to the default printer. If you have selected “Print to File”, a .jpg file will be created. See page 14 for more information about setting options.

b. “Export” - This will export the current test data to a file in the archive folder. Refer to item 1 above for information about where to find this file.



Context Menu

Operation

Filling the Slurry Cup

1. With the slurry cup disassembled, examine the threads on the inside of the cylinder. The end with the larger set of threads is the top.

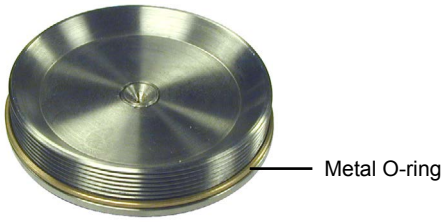
2. Coat the surface of the paddle and the inside of the slurry cup with a high-temperature grease to facilitate cement removal.

3. Insert the paddle assembly all the way into the top of the cylinder.

Cylinder

Paddle

4. Slide the slurry cup lock ring on top of the paddle assembly with the two notches facing upward. Tighten the locking ring completely using the provided slurry cup tool.



Bottom Cell Cap

Locking Ring

5. Prepare the cement slurry as stated in API Specification 10.

6. Pour the cement into the slurry cup through the open bottom of the cylinder.

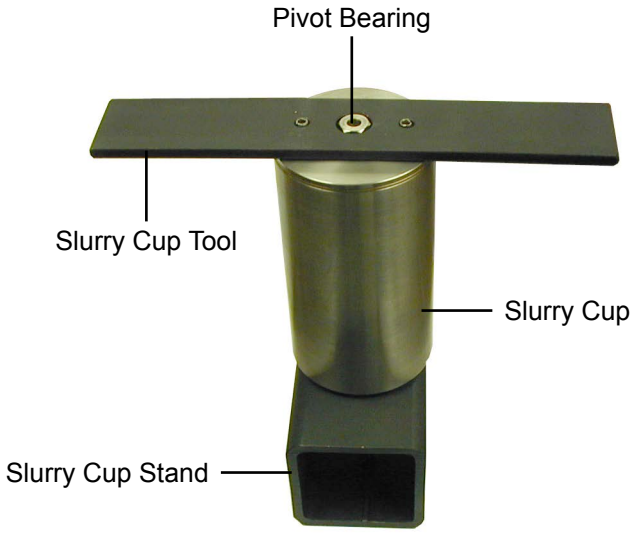
7. Place the metal o-ring around the threads of the bottom cap. Apply high-temperature grease to the o-ring and cap surface. Screw the cap onto the cup and tighten with the slurry cup tool.

Note

The slurry cup should contain enough cement slurry that it leaks out of the hole in the center of the cap. If it is not, remove the cap and refill the slurry cup. Do not add cement through the hole in the cap.

8. Screw the pivot bearing into the hole in the center of the cap and tighten.

9. Wipe the entire slurry cup clean to ensure that no cement remains on the outside.



Operation

Loading the Test Cell

Tip

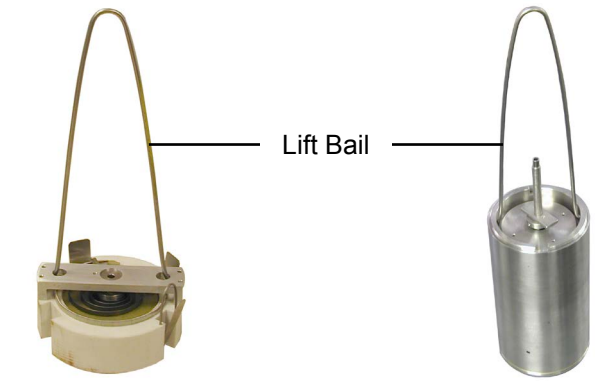
Before attempting to load the test cell, ensure that the “Air To Cylinder” and “Pressure Release” valves are completely closed (turned clockwise). Also, make sure the “Motor”, “Pump”, and “Heat” switches are turned off.

1. Lower the slurry cup into the test cell ensuring that the slurry cup drive pins engage the drive holes at the bottom of the test cell.

   It may be necessary to start the motor briefly to confirm that the slurry cup is properly aligned inside the test cell.

2. Lower the potentiometer mechanism into the test cell ensuring that the contact springs of the potentiometer are in alignment with the test cell contacts.

   The slurry cup and potentiometer both have two holes near the top for the lift bail (provided). Use the lift bail to easily lower the slurry cup and potentiometer into the test cell.



3. To engage the drive bar of the slurry cup into the potentiometer, rotate the cup with the motor for a few seconds while applying slight pressure to the potentiometer. Note that if the unit is in an alarm condition the motor will not engage.

4. Choose an o-ring for the cell cap and place it into the test cell in the o-ring groove. Place the cell cap onto the cell and hand tighten.

   Two o-rings are available for the cell cap. The rubber o-ring is easier to use, but is not suitable for tests involving high temperature or pressure. The metal o-ring is more durable, but requires extra attention when tightening the cell cap.

   If you are using a metal o-ring for your test, be very careful when you tighten the cell cap. Tightening the cell cap flattens the o-ring. If you tighten the cell cap to a certain point for one test, but do not tighten it as much for the next test, the seal will leak and the test will not provide accurate results. Once you have tightened the cell cap, mark the test cell and cell cap so that you know how much to tighten it for the next test. It is recommended that you hand-tighten the cell until it is close to the mark, then use a rubber mallet to gently tap the cell cap into position. This will ensure that you do not accidentally over-tighten.

   If you tighten the cell cap past the marked position, you must make a new mark and refer to it for the next test.

   The o-ring (either metal or rubber) must be replaced after any test above 500°F (260°C).

5. Plug the thermocouple into the port on the side of the unit. Insert the thermocouple into the hole in the top of the cell cap and tighten the thread gland finger tight. Then loosen it ⅛ of a turn.

6. Turn on the air supply.

7. With a ⅝" wrench handy, turn the “Oil Reservoir Valve” to “Fill Cell”. The test cell will begin to fill with mineral oil from the reservoir below. Carefully watch the top of the test cell. When oil begins leaking out of the thermocouple hole, tighten the thread gland with the wrench. This will ensure that no air remains within the test cell.

8. Turn on the “Motor” and “15 VDC” switches. Switch the “Slurry/Test Cell” switch to “Slurry”.

   This switch determines which temperature the temperature controller will display. If the switch is set to “Slurry”, it will show the temperature of the cement slurry via the thermocouple in the cell cap. If it is set to “Test Cell”, it will show the temperature of the test cell body, via the thermocouple inside the cabinet.

9. Put the pump in Automatic mode. The “Pump” switch has three setting:

    - **Up:** Manual: The pump will apply pressure to the cell as long as the switch is held down. This mode is primarily intended for diagnostic purposes and is not recommended for testing.
    - **Middle:** Off: The pump will not engage.
    - **Down:** Automatic mode: This allows the Eurotherm and software to control the pump. This is the correct mode for testing.

    The Pressure Regulator controls the air to the pump. When more air is supplied to the pump, the pressure in the cell will build faster with each pump stroke. Also, more air to the pump allows more pressure inside the cell.

    For most tests, the regulator can be opened all the way (clockwise). This will allow the maximum amount of air to the pump and allow the cell to reach the maximum pressure of the machine. However, for tests at the lower end of the range, opening the regulator completely may provide too much air and cause the pressure to continually overshoot. If this happens, close the regulator by turning it counter-clockwise.

    This is a trial-and-error process. The goal is to set the regulator high enough to reach the pressure required for the test, but not so high that the pressure overshoots repeatedly.

10. Turn the heat on.

11. Start the test:

    a. If you are running a test with the computer, click the “Start Test” button. Refer to page 17 for more information.

    b. If you are running a test without the computer, push the “RUN/HOLD” button on the temperature and pressure controller. Select the test to run and press the “RUN/HOLD” button again to start the test.

12. Turn the “Timer” switch on and push the “R” reset button on the timer display.

    The timer displays elapsed time to the nearest tenth of a minute. If an alarm condition occurs, the timer will stop. This is a troubleshooting measure that shows you the point during the test at which the alarm occurred.

    The “Timer” switch provides power to the timer and the “R” reset switch resets the timer to zero.

13. If the “Alarm” switch is not already on, turn it on now. If the “Alarm” switch is left off, the unit can still enter into an alarm condition, but there will be no visual or audio signal to notify the operator.

Operation

Completing the Test

1. Turn off the “Heat”, “Pump”, and “15 VDC” switches and turn on the “Cool” switch. Make sure the water supply is turned on.

   To turn off the pump, set the “Pump” switch to the middle position.

2. Stop the test:

   a. If you are running a test with the computer, click the “Stop” button on the main screen.

   b. If you are not using the computer, press and hold the “RUN/HOLD” button on the temperature and pressure controller until the “RUN” light goes off. Then immediately set the temperature and pressure channels to manual mode. Refer to page 11 for instructions.

   The temperature and pressure channels must be set to manual mode as soon as possible after starting a test. This will prevent the controller from venting pressure before the cell has cooled.

3. As the test cell cools, watch the pressure carefully. As long as the temperature is over 180°F (82.2°C), make sure the pressure is at least 1,000 PSI (6,900 kPa).

4. Once the test cell has cooled, turn off the“Cool” and “Motor” switches.

5. Open the Pressure Release valve (counter-clockwise) all the way.

   Always release the pressure very slowly to prevent damage to the equipment.

6. Slowly turn the “Fill Cell” valve to “Vent”.

7. Open the “Air To Cylinder” valve (counter-clockwise). Air pressure will force the oil back into the reservoir. You will hear a hissing sound as air is released. When the hissing sound stops, close the valve (clockwise).

8. Carefully unscrew and remove the thermocouple.

   Keep a rag or paper towel handy in case extra oil leaks from the cell.

9. Unscrew and remove the cell cap. Remove the potentiometer and slurry cup.

10. Return the cell cap to the test cell to prevent dust and other material from entering the cell. Close all valves and turn off all switches.

Maintenance

Cleaning

Slurry Cup

After every test, immediately disassemble the slurry cup and clean it thoroughly with soap and water. Be sure to remove any residual cement before it hardens. Hardened cement on any of the parts can cause irreparable damage.

Magnetic Drive

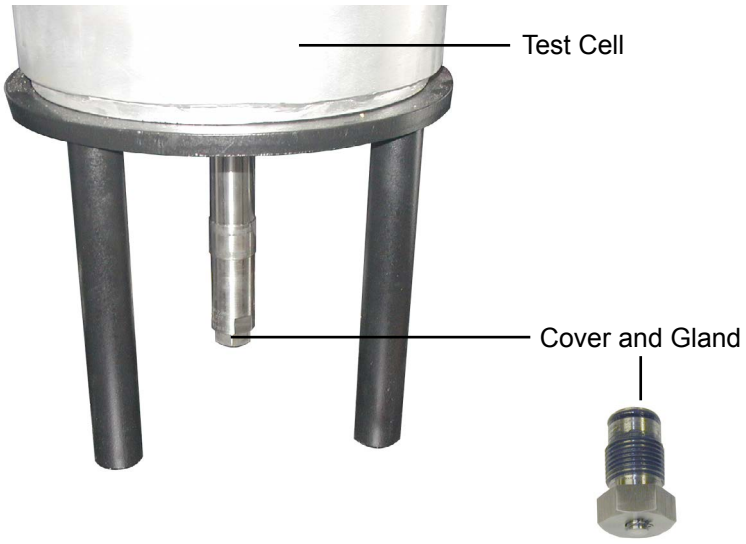
After every test, examine the inside of the test cell for any cement or other debris. If necessary, wipe the inside of the cell with a rag or paper towel.

It is recommended that you periodically flush the test cell with mineral oil to clean out any contaminants that may have collected over time.

1. Make sure all switches are off and all valves are closed.

2. Open the test cell and remove the slurry cup and potentiometer if they are still in place.

3. Locate the cover and gland beneath the test cell and remove them.



4. Pull the slurry cup table and rotor assembly up through the test cell opening.

5. Clean any abrasive particles from the rotor assembly and lay the assembly on a clean, flat, non-magnetic surface.

6. Place a pail or bucket underneath the test cell. Flush the test cell and magnetic drive with mineral oil. Use a soft-bristle brush to remove any debris.

Rotor Assembly

Rotor Assembly with Slurry Cup Table

7. Thread the slurry cup table onto the rotor shaft assembly.

   Pour a small amount of mineral oil into the vessel. This will act as a cushion when inserting the rotor assembly.

8. Insert the rotor assembly into the drive housing. Press down on the slurry cup table until it falls into place.

9. Replace the cover and gland underneath the test cell before beginning another test.

Maintenance

Potentiometer Calibration

The potentiometer should be calibrated once a month to ensure accurate readings. If you are using the Consistometer software, use the built-in calibration procedure. Otherwise, follow these steps:

1. Place the potentiometer on the calibration stand. Place the stand on the edge of the Consistometer and plug it into the port on the side of the unit.

2. Connect the wire clamps to the contacts. From the groove going clockwise around the unit, connect yellow, then black, then blue.

3. Slide the weight into the groove and wrap the cord clockwise around the unit one full turn.

4. Let the cord hang over the wheel and off the table.

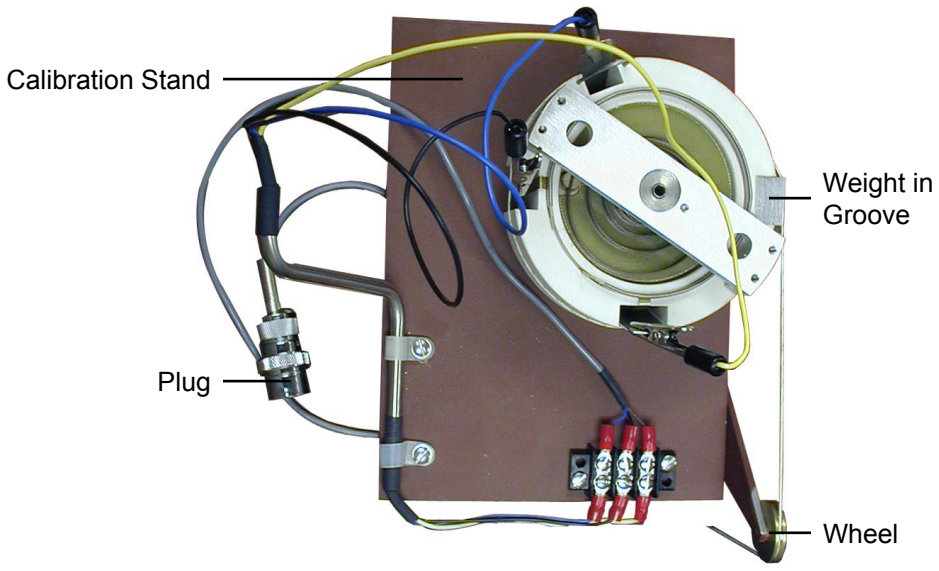
5. Attach the hook to the cord.

6. Apply the weights to the hook according to the chart below. Steady the cord to minimize the amount of swinging.

   When adding weights, remember that the hook weighs 50 grams. Therefore, to test the potentiometer at 200g, you only need to add 150g to the hook.

7. Firmly tap the surface of the calibration stand with a pen or the blunt end of a screwdriver to settle the weights and stabilize the potentiometer.

Note



8. Lift the weight about two inches directly upward and release it. Allow it to fall straight down. Observe the reading on the Potentiometer Indicator.

9. Record the reading and repeat steps 6 through 8 with each weight listed in the chart below.

Note

The voltage values in this chart are only examples. Every potentiometer is different and will, therefore produce different voltages. The calibration process will help you interpret the potentiometer readings provided by the Consistometer.

A 400 g weight corresponds to approximately 100 Bc.

Mass (grams)	Approximate Voltage
100	2.5
200	5.5
300	8.2
400	10.75

Maintenance

Potentiometer

1. The potentiometer should be kept as clean as possible. Periodically submerge the unit in solvent to remove cement and other materials.

2. Troubleshooting potential problems:

    a. If consistency (voltage) readings fluctuate, examine the resistor and verify that the top is smooth and consistent. If necessary, re-insert the resistor and lightly smooth the resistor wire with emery cloth.

    b. If the consistency (voltage) reading is zero, the resistor and contact arm may have lost contact. Adjust the contact arm either up or down. If this does not correct the problem, the resistor may have sufficient space between the windings to prohibit conductance. If this is the case, replace the resistor.

    c. If the potentiometer will not hold a calibration, the spring is probably either damaged or worn by corrosion. Replace the spring.

3. To install a new resistor:

    a. Remove the four small screws holding the shaft-bearing retainer to the potentiometer assembly.

    b. Remove the contact arm.

    c. Carefully lift the damaged resistor away from the potentiometer. Clear the resistor groove of any foreign material.

    d. Carefully place the new resistor into the groove and ensure that it is centered between the two terminating contacts.

    e. Push the resistor completely into the groove with either a mallet or a piece of wood. It is very important to ensure that the resistor is completely inserted into the groove and that the upper surface is level.

    f. Install a new contact arm and if necessary, bend the arm either up or down to obtain consistent contact with the resistor.

    g. Re-install the shaft-bearing retainer and calibrate the potentiometer before use.

4. To install a new calibration spring:

    a. Remove the contact arm and the shaft-bearing retainer.

    b. Carefully lift the calibration spring from the potentiometer assembly.

c. Install the new spring. When properly installed, it should tighten when the center shaft is rotated counter-clockwise.

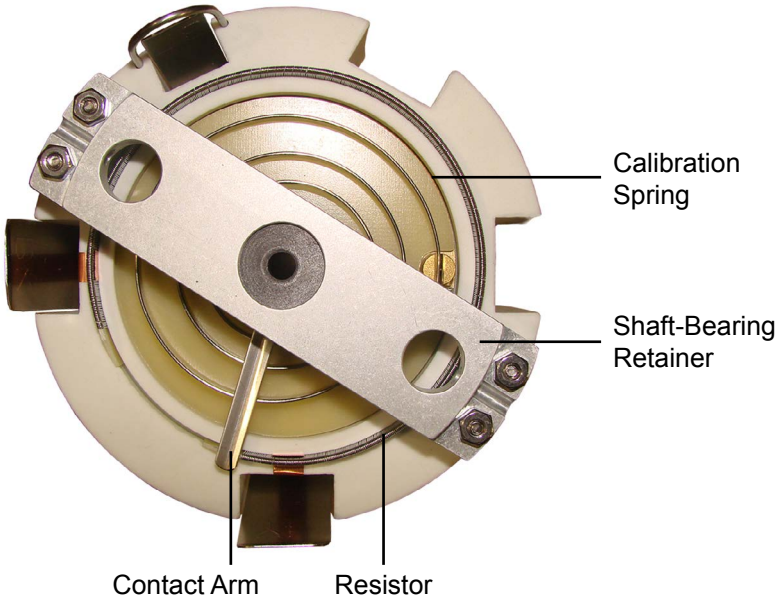
d. Install a new contact arm and make adjustments as necessary to obtain consistent contact with the resistor.

e. Loosen the three adjustment screws on the underside of the potentiometer assembly and rotate the spring adjuster until the spring rests at a relaxed state.

f. Ensure that the contact arm aligns with the contact strip and tighten the three set screws.

g. Rotate the center shaft to ensure that the spring does not bind or rub the potentiometer housing.

h. Replace the shaft-bearing retainer and calibrate the potentiometer.



If you hear the pump running but no pressure is building in the test cell:

1. Make sure the “Pressure Release Valve” is completely closed.

2. Make sure the “Air to Cylinder” valve is completely closed.

3. Make sure the “Fill Cell” valve is set to “Fill”.

4. The Consistometer has a rupture disk to prevent damage due to overpressurization. If the pressure inside the cell exceeds 28,000 PSI, the disk will rupture and release the pressure. If this happens, the cell cannot be pressurized until the rupture disk has been replaced.

   The rupture disk is located inside a square block just upstream from the filter on the inlet side of the pump. To replace the rupture disk, remove this block, discard the ruptured disk, and install a new disk. Then re-install the block into the plumbing line.

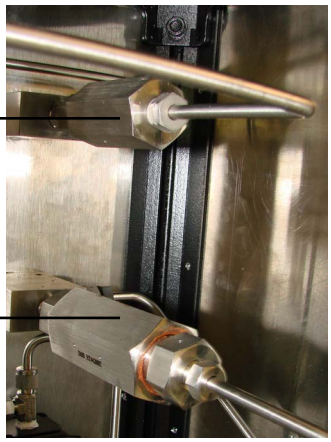
When a test is complete, it should take several minutes to drain the test cell of oil. If it takes more than an hour to completely drain the cell, the oil filter between the cell and the reservoir may be dirty.

1. Locate the oil filter near the top of the unit cabinet in the back. There are two hex-shaped fittings. The smaller one on top is the air filter. This one should never need maintenance. The larger one on bottom is the oil filter.

2. Before removing the fitting, observe the direction arrow on the side. This will be important later when re-installing the filter.

3. Carefully disconnect the pipe from the hex fitting.

4. Remove the filter pieces from the hex fitting.



5. Clean the pieces of the filter with compressed air. This will blow out any dirt and debris.

6. Carefully place the filter pieces back inside the fitting in the same order in which they were removed.

7. Reconnect the fitting to the plumbing.

Important

Make sure the directional arrow is pointing the same direction as before the fitting was removed. Installing the filter backwards could damage the equipment.

If the oil filter between the cell and the reservoir is dirty, it could mean that the oil in the reservoir is also dirty. Observe the oil through the sightglass on the front of the reservoir. If the oil is cloudy, it should be replaced.

1. Make sure all pressure is released from the system and that the cell is open.

2. Make sure the “Fill Cell” valve is set to “Vent”.

3. Remove the reservoir cap.

4. On the back of the reservoir, inside the cabinet, is a drain valve. Place a container underneath the drain and open the valve.

5. When the reservoir is empty, close the drain valve.

6. Using a funnel, pour approximately 4 liters of mineral oil into the reservoir. When full, the oil level in the sight glass should be about 1" from the top.

7. Replace the reservoir cap. Make sure the seal is tight.

If the unit enters an alarm condition, the motor, pump, and heater will all the stopped automatically.

The three controllers on the unit can cause an alarm: pressure, temperature and 15 VDC. Check the display on each of the three controllers. The one that caused the alarm will display “1FSH” or “Sbr”.

Always address an alarm condition immediately. Failure to do so could result is damage to the equipment or even operator injury.

If an alarm condition appears to be in error, follow these steps to diagnose the problem:

1. Compare the reading on the three controllers to the three readings on the chart recorder. If any of the three controllers shows a significantly different reading than the chart recorder, there may be a problem with the devices or the wiring. Make sure all devices are working and are properly connected to each other.

2. Check the following, based on which controller is causing the alarm:

    - Temperature: Make sure the thermocouple is plugged securely into the jack on the unit cabinet.

    - Pressure: Open the panel on the side and locate the shunt. The shunt has three positions: out, middle, and in. If it is either out or in (not middle), the controller will report the maximum pressure, causing an alarm. Make sure the shunt is in the middle position.

      Also, check the cable connection to the transducer inside the cabinet. Make sure it is screwed firmly into the transducer.

    - 15 VDC: Make sure the potentiometer is installed correctly inside the test cell. The orientation of the electrical contacts must match the nodes on the inside of the cell.

3. Check the alarm setting on the controller. If the alarm is set too low (for example: if the temperature alarm is set to 32°F), the unit will always be in an alarm condition. Refer to the documentation for each controller for further instructions.

Maintenance

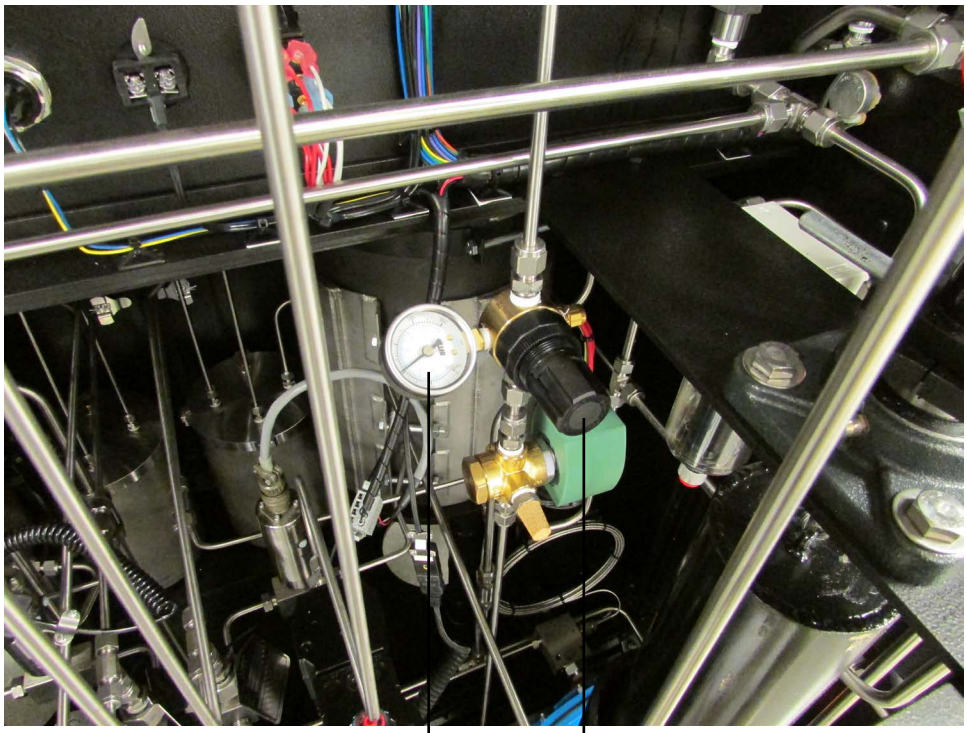
Pressure Relief Valve Regulator

During a test, the computer will be continuously adjusting the pressure inside the cell. As the pressure increases due to thermal expansion, the computer will allow pressure to bleed. Likewise, if pressure begins to drop, the computer will add pressure to keep it within the target range.

There is a secondary **Regulator** (#120-50-037) which controls the air pressure to the pressure relief valve.

This regulator comes calibrated and requires no adjustment unless a part within this system has been replaced.

If the user must gain access to the regulator, simply remove the back panel of the instrument. The regulator and gauge are located inside. There is one set on each side. To set the regulator to the proper pressure, apply pressure to the system and begin opening the regulator between 50 - 80 psi (344.7 - 551.6 kPa). If the pressure relief valve does not open, continue adjusting the regulator to a higher pressure as needed to obtain optimal operation of the relief valve.

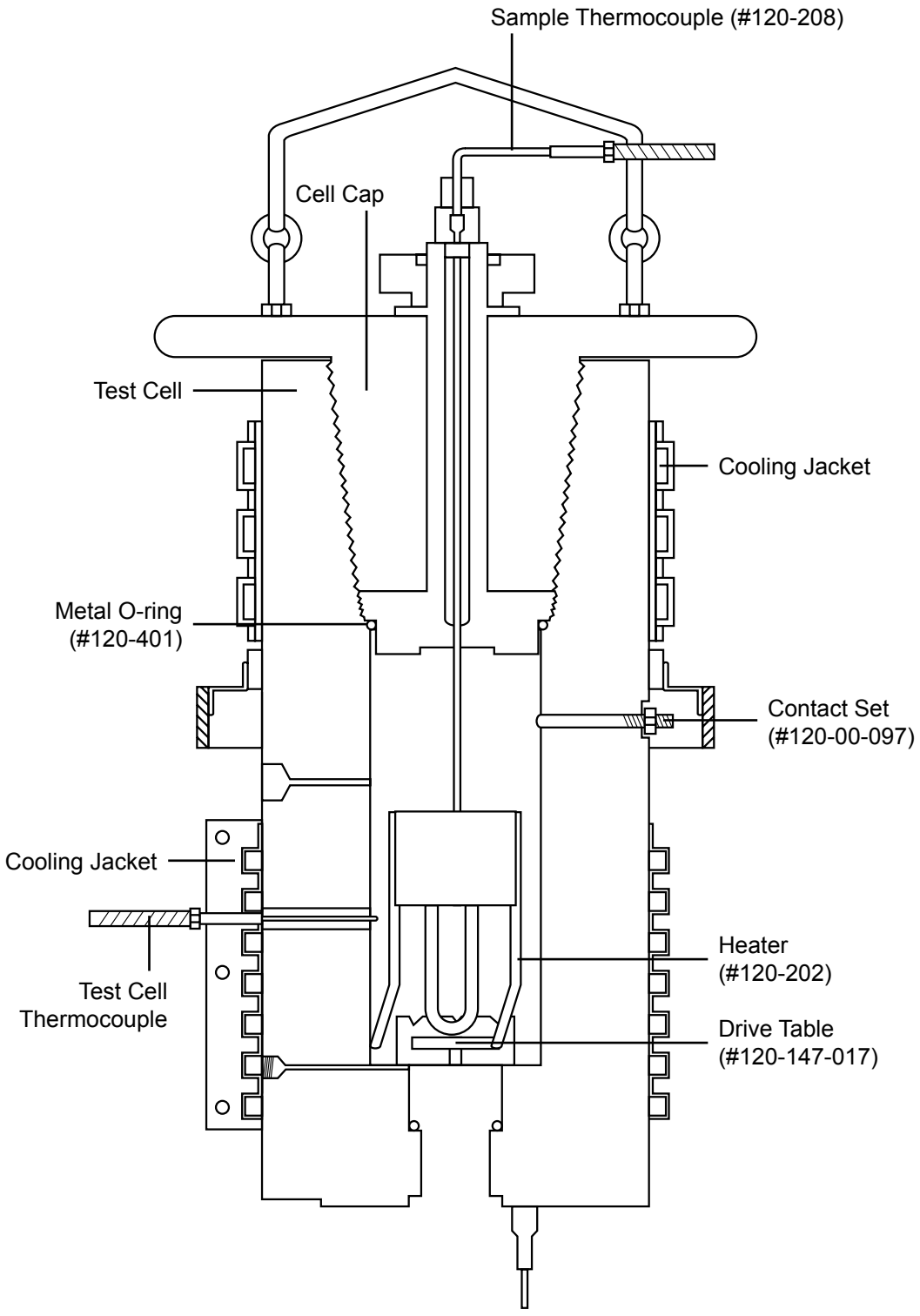


Gauge (#143-01)

Air Regulator (#120-50-037)

Appendix

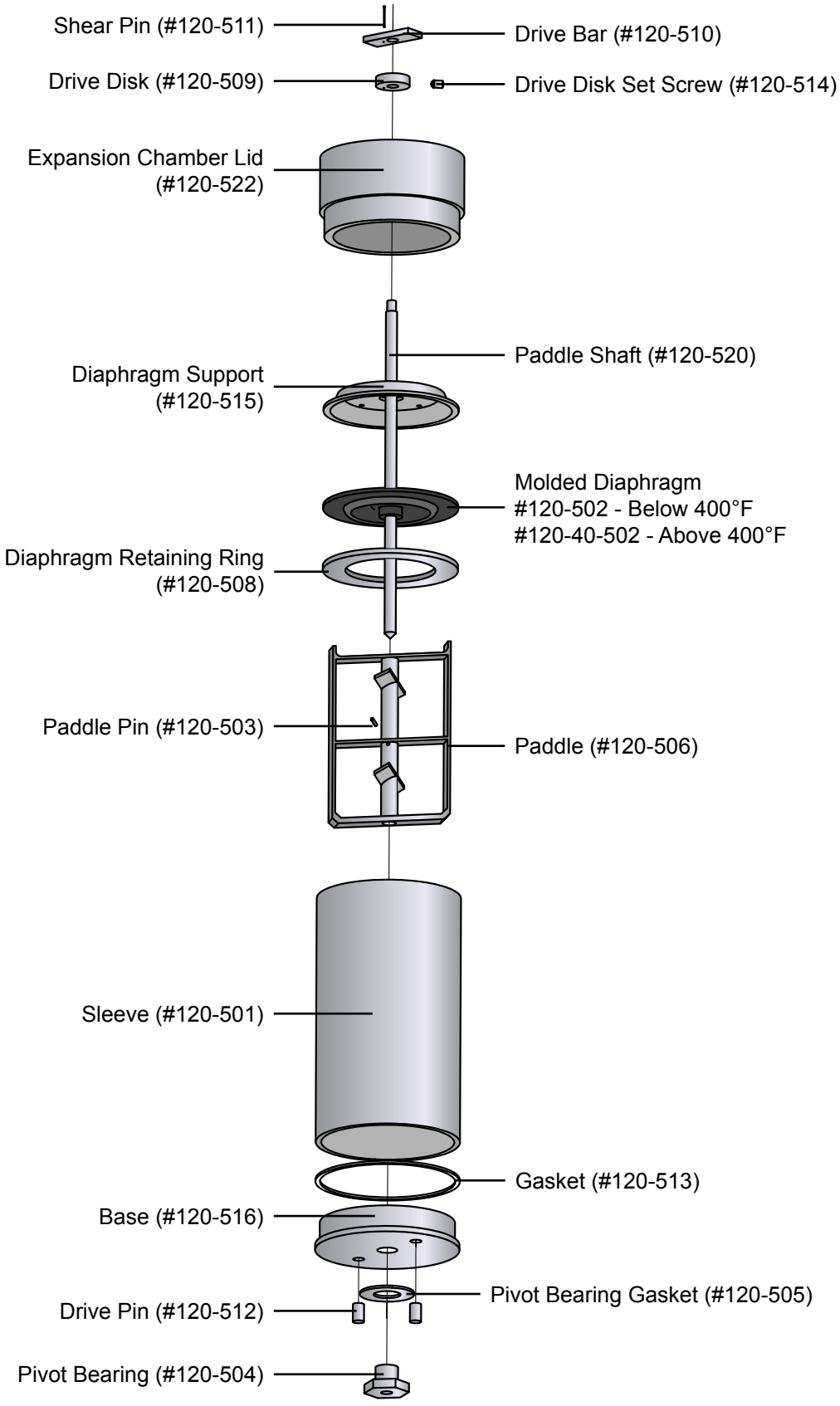
Cell Diagram



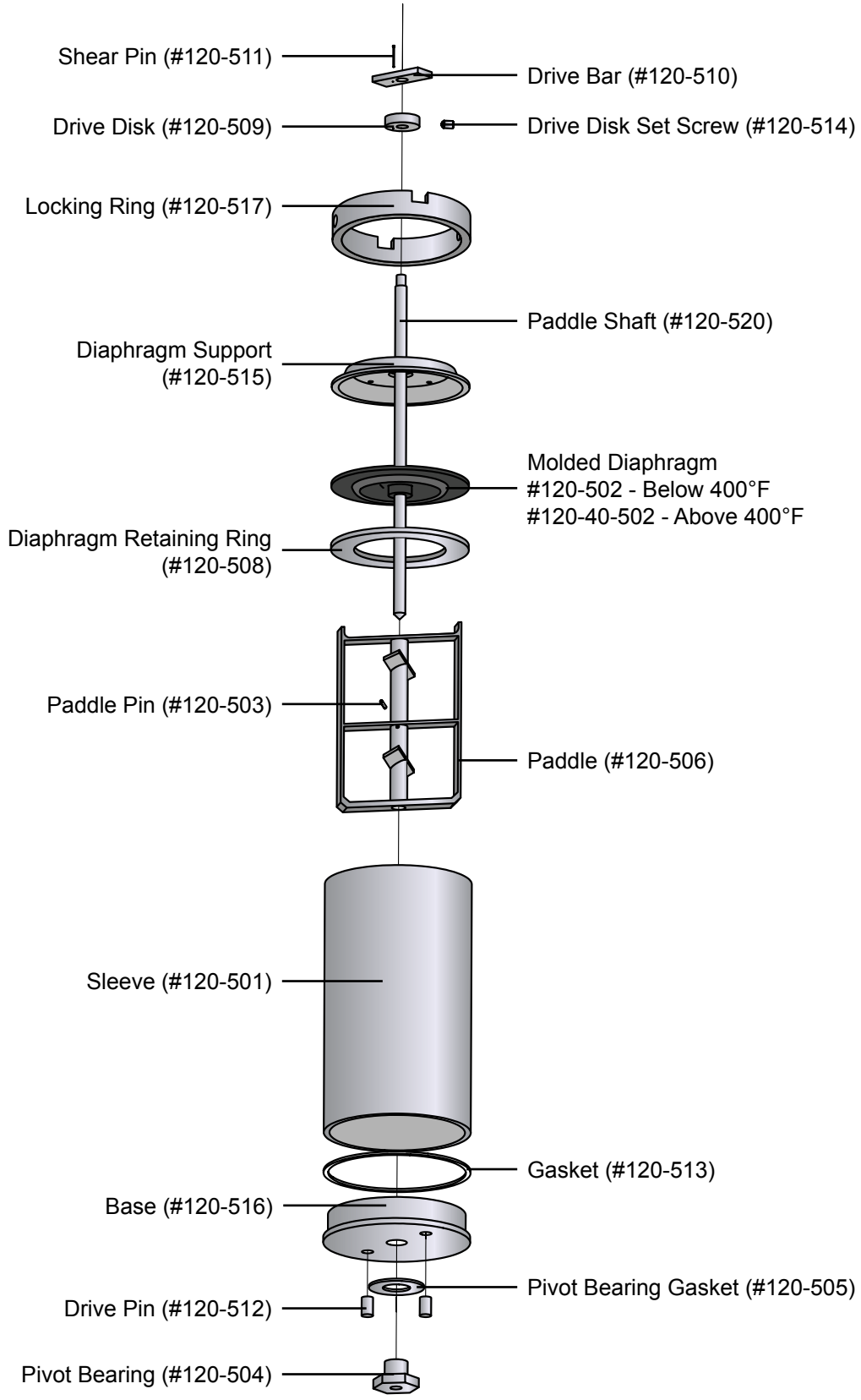
Appendix

Slurry Cup Diagram

#120-521 Slurry Cup Assembly With Expansion Chamber



#120-519 Slurry Cup Assembly Without Expansion Chamber



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.