CEMENT TEST EQUIPMENT, INC.

TULSA, OKLAHOMA, USA

M22-400-Auto Consistometer Instruction Manual

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M22-400 Consistometer Instruction Manual

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CEMENT TEST EQUIPMENT, INC.

Table of Contents

Chapter 1

Introduction

This chapter contains general information about the consistometer and its uses as well as detailed specifications for the instrument.

What is a consistometer used for?

ICON KEY	
	Important information
	Potential Danger or Safety Hazard
!	Operational Warning

Cements are a critical element in the drilling, completion, work over, and abandonment of wells. For each application, cement slurry is designed with specific properties and is given additives that provide predictable slurry density, volume, viscosity, compressive strength, fluid loss, gas migration, and thickening time. Slurry thickening time, or the time a slurry remains pumpable in a well, is one of the most critical properties in designing cement slurry. A predictable thickening time is desired, while maintaining the other specific properties of the cement slurry. The thickening time can be measured in a laboratory by testing a sample of the cement slurry in a pressurized consistometer. The elapsed time between initial application of pressure and temperature on the slurry sample and occurrence of a predetermined value of consistency (usually 100 Bearden Units, Bc) is the thickening time for the sample at the particular specification test schedule. The typical test schedules are listed in API Specification 10 on oil well cements.

Instrument Description

The Model 22-400 Automatic Pressurized Consistometer is able to test cement slurries at temperatures up to 400°F/204°C and 22,000 psig/151 MPa.

The consistometer slurry cup assembly 02-0030 uses a rotating, cylindrical slurry cup and a stationary paddle assembly enclosed in a pressure vessel. Pressure is applied to the vessel using mineral oil and an air driven hydraulic pump. A tubular heater surrounding the slurry

cup supplies heat to the pressure chamber. A centerline thermocouple is provided for determining the temperature of the cement slurry.

The slurry cup is rotated through the use of an electric motor and a magnetic drive unit. The rotational speed of the slurry cup is variable between 25 and 250 rpm to allow the user to study slurries at speeds other than the API prescribed speed of 150 rpm. See the Electronic Controls section on how to adjust motor speed.

The consistency of the cement slurry is measured through a potentiometer mechanism commonly referred to as a 'pot mech'. The potentiometer is coupled with a torsion spring to resist the rotating force of the paddle. The rotational force is proportional to the consistency of the cement slurry and is measured through the potentiometer resistor as the spring deflects under load. The consistency is displayed on the plot generated by the data acquisition system. The consistency values are recorded in Bearded Units of consistency (Bc). Bearden units are defined in API Specification 10.

The consistometer is equipped with two devices for post-test cooling of the instrument. The first is an external-cooling coil attached to the pressure vessel. After completion of the test, cooling water may be circulated through this coil to cool the pressure vessel. The instrument is also equipped with an oil reservoir cooling coil to independently cool the oil after a test.

The CTE pressurized consistometers are equipped with a state-of-the-art control and data acquisition system that provides unparalleled ease of use for the operator. The parameters of interest may be displayed in either English or SI units. Temperature control and data acquisition is programmed through the use of a 22" touch screen monitor. A plot showing temperature, pressure and consistency may be plotted on any compatible ink jet printer. The data and plots may also be transferred electronically to a network or USB drive for use on a separate computer.

A photograph of the automatic consistometer is shown below in figure 1.

Figure 1

Instrument Specifications

ELECTRICAL	
Input Voltage:	230 VAC (±10%)
Input Power:	5500W
Current:	25 A
Input Frequency:	50-60 Hz
MECHANICAL	
Height:	66 in. (168 cm)
Width	24 in. (61 cm)
Depth:	34 in. (86 cm)
Weight:	600 lb. (272 kg)
ENVIRONMENTAL	
Operating Temperature:	(32 to 105°F) 0-40°C
Operating Humidity:	0-95% noncondensing
HEATER	
Heater Power:	5,000 W
Heater Type:	Internal Cast Rod Heater
MAGNETIC DRIVE UNIT	
Drive Motor:	1/8 hp (93 W), 180 VDC
Drive Speed:	25-250 rpm, 150 rpm default
AIR AND WATER CONNECTIONS	
Compressed Air (Maximum):	150 psig (10.2 bar)
(Minimum):	80 psig (5.4 bar)
Cooling Water Pressure:	100 psig (6.8 bar) maximum
Utility Inlets:	¼ inch female NPT

Installation

Upon uncrating the instrument, verify that the instrument and any spare parts on the packing have been received and are undamaged. Notify CTE if anything is missing or damaged.

The instrument's center of gravity is located near the front of the instrument due to the weight of the pressure vessel. Be very careful when rolling or transporting the instrument that it does not tip over toward the front.

It is a good idea to leave room behind the instrument so that qualified personnel may have service access. If this is not possible, try to make the unit easy to disconnect and move for service.

Once the instrument has been moved to its desired location, air, water, and electrical connections can be made. The air inlet, water inlet, and water drain connections are each ¼ inch female NPT connections and are located on the lower right rear of the instrument. A number of ¼ inch male NPT to 8mm tube fittings are included for international locations. The air and water inlet connections may be made with either metal or plastic tubing. It is recommended that the water drain lines be made from metal, since this line may carry very hot water and steam from time to time.

Electrical connections are made using the twist lock receptacle on the rear of the instrument. A 30 amp female plug is included with each M22-400 consistometer. Please observe the following precautions when making the wiring connections.

- A qualified installer should do the wiring in accordance with local electrical codes.
- The instrument should be securely connected to a separate earth ground. The ground wire must be larger in diameter than the supply conductors. An 8-gauge minimum ground wire is recommended for a dual consistometer and a 10-gauge minimum ground wire is recommended for a single consistometer.
- An 8BC or larger fire extinguisher to fight electrical and oil fires should be placed within 50 feet of the consistometer.

Certain components are supported during shipment with wooden blocks, foam padding, plastic ties, etc. to prevent damage. Open the front doors and remove all the packing materials that would interfere with the operation of the instrument before powering the instrument. Some components such as touch screen LCD monitor and computer control modules are removed from the instrument prior to shipment and may be in a separate container to prevent damage. These devices must be reinstalled and reconnected before operating the instrument. Before operating the instrument, it is a good idea to check the bottom of the consistometer for loose screws or bolts that may have loosened and/or fallen out during shipment. This is particularly true for overseas shipments.

Locate the box containing the monitor, reticulating arm and computer and remove them from their shipping containers. Secure the arm and monitor to the consistometer by sliding the arm mount onto the rear side of the cabinet mounting panel as shown in figure 1a.

Connect the power cord from the monitor to the A/C outlet on the back of the instrument. Failure to do so can cause the instrument to malfunction. Alternately, the touchscreen may be powered using a DC power adapter.

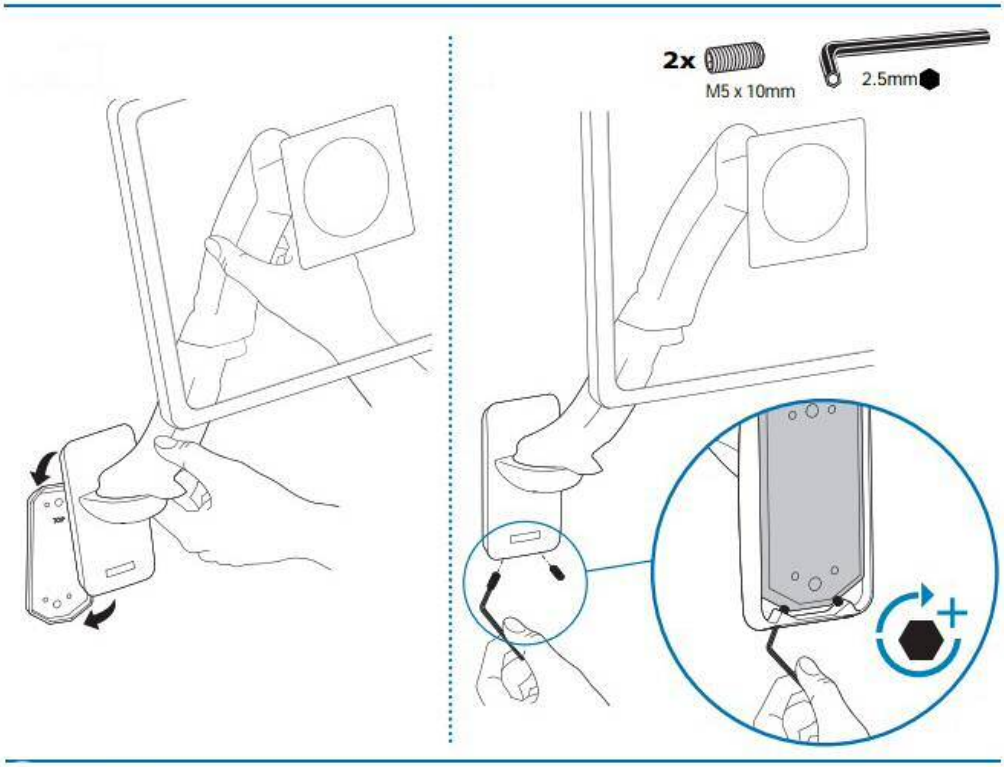
Plugging the touchscreen and printer into a different outlet creates an undesirable ground loop to occur. This creates an unstable electrical system.

The control box should be connected to the instrument by connecting the 5-pin power cord to the back of the instrument frame as well as the supplied USB cable. The instrument will not operate without this USB cable connected from the computer to the machine.

It is strongly recommended that a 230V uninterruptable power supply (UPS) be installed on the instrument. This will condition the power signal and prevent loss of power to the computer. There are two power connectors on the back of the electrical box. A UPS may be connected between these power connectors to maintain consistometer computer operation during short power outages or interruptions. If a UPS is not used, a jumper cord must be connected between these two connectors or the unit will not power on. An appropriate jumper cord is included with the consistometer accessories.

A printer is included with the instrument and may be connected to the computer control box. Connect the USB connector on the printer cable to any USB input on the control box. The printer must also be connected to the A/C power outlet on the back of the instrument. Failure to connect the power adapter to the A/C power outlet on the back of the instrument can cause the instrument to malfunction. A USB flash drive may also be connected to the control box in lieu of a printer. Test data may be uploaded to the USB drive and then transferred to a PC for archival storage. Refer to Chapter 2*, Using the Touch Screen Software*, for more information on printer and USB drive. It's a good idea to keep a keyboard connected to the computer as it will be necessary to input programming features, save data files, etc.

Before attempting to operate the instrument, it is recommended that the operators read the remainder of the manual and study the drawings that appear in the Drawings/Schematics section of this manual to become familiar with the consistometer operation.



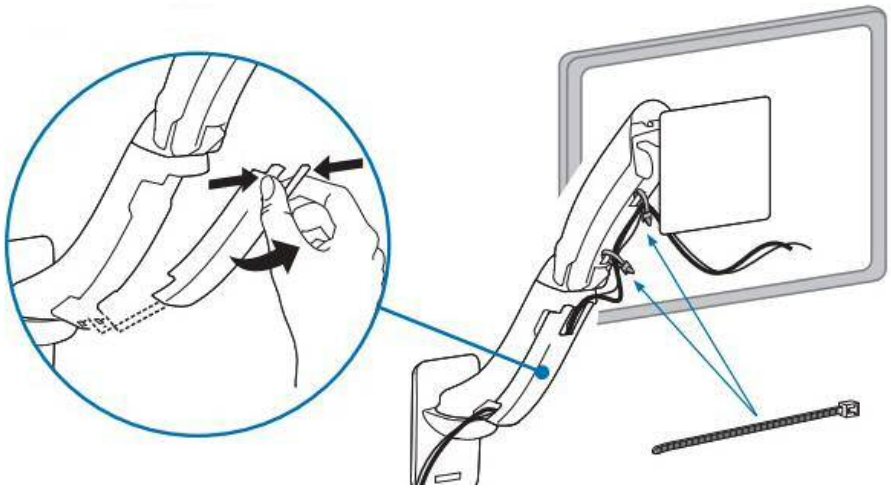


Figure 1a

Chapter

2

Using the Touch Screen Software

This chapter discusses the touchscreen and how to operate the consistometer.

What is a touch screen and how does it work?

Touch screens were created to provide users with an easy to use interface. This allows the user to input and view data without a keyboard or mouse. The touch surface is able to detect contact and send position information back to the processor. Using the touch screen has the same result of using a mouse to point and click. One mouse click is accomplished by one touch of the screen. A double-click is achieved with two quick touches. With this standard method of input, no special software is required to utilize the screen.

Using the Touch Screen

A finger or stylus is most often used on the touch-screen. Experimentation will quickly show which objects will activate the screen and which will not. It is important to note the touch surface does NOT use pressure to detect input. A light touch is all that is needed. In addition sharp instruments (such as pencils, pens, screwdrivers, etc.) should not be used as they may damage the touch surface. A pen-like touch stylus has been included in your accessories to use if desired.

What can you do with the touch screen software?

The purpose of the touch screen is to provide the user with a single interface to the instrument. All instrument operations are accessed

and controlled through the touch screen. This consistometer is a leap forward in designed because it is the first time that mechanical control has been eliminated from the point of view of the operating technician. Filling and draining the pressure vessel with oil, heating and cooling, pressurizing and depressurizing, and rotational speed are all fully automated. Our unique testing and test data screens offer detailed control over test parameters and the way your plot looks including color designations and job properties. Alternately, test data can be exported raw and utilized however one wishes. Each instrument is complete and requires no additional software or hardware to function.

One Key Recovery for the Computer

Instruments manufactured after March 2014 have computer systems which have One Key Recovery factory restoration points. What this means is that if the computer has a severe virus attack, operating system crash, hard disk failure or corrupted programs and software then the user may take simple steps to restore the system to its original factory condition. Simply pressing F3 during the 10 second boot sequence brings up access to the recovery menu. Select option 1 for a factory restore. Original application programs and configurations will be restored. Alternately, a newer backup point can be created. For example if you have updated the Cementlab software to a newer version, performed new calibrations, and have installed any new programs then a new backup point would restore these. Option 2 creates a new backup.

Software Upgrades

From time to time, CTE makes software upgrades available that provide increased functionality or problem fixes. Generally, the only file that needs to be upgraded is *CementLab.exe*. It is located in the c:\Program Files\CementTestEquipment folder. If it is necessary to install an updated *CementLab.exe* file, it may be copied from the USB memory stick. It may also be copied over a network if the instrument is connected to one. To copy the file from a memory stick, put the new file on the memory stick, rename the old *CementLab.exe* file to "Old.exe" and copy the new file into the proper folder using Windows Explorer, which is accessible from the start menu or **My Computer** icon. The memory stick will generally be the D: drive. Should the new *CementLab.exe* program not work properly, simply delete it and restore *Old.exe* to the original. However, we recommend you only

upgrade your system with the expressed permission of a CTE engineer.

Using the USB Port and the Printer

The instrument is equipped with a Universal Serial Bus (USB) port on the front panel that allows the use of a USB memory stick for mobile storage. The memory stick is a flash disk that can be connected to the USB port on the instrument control box and used as an external hard drive. Simply insert the memory stick into the USB port and the memory stick will become the *D:* drive. Software upgrades may be installed using the memory stick and tests may be archived to the memory stick and transferred to a PC for permanent storage. A color inkjet printer is pre-installed at the factory and is shipped with a new instrument. The printer is a useful tool for providing immediate printed results directly from the instrument. A 115/230V power adapter and a USB data cable are provided to connect the printer. The printer power adapter must be connected to the back of the instrument to prevent instrument malfunction. See Installation section in chapter 1. The printers use 8.5x11" paper.

The Main Menu

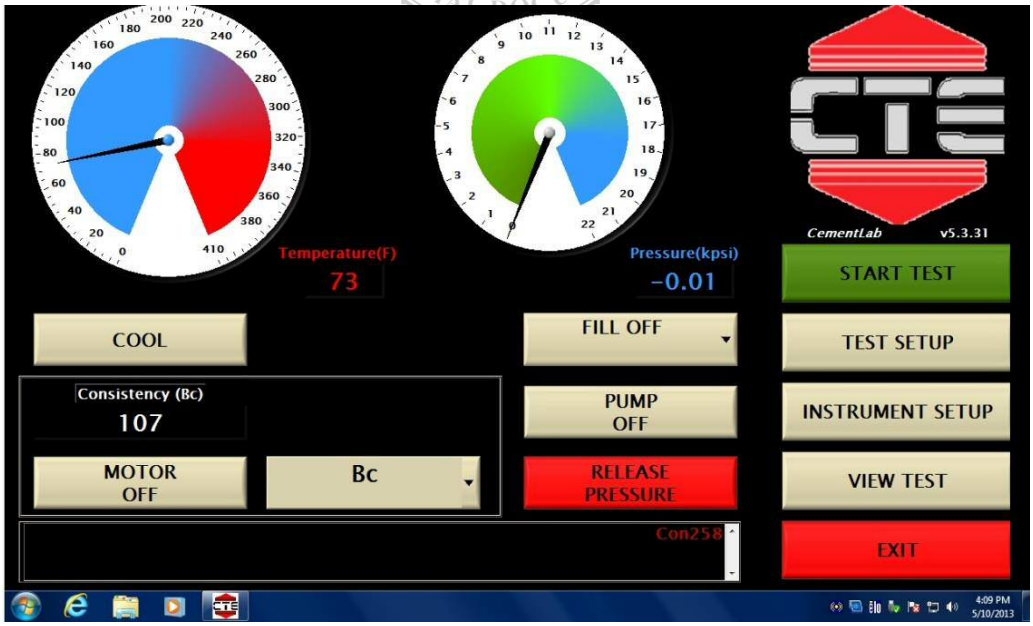


Figure 2

The main menu is starting point for the instrument. From here users may start new tests, set up test parameters, setup instrument parameters, or view an old test. Also located on the main menu is the reading for current temperature, consistency, and pressure. On the right side of the screen you will also notice the version software that is currently installed on your instrument. In the example figure 2 above, the version is 5.3.31.

- The cooling button is located on the main screen and is operated by selecting it to turn it on. Select again to turn off. The cooling button is connected to a solenoid valve which is connected to the cooling input located on the back of the instrument. Typically, water is used at house pressure and temperature. However, you may also connect a circulating chiller. If cooling is turned on when start test is activated, the cooling will remain on and heating will not ensue. Turn cooling off if you wish to start a normal test.
- The motor switch is located on the main screen and is operated by selecting it to turn it on. Select again to turn off. The motor speed is set to turn at 150 rpm.
- The fill button is located on the main screen. This button operates several functions in one. As shown in figure 3, the fill button shows *fill off, fill on, run test, and drain cylinder*. The fill off position neither allows oil or air into the cylinder. The fill on position allows oil to flow from the reservoir into the cylinder. The run test position performs the same function as fill on but gives the user the understanding that the cylinder is ready for pump pressure application. The drain cylinder position will open the pressure release valve thereby releasing any high pressure and start the flow of oil back to the reservoir.
- The pump button located on the main screen is operated by pressing and holding it to turn on and releasing to turn off. This button operates the high pressure pump connected to the cylinder.
- The release pressure button is operated by pressing and holding to open and releasing to close. The button is connected to the high pressure release valve.

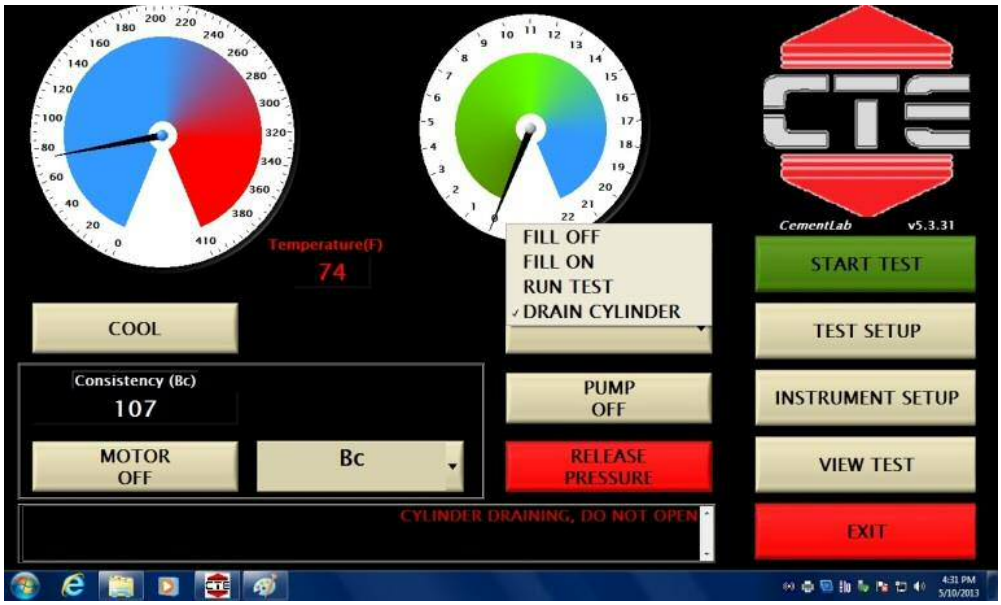


Figure 3

Instrument Setup

Figure 4

The instrument setup button takes the user to the instrument setup screen shown in figure 4. From this screen the user may perform a variety of operations and change options.

Calibrating Temperature

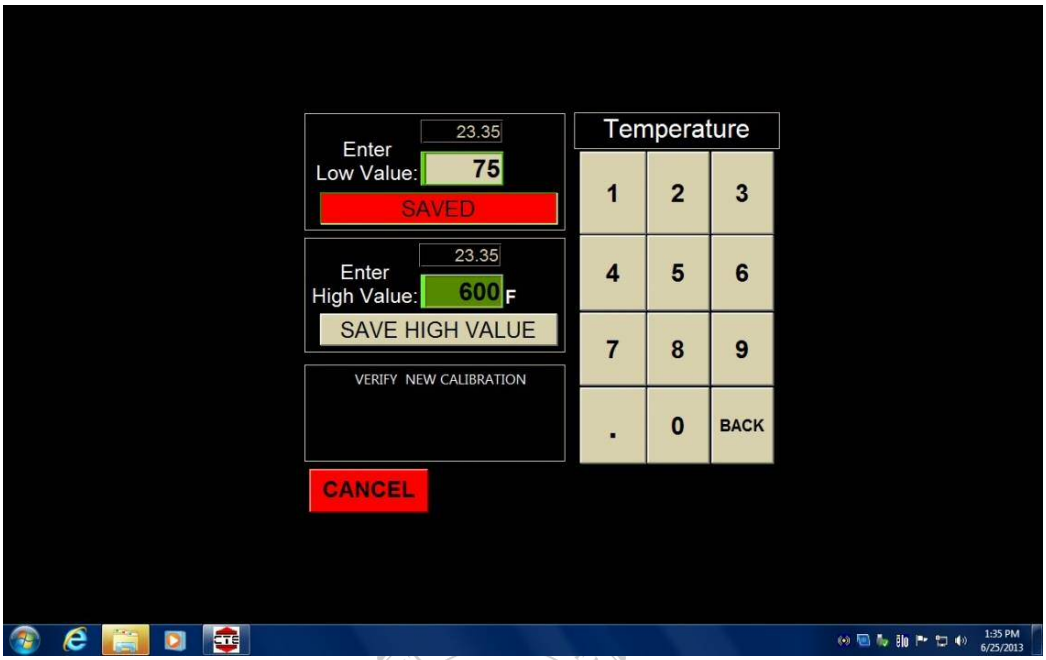


Figure 5: Values shown are for example purposes only

Temperature calibration must be performed by a qualified individual that has a certified temperature calibration device. When the screen in figure 5 appears, connect a J type temperature calibrator to the thermocouple connector input on the instrument. Enter a lower-limit temperature value on the calibrator. Touch the Enter Low Value parameter box shown in figure 5 and then enter the correct temperature value for the low data point using the touchpad at the right. The raw value is the voltage signal read directly from the I/O hardware and it should change as the calibration signal changes. When the low data point has been entered, press the **SAVE LOW VALUE** button. The user can now enter the high data point on the calibrator and then again on the touchscreen as before. The raw value should be different for the low and high data points or there will be a computation error. After the high data point has been established, press the **SAVE HIGH VALUE** button. We recommend using a low value of room temperature and a high value of 400F or near maximum operating temperature. The user can now vary the calibration signal and see how the calibrated signal compares with that of the calibration device in the **VERIFY NEW CALIBRATION** box. If the signals compare favorably, press the SAVE button to save the calibration. The calibration values will be stored in a configuration file and take effect upon saving and exiting the Instrument Setup menu.

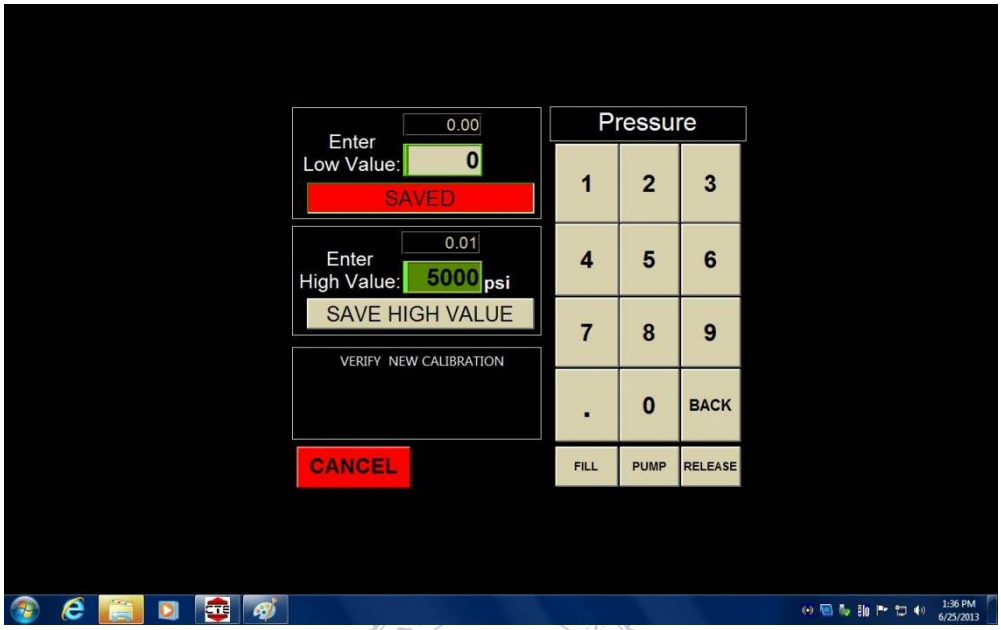


Figure 6: Values shown are for example purposes only

Pressure calibration must be performed by a qualified individual that has a certified pressure calibration device. When the screen in figure 6 appears, connect the pressure calibrator to the top of the pressure vessel using a 9/16-18 high pressure nut. Enter a lower-limit pressure value on the calibrator. Touch the Enter Low Value parameter box shown in figure 6 and then enter the correct pressure value for the low data point using the touchpad at the right. The raw value is the voltage signal read directly from the I/O hardware and it should change as the calibration signal changes. When the low data point has been entered, press the **SAVE LOW VALUE** button. The user can now enter the high data point on the calibrator and then again on the touchscreen as before. The raw value should be different for the low and high data points or there will be a computation error. After the high data point has been established, press the **SAVE HIGH VALUE** button. We recommend using a low value of house air pressure and a high value of 20,000psi or near maximum operating pressure. The user can now vary the calibration signal and see how the calibrated signal compares with that of the calibration device in the **VERIFY NEW CALIBRATION** box. If the signals compare favorably, press the SAVE button to save the calibration. The calibration values will be stored in a configuration file and take effect upon saving and exiting the Instrument Setup menu.

Calibrating Consistency

Consistency should be calibrated by using the consistency calibrator kit 02-0090-1. Kit includes calibrator base, weight set and hanger, wedge with cord, and 3 clip wiring harness. This device applies a known torque to the potentiometer mechanism spring, allowing the readout to be observed on the screen. Calibration of the potentiometer mechanism is described in the example below. It is recommended that you calibrate consistency at least once a month. Refer to the potentiometer maintenance section in chapter 5 for adjustments that may be necessary to provide accurate calibration.

1. Connect the calibrator base near the front edge of the consistometer using the two holes, nuts and bolts.

2. Install the potentiometer mechanism to be calibrated on the holder. Insert the wedge into the open slot nearest the potentiometer ground spring.

3. Wind the cord around the potentiometer mechanism frame and over the pulley. Place the hanger weight hook in the loop on the end of the cord.

4. Install the alligator clips to the potentiometer mechanism springs matching the wire colors to the contact pin wire colors.

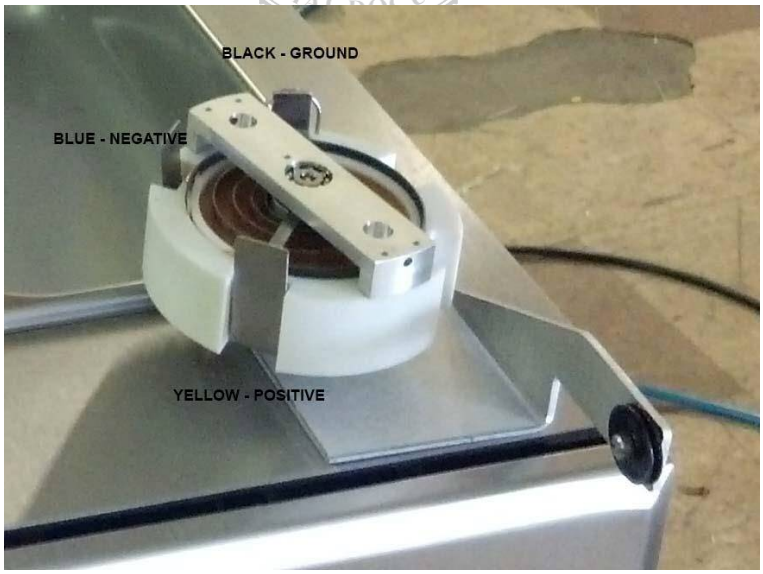


Figure 7

5. Insert the calibrator plug into the **CALIBRATOR** socket on the deck of the instrument.

6. Within instrument setup, select **CALIBRATE - CONSISTENCY.**

7. The weight of the hanger on the string is 50g. This is an equivalent of 9 Bc. On the touchscreen in the box labeled **LOW DATA POINT** input 9 on the touchpad. Select **SAVE LOW VALUE**. See figure 8. It may be necessary to tap the calibrator base to loosen any wound tension on the spring while in this screen.

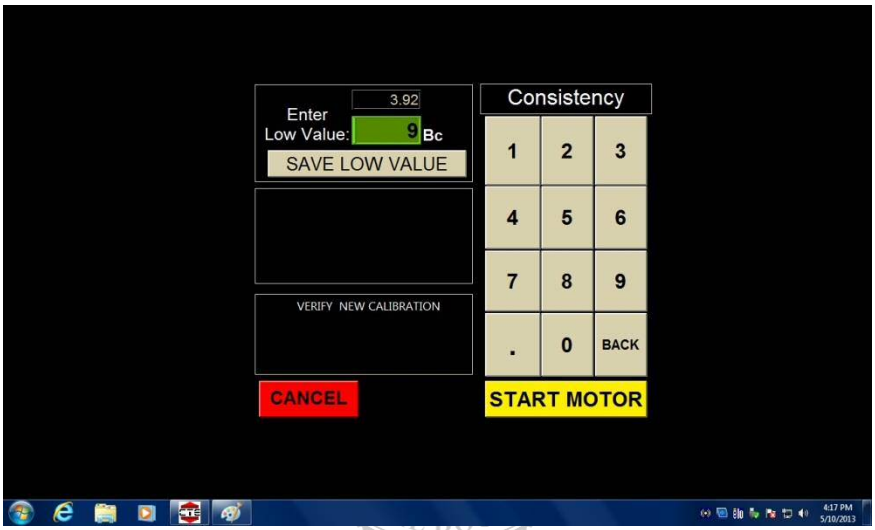


Figure 8

8. Place 400g of weights on the weight hanger. This is the equivalent of 100 Bearden Units of Consistency (Bc). On the touchscreen in the box labeled **HIGH DATA POINT** input 100 on the touchpad. Select **SAVE HIGH VALUE**. It may be necessary to tap the calibrator base to loosen any wound tension in the spring while in this screen.

Figure 9

9. By removing weight from the hanger it is possible to verify the **CALIBRATED VALUE** as shown in figure 10. If the values are correct, calibration is complete. If the values are incorrect, repeat steps making adjustments to potentiometer mechanism as required. Refer to table 1 for weight to Bc conversions for your pot-mech.

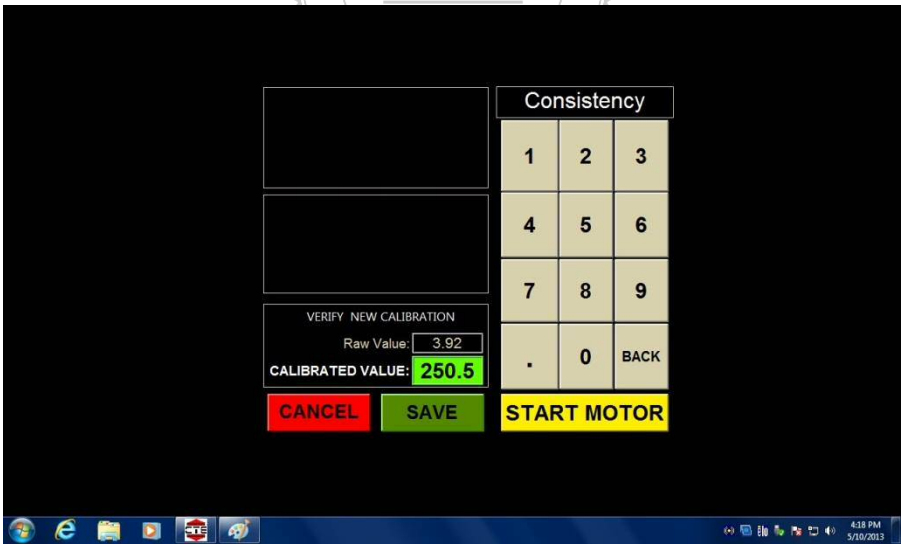


Figure 10

By applying additional weights between 0 and 400g and plotting consistency display as a function of applied weight, the linearity of the potentiometer mechanism may be assessed.

Table 1 Consistency as a function of Weight vs. Torque*

WEIGHT (g)	CONSISTENCY (Bc)
0	-4
50	9
100	22
150	35
200	48
250	61
300	74
350	87
400	100

* Based on the equation from API Spec 10, Section 8.2T = 78.2 + 20.02 Bc
T = Torque, g.cm
Bc = Bearden units of slurry consistency

Print Report

A copy of the calibration time and date for temperature, pressure, and consistency may be exported to an attached printer or saved as a jpg file. An example is shown in figure 11.

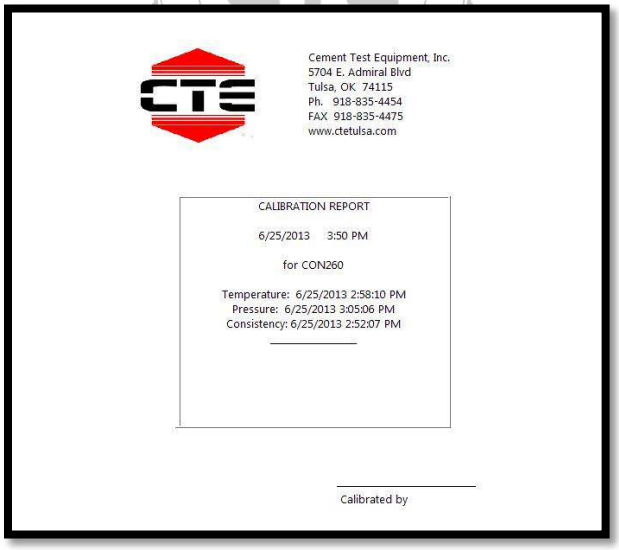


Figure 11

Auto Cool Time

After a test is completed and auto cooling has been selected in the test screen (see Start Test section), the cooling valve automatically opens and begins to cool the cylinder and oil reservoir. It is possible to select how long a period of cooling is active. Selections include between 1-24 hours and always on. If a test is started while cooling is still activated, the test will not heat even if it is programmed to heat. In other words, cooling must be deactivated if a test is to be started, even if it is still in automatic mode.

Sample Rate

This button allows the user to select a sampling rate for taking data. Rate is given in number of seconds between samples. To save data space and achieve acceptable test resolution, a sample rate of 30 or 60 seconds is recommended. For increased resolution lower the sample rate.

Temperature and Pressure Units

These buttons allow the user to select English or SI.

Archive Data

This button allows the user to transfer copies of all the test files stored in the consistometer to another location. The tests may be saved to the USB memory stick or to a local/network folder. Note that the program will ask for the storage location and the user may browse to any available drive or folder as shown in figure 12. Selecting 'current folder' accomplishes the destination selection. Once the files are copied from the consistometer to another location, the files remain on the consistometer and will still be accessible from the instrument. To permanently delete these files, the user must go to their stored location and delete them manually. The default location for CTE test files is C:/CTE/Tests. This folder also stores the actual test parameters so any test deleted cannot be run again without reprogramming **TEST SETUP**.

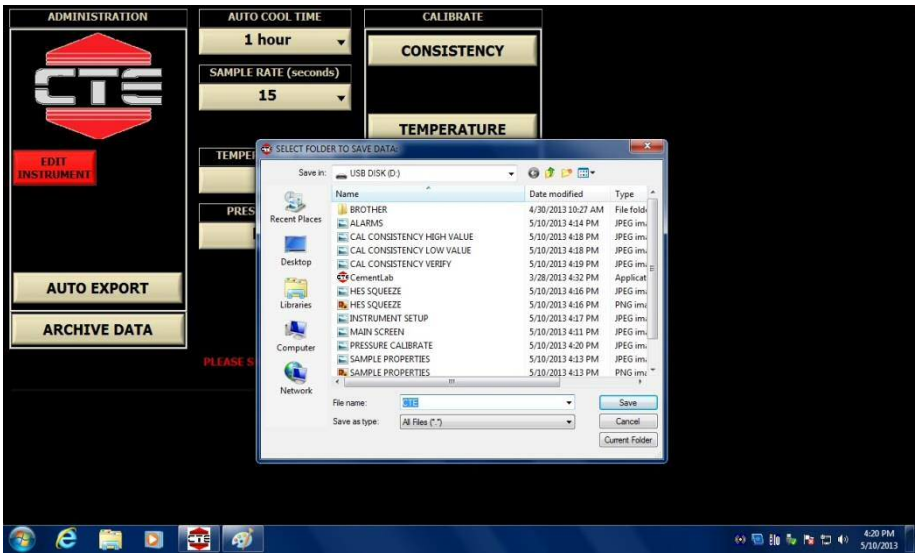


Figure 12

Auto Export

This button allows users to store test files in a completely different folder automatically. If YES is selected, the user is prompted to select a destination folder to store test files. If NO is selected, test files are stored in their default Tests folder location. If yes is selected and tests are being stored in another location, no copies are kept anywhere else. If the user desires to change back to default, they must select NO as shown in figure 13.

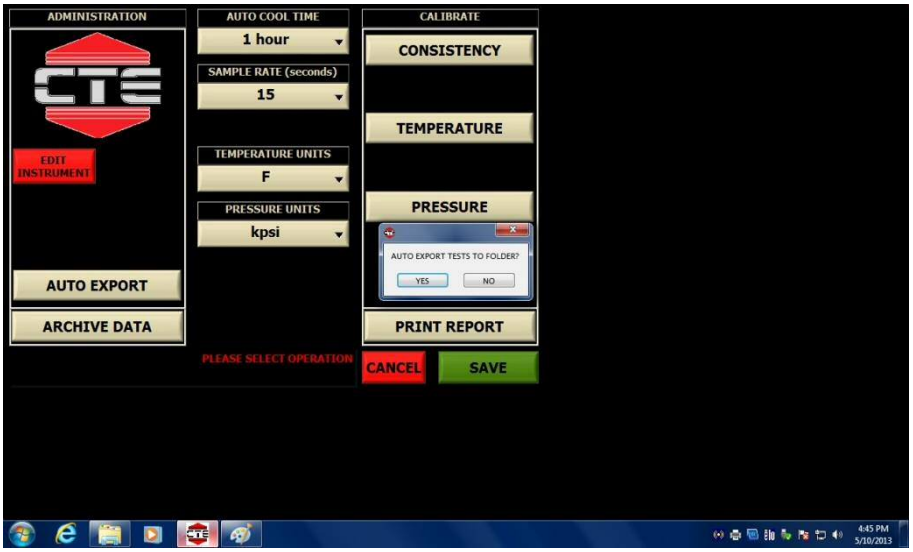


Figure 13

Edit Instrument

This button should only be used when instructed to by CTE and is password protected. This application performs changes the config.ini file.

Test Setup

From this menu the user can enter or reset a temperature and pressure ramp and soak schedule. The user can also configure the hesitation squeeze schedule, input sample properties, input time or consistency alarms, and input customer data.

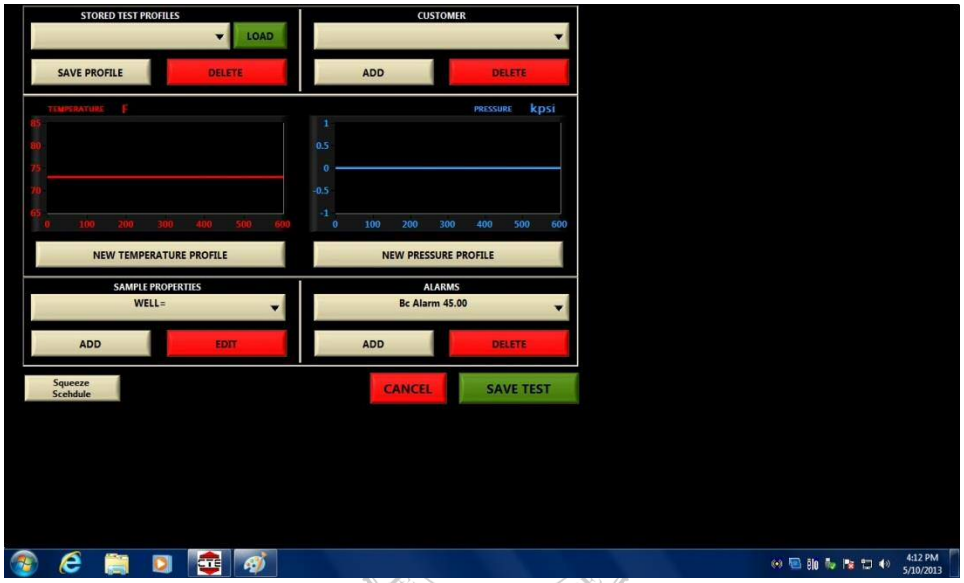


Figure 14

Temperature Control

Temperature is automatically controlled by programing a temperature ramp into the software. To create a new temperature profile either select that button or just above select the graph with the red temperature line. The program temperature screen is shown below in figure 15. Enter desired set point values by touching the SET POINT parameter box and entering the values on the keypad. Time to set point is selected by touching the TIME parameter box and entering a time in minutes on the touch pad. The final segment should always be a SOAK segment where the temperature equals the final test temperature and the time equals SOAK. This guarantees the instrument will maintain final temperature for the remainder of a test. After a profile has been entered, press the SAVE button. At this point a graph of the desired temperature ramp is displayed for confirmation. Press: **ACCEPT** to save ramp or **CANCEL** to exit without saving as shown in figure 16.

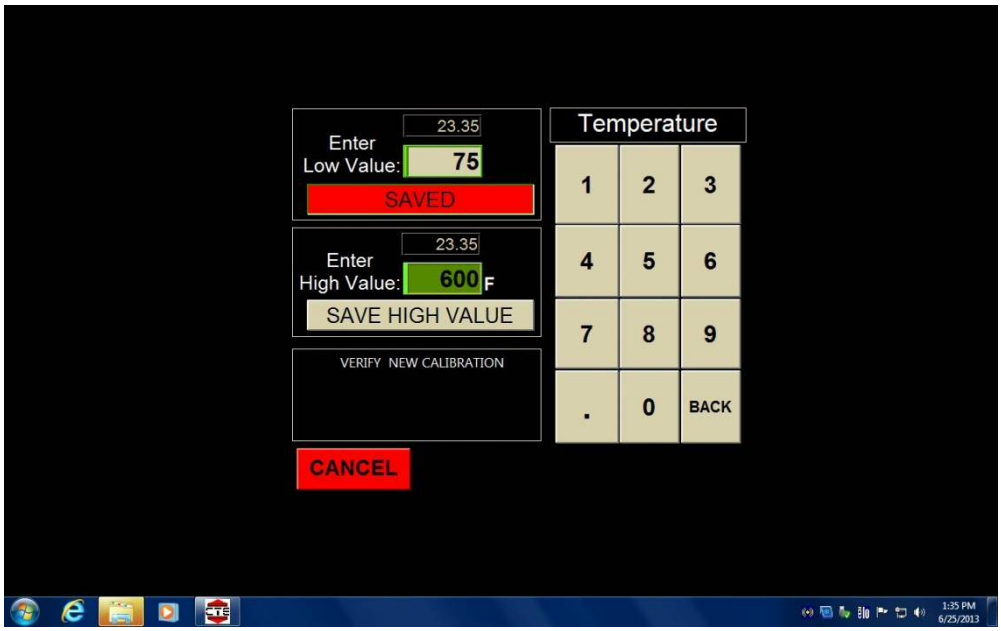


Figure 15

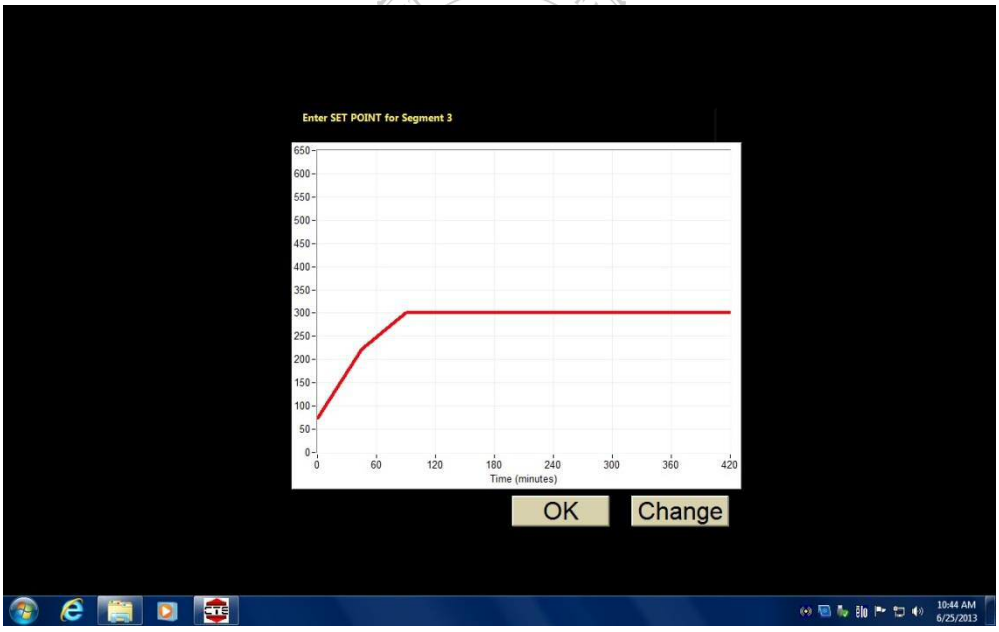


Figure 16

Pressure Control

Pressure is automatically controlled by programming a pressure ramp into the software. To create a new pressure profile either select that

button or just above select the graph with the blue pressure line. The program pressure screen is shown below in figure 17. Enter desired set point values by touching the SET POINT parameter box and entering the values on the keypad. Time to set point is selected by touching the TIME parameter box and entering a time in minutes on the touch pad. The final segment should always be a SOAK segment where the pressure equals the final test pressure and the time equals SOAK. This guarantees the instrument will maintain final temperature for the remainder of a test. After a profile has been entered, press the SAVE button. At this point a graph of the desired temperature ramp is displayed for confirmation. Press accept or cancel to return to the programming screens. An example of confirmation is shown in figure 18.

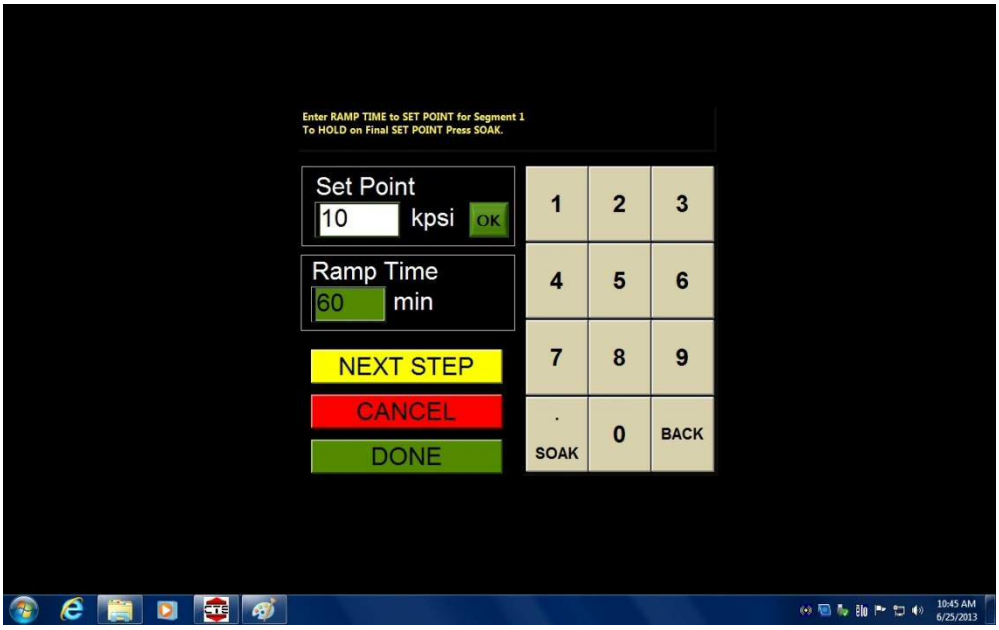


Figure 17

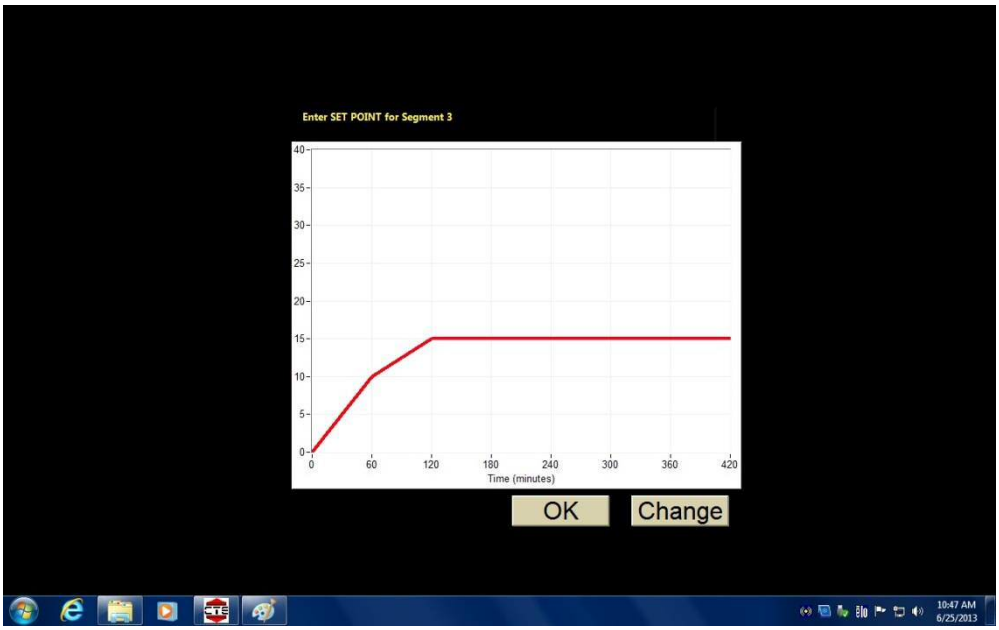


Figure 18

Hesitation Squeeze (Squeeze Schedule)

On units equipped with the hesitation squeeze option it may be accessed using the button labeled **Hesitation Squeeze**. Pressing this button will bring up the screen shown in figure 19.

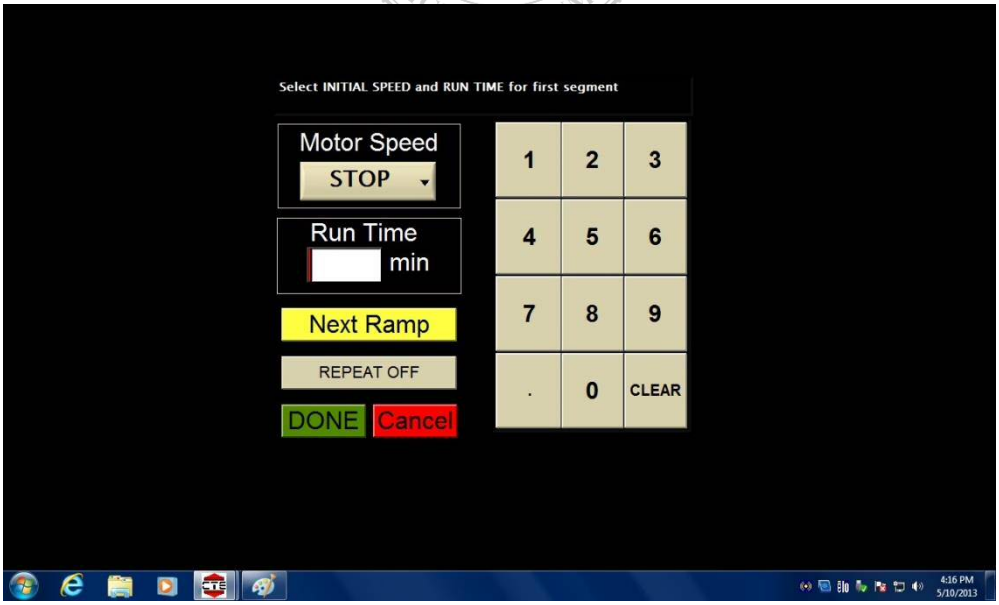


Figure 19

This allows a very random schedule to be programmed using user selected timing intervals.

Select Motor Speed = **Bc**, select the empty box under **Run Time** and enter the hesitation start time in minutes using the touch pad a right. The Start Time is the elapsed time from the beginning of the test to the first hesitation squeeze start.

Select **Next Ramp** to enter first stop. The screen will re-initialize and you can select **STOP** for motor speed and enter desired amount of time for STOP segment in **Run Time** box. Selecting **Next Ramp** again will allow you to enter run time after first STOP segment. If you wish to repeat the schedule for the remainder of the test simply select **AUTO REPEAT** after 3 segments have been entered (Bc-STOP-Bc). An infinite number of sequences can be input. Select **SAVE** to save or **Cancel** to exit without new schedule. A preview of the schedule will be shown for approval.

Sample Properties

Test printouts contain information cells which can be edited by the user. Sample properties such as well, district, cement, density, weight, water, etc. can be chosen as suitable information. An example of these sample properties is shown in figure 20. Properties can be added and deleted here. The value for these properties will be selected after a test is complete. Select view test and select the test file to be chosen. Then select the PRINTING tab on the left hand side and sample properties can be seen and values edited accordingly. See the View Test section of the manual.

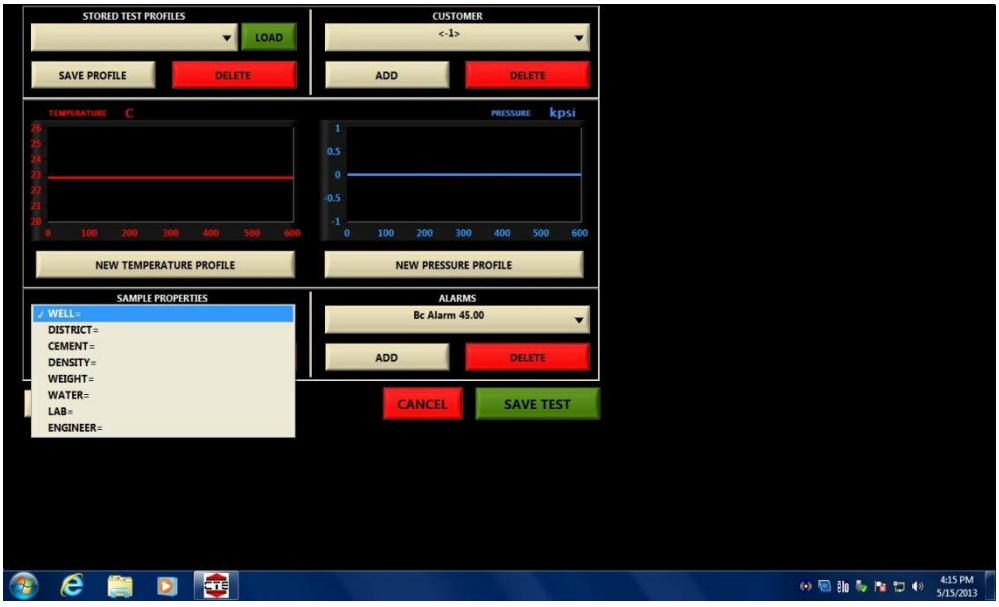


Figure 20

Alarms

Consistency and time alarms can be added to and deleted from a test setup. These alarms produce audible alerts are displayed in the test printout. An example of programmed alarms is shown in figure 21. Factory defaults contain Bc alarms only.

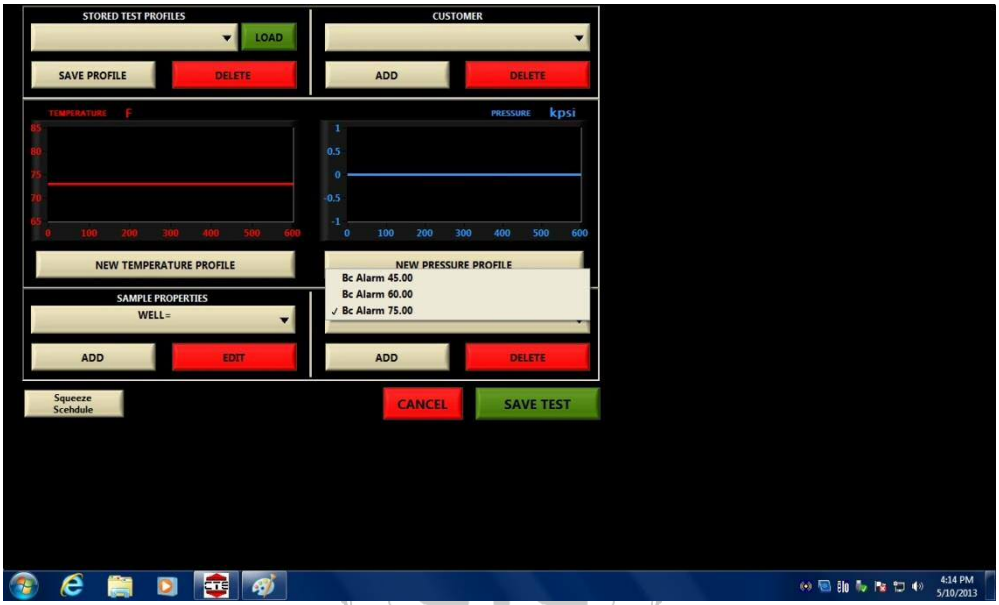


Figure 21

Customer Data

The customer button allows the user to input a customer name for the test being performed. It's no different than a sample property and can be added and deleted from the test setup.

Save Test

Once the user has finished selecting temperature and pressure ramp profiles the last step is to push SAVE TEST. A pop-up appears and requires the user to select a test name. This will be the test file name and will be stored in the tests folder located on the C drive. An example is shown in figure 22. Choose a descriptive test name and select save. Once you have performed this action the software is ready and programmed for that specific test. The next action would be to start test. Refer to the start test section. If a test setup is not performed prior to starting a test, the previous test file will continue to be written to. It is not

automatic for the machine to know to start a new test file without user input.

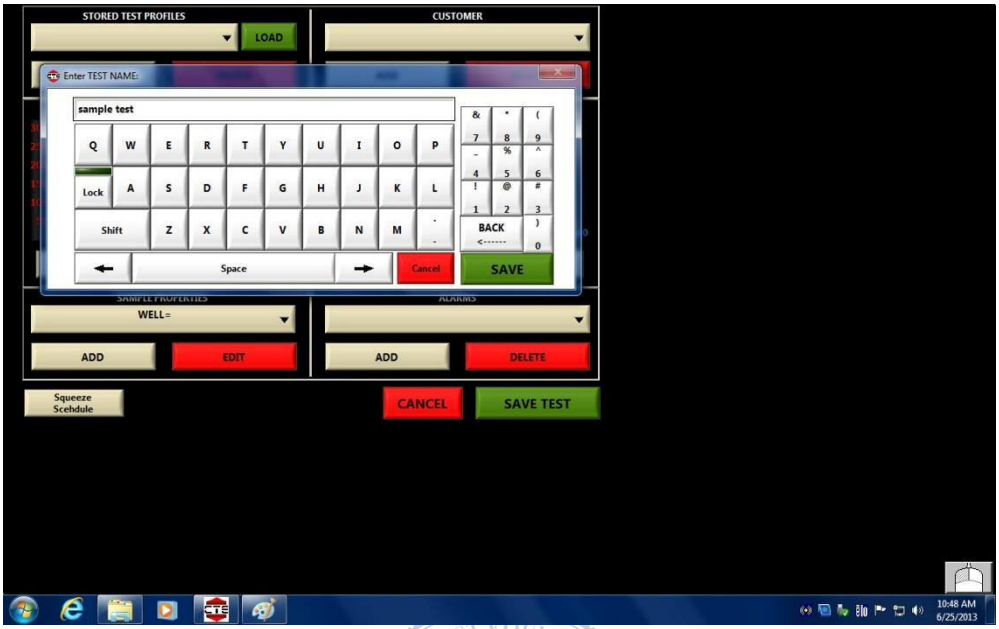


Figure 22

Start Test

Once your instrument is properly configured and a test has been entered in the **TEST SETUP** section. You may begin testing by selecting the **START TEST** button from the main menu.

Live Testing Screen

Once a test has begun, a real-time display of current values will be presented. The user may view a live chart at any time by pressing the **LIVE CHART** tab button located at the top of the screen. Printing can be done at any time by selecting the **ADVANCED CHART & PRINTING OPTIONS** button (Please note that a printer must be connected to the instrument before trying to print.). This button will also enable the user to view detailed test information and streaming numerical data. The user can also create custom header and footer segments of the printed plot. Pressing the **EXIT** button returns the user to the **RUN TIME MENU** shown below.

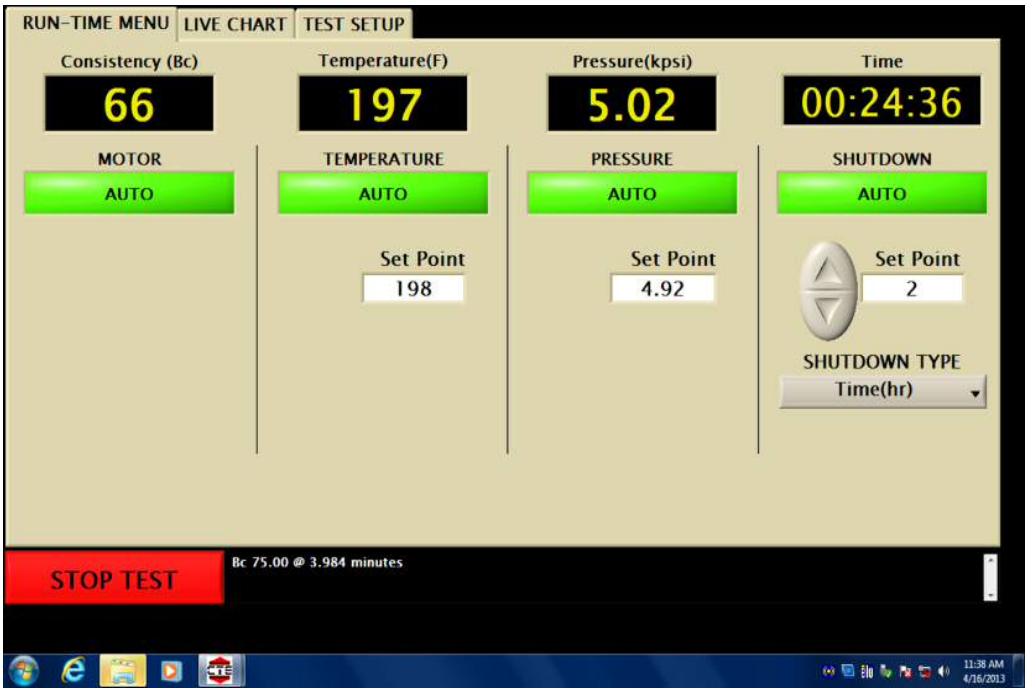


Figure 23

The instrument is equipped with an automatic consistency shutdown and alarm. Use the up/down arrows to select the consistency value at which the alarm should occur. If the Auto Shutdown feature is ON, the instrument will automatically stop the test when the indicated alarm value is reached. In addition to stopping the test, automatic shutdown will also turn the heater and motor off and the cooling water on. Note that the Auto Shutdown Alarm is in addition to the alarm values entered in **TEST SETUP** that are printed with each plot. In addition to the automatic consistency shutdown there is a timed shutdown. It is necessary to select the number of hours from the drop-down box that is required for a timed shutdown.

Stopping a Test

To stop the current test, the user must press the STOP TEST button on the **RUN-TIME MENU** screen. Once the test has been stopped, no further data will be logged and no further temperature or pressure control will be provided. The software will save the current test in a file on the instrument's local hard disk. The default location is C: /CTE/Tests. If auto-shutdown is enabled, the test will be stopped when the Consistency Alarm value has been reached. This action has the same effect as the user pressing the STOP TEST button; however it also turns the motor and heater off and the cooling water

on. Note that there is a 5-10 second delay from the time a consistency alarm is triggered until automatic shutdown occurs. This is to prevent noise or spikes in the consistency signal from triggering automatic shutdown prematurely.

View Test

The view test button allows the user to access previously completed test data. The data may be viewed either graphically or in spread sheet format, customized, scaled, printed, and exported. The print button will open a dialog box giving the user the option to select a printer or jpeg file option. The export button gives the user to option to output a txt file to a destination folder.

Graph Tab

The left y-axis displays Gel (if option is installed on the instrument), Consistency, Temperature, and Pressure. Each Curve is given a specific scale, color and units. The x-axis is given in minutes. As shown in figure 24.

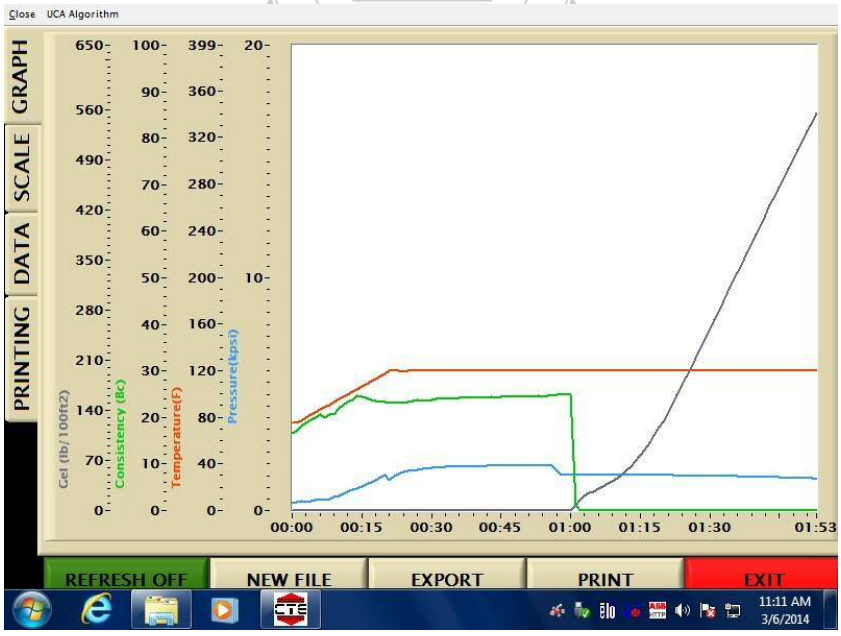


Figure 24

Scale Tab

The scale and plot customization tab allows the user to turn on or off the display of each curve by pressing the green “Visible?” button. The maximum and minimum scalar may also be edited using the Max and Min boxes. The color of the curve may also be edited using the Color box. These custom settings are shown in figure 25.

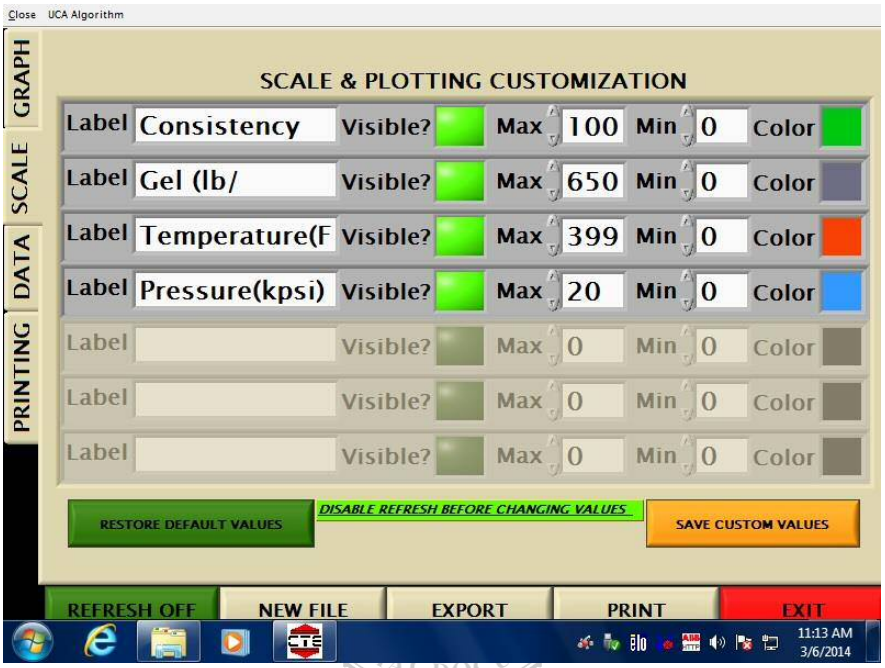


Figure 25

Data Tab

The data tab displays the test file name and date recorded at the top of the screen. The data tab also displays all data for each sample point including time (HH:MM:SS), consistency (Bc), Gel (lb/100ft2) (if option is equipped on the instrument), Temperature (units optional), and Pressure (units optional). Depending on the sample time selected the time stamp will be congruent. Data tab shown in figure 26.

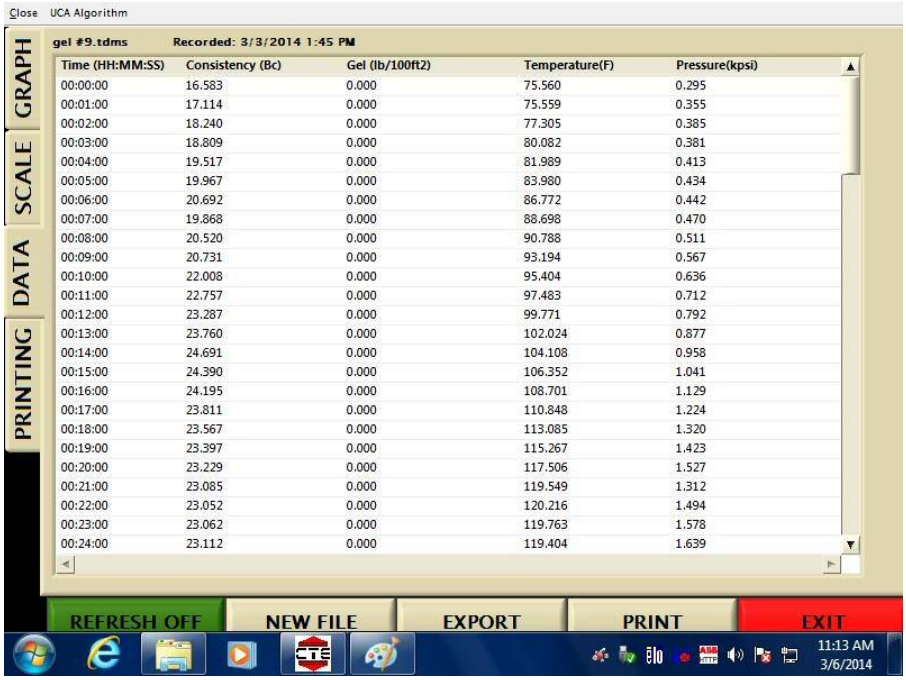


Figure 26

Printing Tab

The printing tab allows the user to change specific test data that is outputted to the test print out. A company logo may be inserted into the print out header by selecting the logo box. Pixel size must be 192x96 before you insert the picture. Values for well, district, cement, density, water, etc. may be entered to further populate the test print out and further provide information to customers. Printing options are shown in figure 27.

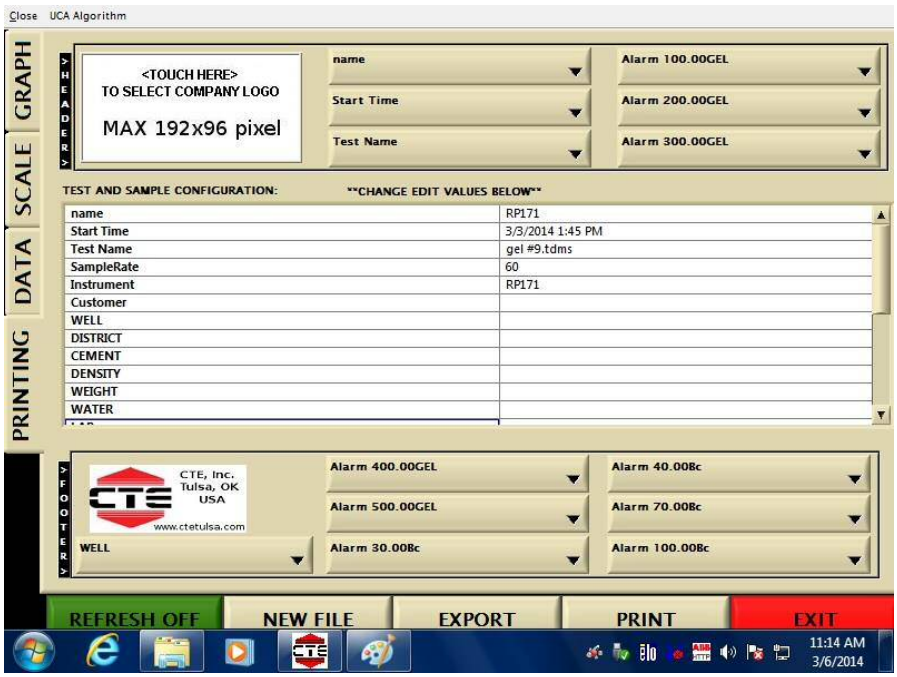


Figure 27

Chapter

3

The Pneumatic, Cooling and Electronic Controls

This chapter discusses the pneumatic and cooling settings and how to operate the electronic switches.

The Pneumatic Controls

The pneumatic controls consist of the pressure release, drain cylinder, and pump air regulators. The components in this section are used to release pressure and drain oil from the pressure vessel and to power the air driven hydraulic pump that applies pressure to the sample. The piping schematic is located in chapter 6.

IF THE PUMP AIR PRESSURE DROPS OFF SIGNIFICANTLY WHEN THE PUMP IS OPERATING, AN AIR LINE MAY BE BLOCKED OR THE COMPRESSOR MAY BE INSUFFICIENT TO DELIVER THE VOLUME OF AIR REQUIRED.

The pump air pressure regulator is located on the back side of the motor mount bracket and is used to control the air pressure to the air driven hydraulic pump. Higher hydraulic pressures require higher air pressures. To adjust the pressure of the air supplied to the pump, pull the knob on the regulator out to unlock it. Turn the regulator knob clockwise to increase the pressure and counterclockwise to decrease the pressure. The pump air pressure gauge shows the pressure of the air delivered to the pump. When the adjustment is finished, push the knob in to lock it in place if desired. The air pressure is factory set at a default value of around 120psig.

The pressure release air pressure regulator is located on the underside of the instrument deck and is used to control the air pressure to the pressure release air-operated valve (AOV). Smaller cylinder release pressures require higher air pressure. To adjust the pressure of the air supplied to the air-operated valve, pull the knob on the regulator out to unlock it. Turn the regulator knob clockwise to increase the pressure and counterclockwise to decrease the pressure. The pressure release AOV air pressure gauge shows the pressure of the air delivered to the air-operated valve. When the adjustment is

finished, push the knob in to lock it in place if desired. The air pressure is factory set at a default value between 35-40psig.

The drain cylinder air pressure regulator is located on the underside of the instrument deck and is used to control the air pressure to the drain cylinder AOV. The drain cylinder air regulator is set at 40psig and does not usually require any adjustment as long as the AOV is cycling on and off when the drain cylinder button is pushed. However, adjustment is the same as it is for the pressure release air pressure regulator as detailed above.

The Cooling Controls

The cooling controls are most often used to cool the cylinder and oil reservoir upon completion of a test. Water is most often the choice of cooling fluid but a chiller may also be employed to provide further cooling capacity. The cooling controls consist of a cooling button located on the main screen. The pressurized consistometer is equipped with internal cooling coils in the oil reservoir for quick cooling of the hydraulic oil and faster turnaround between tests. The cooling button also allows cooling fluid to flow through the cooling jacket surrounding the pressure vessel. The cooling button may be turned on manually at the completion of a test to cool the pressure vessel. Alternatively, an automatic cooling procedure can be used to cool the cylinder as described in the Start Test section. The reservoir and pressure vessel cooling are simultaneously operated.

Electronic Controls

The main power switch is located behind the touchscreen stand towards the rear of the instrument. This push-button switch contains a red colored LED that illuminates when depressed and electrical current is flowing. To power off the instrument, first shut down the Windows operating system properly and then depress the power switch to the off position. The red LED will power off.

The electrical box is located at the rear of the instrument along the top. There is a panel cover for this box which may be removed to access most of the electrical components. Move the touch screen stand forward to allow removal of the top panel cover. Always use caution when accessing the electrical box. It may be necessary to properly shutdown the instrument and remove power before accessing the electrical components.

The instrument is equipped with a current monitoring relay which monitors the amount of current being supplied to the instrument. There is an initial start-up delay and a trip delay. The monitor is set to cut off power to the instrument if it senses more than 25 amps for more than 30 seconds. This safety device prevents a run-away heating situation that may be caused by a short or other dangerous current situation. If the current monitoring relay has been tripped, it is necessary to unplug the main power cord from the back of the instrument and then plug it back in to reset.

The motor speed control knob and speed control board are located inside the electrical box. The motor speed is default set at 150 rpm at the factory. To increase the motor speed, turn the knob clockwise. To decrease the speed, turn the knob counterclockwise.

There is a manual pressure release button switch located on the instrument. It is labeled MANUAL PRESSURE RELEASE. The button switch is for manual override purposes in case the computer becomes unresponsive to commands and the need to evacuate chamber pressure becomes necessary. If this switch is depressed, the instrument will immediately release all pressure within the pressure vessel. Another use for the manual pressure release switch is to evacuate any residual pressure left over from a test. When the instrument has finished the “drain cylinder” procedure, there is sometimes residual air pressure from the air inlet pushing the oil back into the reservoir. Usually, this residual pressure is vented when carefully and slowly loosening the thermocouple nut on top of the pressure vessel plug.

Chapter 4

Operation

Chapter 4 will discuss in detail the steps required to run a thickening time test. Examples will be provided when necessary.

A Brief Example of Running Thickening Time Test

The steps listed below are for experienced users who are familiar with consistometer operation.

1. Turn the instrument on. Depress the red LED **POWER** switch to the ON position.

A light coating of grease on the threads is important to prevent cement from filling the threads.

2. Once the Windows operating system has fully loaded double click the CementLab windows icon on the home screen.

3. Once CementLab has loaded press Test Setup and program a temperature and pressure ramp as described in the Test Setup section.

4. Mix the slurry and fill the slurry cup.

Do not pound the lid closed with a sledgehammer. It is recommended that the lid be loosened a few degrees to allow easy removal after a test is finished.

5. Prior to placing the slurry cup and potentiometer mechanism (pot mech) into the pressure vessel, place the pot mech onto the assembled slurry cup and fit the drive disc and bar using the supplied hex key and drive bar set screw.

6. Place the slurry cup then the potentiometer mechanism (pot mech) into the pressure vessel using the supplied slurry cup and potentiometer bails. Engage the slurry cup to the cup table. The motor may be turned on now using the motor button. Engage the pot mech onto the drive shaft bar making sure the top pot mech bearing is aligned with the paddle shaft.

7. Verify the instrument is reading consistency. If not, there is a problem with slurry cup and potentiometer alignment. Locate the problem and adjust.

8. Close the lid on the pressure vessel. Insert the thermocouple, but do not tighten thermocouple fitting.

9. Press the **FILL** button and fill the pressure vessel with oil. With a paper towel and the supplied 5/8" wrench, wait for all the air to escape the thermocouple hole and oil to begin seeping out. Once you begin to see oil fully tighten the thermocouple fitting.

10. Turn off cooling if active. Verify the instrument is reading consistency and press Start Test.

A Brief Example of Stopping a Thickening Time Test

The steps listed below are for experienced users who are familiar with consistometer operation.

1. There is a selection available for automatic or manual shutdown. In automatic shutdown you may choose the type of shutdown. Automatic shutdown is achieved by either selecting a maximum consistency or elapsed time value in the live testing screen or waiting for that value to be reached. It takes 60 seconds after the value has been reached for the control software to perform shutdown. To manually stop a test, press Stop Test.

2. If manually shut down and the temperature is above ambient, press Cool in the main screen. If automatic shutdown has been activated you will see the cooling activate automatically.

3. Turn the pump off by pressing the Pump On/Off button.

4. Select Drain Cylinder from the drop down box and wait for the pressure to be released from the pressure vessel.

5. Wait for the cylinder to cool enough to touch and then slowly loosen the thermocouple using a shop towel to prevent any residual pressure spray from going everywhere.

6. Take care to observe the temperature of the various components as they will be hot after a test. When the cylinder is cool enough to touch, remove the top plug from the pressure vessel.

7. Using the supplied slurry cup and potentiometer bails remove the potentiometer and slurry cup. Take care to drain any leftover oil from the tops back into the cell.

8. Disassemble the slurry cup and remove the slurry before it sets and becomes too hard.

9. All CTE slurry cups are tapered, with the large end at the top. This makes it easier to press the cement plug out of the slurry cup. Press the cement plug out from bottom to top. Take care to not bend the paddle shaft.

10. Clean all surfaces and threads using a mild detergent. Be very careful not to damage the threads or sealing surfaces of components as this may make reassembly difficult.

11. Flat diaphragms are generally thrown away after every test depending on the maximum temperature reached during a test.

12. Check the potentiometer for proper operation. Lightly re-grease threads.

Chapter 5

Maintenance, Servicing, and Troubleshooting

This chapter contains information about the necessary periodic maintenance of the instrument as well as common service and troubleshooting guidelines.

Maintenance

Consistometers can be relatively reliable and trouble free - provided they are serviced and maintained properly. Instruments that are neglected and receive infrequent service or are subject to abuse are certain to cause trouble.

Pressure Vessel and Hydraulic System Maintenance

The metal o-ring, the pressure vessel o-ring seat, and the bottom of the seal shaft are the keys to reliable pressure sealing. If these components are free from debris and scratches/dents, reliable sealing will be easily achieved. Refer to drawings 11-0020 in Chapter 6 for information on the cylinder assembly and the hydraulic system.

1. Inspect the pressure vessel's o-ring and the seat below it after each test and wipe it free of cement particles and other debris. Do not use sharp objects, such as screwdrivers, when removing the o-ring as it will likely bend or scratch the o-ring, ruining it. Should the seat below the o-ring or the seal shaft become pitted or scratched from cement particles that have migrated into the seal, lapping of the seat and seal shaft may be required.

2. The cylinder plug threads have been coated with a friction reducing PTFE coating by the factory to help prevent thread seizing and galling. However, it is still recommended to apply a molybdenum disulfide anti-seize compound to the threads periodically.

If the transfer of the oil from the pressure vessel to the reservoir is slow, the filter probably needs to be cleaned or replaced.

3. The high-pressure filter is located just to the right of the pressure vessel. This filter protects the air operated valves and capillary tubes from cement particle damage and/or blockage. It also prevents cement particles from being carried into the oil reservoir. This filter must be disassembled and the filter element cleaned or replaced periodically.

4. The mineral oil in the reservoir should be drained and replaced when it becomes dirty. The low-pressure oil filter element (part number C-0197) should also be replaced periodically. The oil reservoir is equipped with drain valve on the bottom and a filling plug at the top. To thoroughly clean the reservoir, the entire unit may be taken out of the instrument and the bottom removed. Mineral oil may be conveniently added by pouring oil into the pressure cylinder and transferring it to the oil reservoir. The mineral oil supplied with the instrument has an open cup flash point of approximately 188°C/370° F.

5. The magnetic drive should be flushed with clean solvent periodically and whenever cement spills into the cylinder or particles contaminate the drive. If cement enters the magnetic drive, it will cause the bearings to wear quickly. If the worn bearings are not replaced, it may cause the inner magnetic drive shaft to wear out prematurely. Worn bearings may also cause excessive slurry cup run-out.

Potentiometer Mechanism Maintenance

Refer to drawing 02-0050 in Chapter 6 for an exploded view of a potentiometer mechanism assembly.

1. Check upper and lower bearings for smooth, friction free operation. If bearing operation is not smooth, clean or replace the bearings. If the bearings do not operate smoothly, it may cause thickening times to increase.

2. Check for broken wires in the potentiometer resistor. The resistance should measure between 80 and 100 Ω. The surface of the resistor that is in contact with the wiper may be burnished with a smooth, round rod (such as a screwdriver blade) to reduce noise in the consistency signal if necessary.

3. Periodically check that the wiper is making contact with the potentiometer resistor throughout its entire length of travel. The wiper arm should make a nice friction sound with the resistor.

4. Check to make sure the two brass contact strips (02-0051) are exactly located like in figure 24. They should be placed towards the ends of the resistor. The ground wire 02-0066 should make contact with ground contact spring 02-0059-2 and fed through the small hole and into the body making contact with the spring retainer 02-0053. The potentiometer slider (02-0077) should rest right at the beginning of the resistor winding. Make adjustments to the pointer location using the triangular patterned screws on the underside of the pot mech. The stop arm (02-0058) should rest against the only cap screw on the underside of the potentiometer.

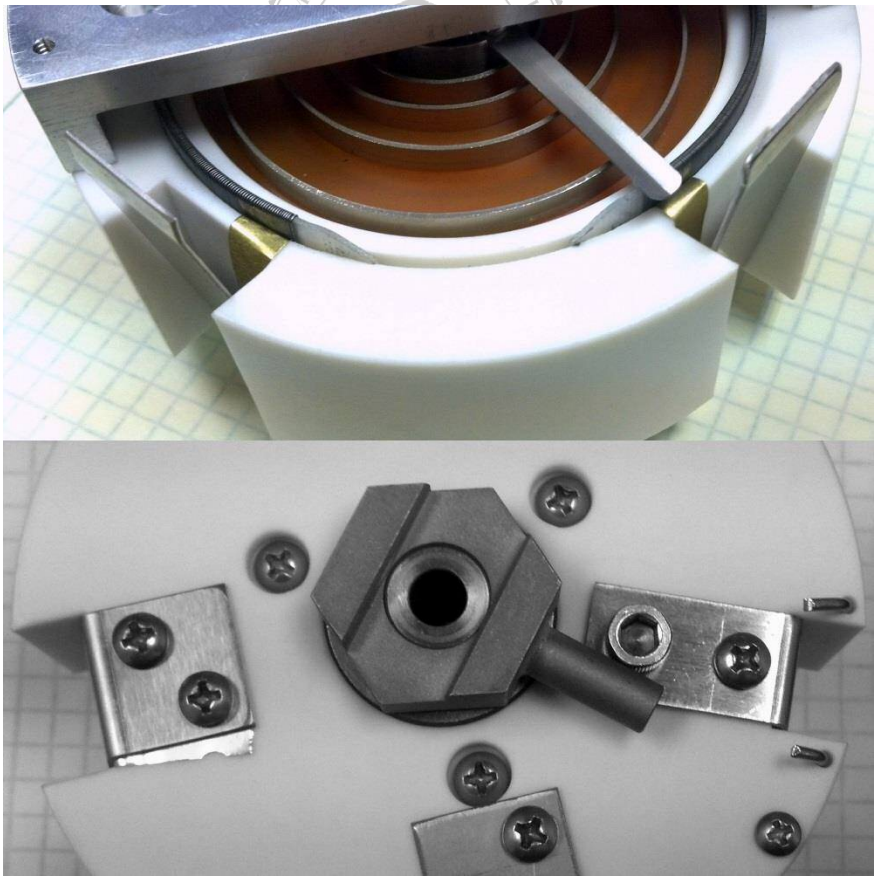


Figure 28

Slurry Cup Maintenance

Refer to drawing 02-0030 in Chapter 6 for a section view of a slurry cup.

1. Check the slurry cup after every test to be certain the threads are not contaminated with cement. Lubricate the threads with grease prior to the start of every test.

2. It is recommended that hardened cement slugs be pressed out, rather than pounded out with a hammer. Pressing tends to cause less damage. When pressing the slug out, be careful not to damage the paddle shaft point or the paddle itself. If the slug is not pressed out straight, it may cause the cup sleeve to become oval and prevent the threaded closures from threading into the sleeve.

3. If so equipped, periodically disassembly the diaphragm hub and clean any cement from the Teflon o-rings. Replace the o-rings if they are badly worn.

4. Check the rubber diaphragm for signs of brittleness or cracking. Replace if necessary.

5. Check the point on the bottom of the paddle shaft. Replace it if it is worn to the point that the paddle rubs on the bottom of the slurry cup. Check to see that the paddle shaft is not excessively worn where the shaft extends through the diaphragm hub. Replace if wear is excessive.

6. Check the slurry cup seal plug for wear. Replace it if it is worn to the point that the paddle rubs on the bottom of the slurry cup.

Servicing

This section provides information on servicing the components most commonly in need of repair.

Changing the Plug o-ring

1. Refer to drawing 11-0020 Cylinder Assembly in Chapter 6 when changing this o-ring. Remove the spiral retaining ring C-0501 from the top plug.

2. Remove the o-ring and seal ring. Clean the seal ring and lightly coat with suitable high temperature grease. Be careful to not damage the seal ring by dropping it or mishandling.

3. Replace the o-ring with a new C-0125. Lightly coat the o-ring with suitable high temperature grease.

Changing/Cleaning the High Pressure Filter Element

Refer to drawing 02-0071 Filter Assembly when servicing filter.

1. Disconnect the 1/4-inch high-pressure connections and remove the 02-0071 Filter Assembly.

2. Secure the 02-0072 Filter Housing in a bench mounted vice and remove the 02-0074 Seat Retainer.

3. Compressed air may be forced through the 02-0076 Filter Element to remove the debris attached to the filter. The 02-0076 Filter Element may also be unscrewed from the 02-0075 Filter Nipple and cleaned with solvent or a weak acid solution.

4. Thread the filter onto the filter nipple. Install the filter element and 02-0073 Filter Seat into the housing and secure tightly with the seat retainer.

5. Install the filter back in the instrument. If transferring the oil from the pressure vessel to the reservoir is still slow, replace the 02-0076 Filter Element.

To minimize the mess, place a bucket or cup under the filter housing to catch any oil that might spill.

Replacing the Low Pressure Filter

1. Make certain the fill button is not active and that the unit is not trying to pump oil. Instrument must be in stand-by with nothing active.
2. Locate the automotive style low-pressure oil filter housing near the front door of the instrument. C-0197.
3. Unscrew the filter.
4. Replace the filter element with a new element.
5. Check for leaks.

Potentiometer Mechanism Resistor Replacement

Refer to drawing 02-0050 when replacing the 02-0062 Resistor.

1. Remove 02-0064 Shaft Bearing Retainer and 02-0077 Potentiometer Slider.
2. Remove old resistor from 02-0052 Mounting Frame, being careful not to damage slot.
3. Position new resistor over the slot in the mounting frame with the straight side down. The 02-0051Connecting Strip must be installed under the resistor in the groove in the mounting frame. The length of resistor extending past the connecting strip should be approximately even on both ends.
4. Seat the resistor securely in the slot in the mounting frame. Use care to avoid damage to the resistor. The top surface of resistor must be level with the top of the mounting frame.

5. Use a smooth, round rod (such as the round shank of a screwdriver) to rub top surface of resistor, burnishing resistance wire lightly so potentiometer slider will slide smoothly with minimal noise.

6. Rotate potentiometer slider by hand. Assure that slider makes contact with the resistor during its entire range of motion. If necessary, adjust slider by bending it up or down.

7. Replace shaft bearing retainer and check the potentiometer mechanism with a calibrating device.

Potentiometer Mechanism Spring Replacement

Refer to drawing 02-0050 when replacing the 02-0060 Spring.

1. Remove 02-0064 Shaft Bearing Retainer and 02-0077 Potentiometer Slider.

2. Remove old spring.

The spring should wind tighter when the slider is moved in the counter-clockwise direction.

3. Install new spring.

4. Replace potentiometer slider.

5. Loosen the three spring adjuster clamp screws on underside of the frame, but do not remove the screws.

6. Rotate the 02-0053 Spring Adjuster until the potentiometer slider lines up with the front contact strip. Tighten adjuster clamp screws.

7. Rotate potentiometer slider by hand. Assure that slider makes contact with the resistor during its entire range of motion. If necessary, adjust slider by bending it up or down.

8. Replace shaft bearing retainer and check the potentiometer mechanism with a calibrating device.

Servicing the Inner Magnetic Drive Shaft

Refer to drawing 03-0063 Magnetic Drive Assembly in Chapter 6 for servicing all magnetic drive components.

1. Pull the 03-0070 Inner Magnet Shaft Assembly out through the top of the pressure vessel.

   CAUTION: The inner shaft is composed of extremely powerful magnets. If these magnets are allowed to get too close to steel objects the magnetic force may cause injury or damage to the shaft. Also keep the shaft away from metal filings, as they will adhere to the shaft and cause premature wear.

It is sometimes necessary to remove the 3-0065 Plug Assembly from the bottom of the 3-0062 Magnetic Drive Housing. The oil in the magnetic drive can create a vacuum that makes removal of the inner shaft difficult, especially if the housing is contaminated with cement.

2. Unscrew the cup table from the magnet shaft assembly.
3. Press the C-0108 Roll Pin out of the 03-0071 Thrust Ring and remove the thrust ring. Take care not to bend the shaft. Replace the thrust ring if badly worn.
4. The upper 03-0072 Bronze Bearing may now be removed. Replace if badly worn.
5. Remove the C-0130 Snap Ring. Replace is corroded or damaged. The 03-0073 Carbon Bearing or the 03-0073-1 Bronze Bearing may now be removed. Replace if badly worn.
6. Remove the hex head screw and 03-0074-6 Washer from the other end of the shaft to remove the second 03-0073 or 03-0073-1 Bearing. Replace if badly worn.
7. Assemble in reverse order of disassembly.

Servicing the Outer Magnetic Drive Rotator

Refer to drawing 03-0063 Magnetic Drive Assembly in Chapter 6 for servicing all magnetic drive components.

CAUTION: Make certain that the power to the instrument is disconnected before servicing the magnetic drive rotator. The rotator is very close to the heater terminals and severe shock or electrocution could occur if contact is made with a live heater circuit.

1. Loosen two of the three setscrews on the 03-0067 Outer Magnetic Drive Support. The 03-0066 Outer Magnetic Drive Rotator Assembly will fall off. It may be necessary to loosen the 03-0061 Magnetic Drive Sprocket to completely remove the rotator.

CAUTION: The inner shaft is composed of extremely powerful magnets. If these magnets are allowed to get too close to steel objects the magnetic force may cause injury or damage to the shaft. Also keep the shaft away from metal filings, as they will adhere to the shaft and cause premature wear.

2. To remove the 03-0056 Upper Bearing, remove the C-0090 Retaining Ring and slide the bearing out. Expect for excess wear and replace if needed.

3. To remove the C-0087 Lower Bearing, remove the C-0091 Retaining Ring and slide the bearing out. Inspect for excessive runout or rough operation and replace if necessary.

4. Removal of the 03-0052 Inner Magnet Sleeve is usually not necessary and is not recommended.

5. Assembly is the reverse of disassembly.

Removal of the Magnetic Drive Housing

Refer to drawing 03-0063 Magnetic Drive Assembly in Chapter 6 for servicing all magnetic drive components.

CAUTION: Make certain that the power to the instrument is disconnected before servicing the magnetic drive rotator. The rotator is very close to the heater terminals and severe shock or electrocution could occur if contact is made with a live heater circuit.

1. Loosen two of the three setscrews on the 03-0067 Outer Magnetic Drive Support. The 03-0066 Outer Magnetic Drive Rotator Assembly will fall off.

CAUTION: The inner shaft is composed of extremely powerful magnets. If these magnets are allowed to get too close to steel objects the magnetic force may cause injury or damage to the shaft. Also keep the shaft away from metal filings, as they will adhere to the shaft and cause premature wear.

2. With a spanner wrench, loosen the 03-0064 Lock Ring is found in the recessed hole in the bottom of the pressure vessel.

Use care when working near the heater terminals. They are easily bent or broken.

3. Push the 03-0062 Magnetic Drive Housing up through the pressure vessel bore and out the top. It may be necessary to gently tap the housing with a hammer to break it loose if it is cemented in place. If cement contamination is severe, cement may have to be removed out through the bore of the pressure vessel before the housing can be removed.

4. Replace the C-0111 Teflon o-ring prior to assembly.

5. Assembly is the opposite of disassembly.

Heater Replacement

The 03-0022 heater replacement steps are listed below.

1. **CAUTION**: Make certain that the power to the instrument is disconnected before servicing the heater. Severe shock or electrocution could occur if contact is made with a live heater circuit.

2. Remove the 03-0035 Upper Heater Spreader from the pressure vessel bore.

3. Remove the 03-0057 Lower Heater Spreader.

A deep socket or a piece of 3/8-inch tubing may be placed over the heater terminals and used as punch to loosen the heater ferrules.

4. Remove the 03-0066 Magnetic Drive Rotator Assembly as described above.

5. Remove wires from heater terminals.

6. Remove both C-0250 Heater Nuts.

7. Tap on heater ferrules until loosened then pull heater out through bore of pressure vessel.

8. Make certain that the 03-0025 Heater Gaskets came out with the heater. If the gaskets did not come out, a 7/16-inch bolt or rod

inserted through the bottom of the heater holes will normally snag the gasket and push it out. In lieu of this, a screwdriver may be used to push the gasket out. Be careful not to damage the sealing surface inside the heater holes.

9. Clean the bottom of the pressure vessel and the heater holes before installing new heater. Assembly is the reverse of assembly.

10. With the 3-0025 Heater Gaskets removed from the heater insure that the heater is bent so that it drops through the heater holes with minimal effort and that the heater coils lay flat against the pressure vessel bore. Forcing the heater into the holes usually deforms the heater and makes the slurry rub the heater. An installed heater is almost impossible to bend.

Troubleshooting

The following section consists of a table listing possible remedies for the most common consistometer problems.

Symptom	Cause	Remedy
System builds pressure but will not hold pressure	Leak	Check fittings for leaks and tighten fittings. Heater ferrules, contact pins, and magnetic drive housing are also possibilities.
System builds pressure and oil runs out between pressure vessel and top plug.	O-ring (C-0125) is deformed or worn.	Replace o-ring.
	O-ring sealing surfaces are worn, pitted, or scratched.	Lap o-ring sealing surfaces. A lapping kit is available from CTE.
Pump strokes but little or no pressure is obtained.	Valve open, severe leak, blown rupture disc.	Locate problem and correct.
	Pressure vessel has trapped air.	Open thermocouple connector slightly and release trapped air.
	Oil reservoir is empty	Fill reservoir with oil
	Severely clogged low-pressure filter.	Replace low-pressure filter element.
	Faulty pump check valve.	Clean and/or overhaul pump outlet check valve.
	No air supplied to air operated valve.	Check air lines leading to valve. Check valve solenoid valve. Restore air supply.
Pump builds and maintains pressure to a certain level than then stops.	If not oil is coming from pump muffler, oil reservoir ran dry.	Add oil to reservoir.
	If oil is coming from pump muffler, the pump high-pressure seal is probably worn out.	Overhaul or replace pump.

Symptom	Cause	Remedy
Pressure cannot be released.	Stainless steel are plugged with cement.	Remove lines and inspect for blockage. Replace any that are plugged.
Air operated valve will not release pressure.	If valve cannot be heard exhausting air, the problem is a faulty solenoid valve on the air-operated valve.	Repair or replace solenoid valve.
	If valves can be heard exhausting air, the problem is most likely a plugged capillary tube connected to the exit port of the valve.	Replace capillary tube.
Slurry cup rubs on heater or heater spreader.	Heater does not sit flush with bore of pressure vessel or heater spreaders missing.	Bend heater to sit flush with bore of vessel and add heater spreaders.
	Magnet drive bearings are worn.	Check bearings on inner magnet shaft and replace if necessary.
	Missing pin on slurry cup base.	Replace pin or base.
Slurry cup will not turn.	Magnetic drive severely contaminated with cement.	Remove magnetic drive plug and inner magnet shaft and clean magnetic drive thoroughly.
	Blown fuse on motor control board.	Check fuses on motor control board located inside electrical box.
	Faulty motor or controller.	Replace as necessary.
	Broken drive belt.	Replace drive belt.
Consistency always displays approximately 150 Bc.	Shorted contact pin.	Check electrical continuity between contact pins and cylinder. If continuity exists, replace contact pin. This does not apply to the ground pin, which always has continuity with cylinder.
Heater will not get hot.	Blown fuse.	Check fuses inside electrical box. Replace any that are blown.
	Loose heater wire.	Check heater terminals for loose wires and reconnect if necessary.
	Faulty heater.	Replace.
	Faulty solid state relay.	Replace.

Symptom	Cause	Remedy
Temperature display is erratic.	Faulty thermocouple. Loose connection in thermocouple wiring.	Replace thermocouple. Check for loose wiring and correct if necessary.
Temperature displays and unusually high number (>1500°F)	Open circuit in thermocouple. Open circuit in thermocouple circuitry	Replace thermocouple. Check thermocouple circuitry for open circuits or loose connections. Correct if necessary.

Parts List

The following is a table of frequently used replacement parts along with the CTE part numbers. This list is subject to change and may contain errors due to evolving designs. Please consult with a sales representative to confirm a part number's use.

Description	Part Number
Slurry Cup Assembly	2-0030-2
Slurry Cup Sleeve	2-0034
Slurry Cup Base, Slotted	2-0035
Cup Base Plug	2-0033
Cup Lock Ring	2-0039
Cup Diaphragm Collar, Flat Diaphragm	2-0036-1
Diaphragm, Flat	2-0078
Diaphragm Support	2-0037
Slurry Cup Paddle	2-0031
Cup Shaft (short)	2-0032
Drive Shaft Disc	2-0040
Drive Bar	2-0038
Stop Arm	2-0058
Spring Sleeve	2-0056
Shaft Bearing Retainer	2-0064
Resistor	2-0062
Collar, Spring w/Screws	2-0057
Potentiometer Slider	2-0077
Calibration Spring	2-0060
Spring Adjuster	2-0053
Potentiometer Bail	2-0029
Oil Reservoir	3-0330
Upper Heater Spreader	3-0035
Lower Heater Spreader	3-0043
Heater Assembly Gasket	3-0025
Calibration Device Assembly	2-0090-1
Potentiometer Mechanism Assembly	2-0050
Contact Strip	2-0051
Heater Element	3-0023
Low Pressure Filter Assembly	C-0197
Element, High Pressure Filter	2-0076
High Pressure Filter Assembly	2-0071
Filter Housing	2-0072
Filter Seat	2-0073
Seat Retainer	2-0074

Description	Part Number
Potentiometer Contact Spring Set	2-0059
Pressure Vessel	11-0020
Filter Nipple	2-0075
Motor Pulley	C-0382
Motor Shaft Bushing, Sheave	C-0381
Seal Ring, Pressure Vessel	11-0023
Copper Gasket, Slurry Cup Assembly	3-0033
Rotator Sprocket	3-0061
Retainer, Magnetic Drive Housing	3-0064
Magnet Shaft Bearing	3-0073-1
Upper Bronze Bearing	3-0072
Thrust Ring	3-0071
Washer, Inner Mag Drive Shaft	3-0074-6
Cup Table	3-0034-1
Spacer	3-0058
Lower Bearing Spacer	3-0057
Upper Bearing Spacer	3-0059
Teflon Bearing, Rotator Assembly	3-0056
Bearing, Stainless Steel, Rotator Assembly	C-0087
Plug Handle	11-0030
Outer Magnet Assembly	3-0051
Seal Plug Assembly	3-0065
Lower Spacer	3-0057
Holder, Rotator Assembly	3-0054
Upper Spacer	3-0059
Pin, Rotator Assembly	3-0055
Magnetic Drive Rotator Assembly	3-0051
Shaft Assembly, Magnetic Drive	3-0070
Seal Nut	3-0065-2
Seal Plug	3-0065-1
Seal Plug Assembly	3-0065
Pressure Transducer	C-0022
O-ring, Teflon	C-0006
Roll Pin	C-0007
Shear Pin	C-0008
Roll Pin	C-0009
Fuse, 30A	C-0217
Fuse, 1A	C-0235
Fuse, 25A	C-0482
Air Pressure Regulator	C-0021
Pressure Transducer Cable	C-0022-1
Solenoid Valve, 2 way	C-0024
Rupture Disc, 25,000 psi	C-0243

Description	Part Number
Safety Head	C-0146
Current Monitoring Relay	C-0659
Power Switch, Red LED	C-1337
Solid State Relay, 50A, DC control	C-0080
Bearing, Pot Mech Frame	C-0085
Bearing, Paddle Shaft	C-0086
Roll Pin	C-0108
O-ring, Cylinder Drain Plug	C-0109
Retaining Ring	C-0110
O-ring, Teflon	C-0111
Power Supply, +-5 VDC, 3A	C-1165
Power Supply, +-12 VDC	C-0481
Contactor, 25A, 240VAC coil	C-0658
Module, Relay, I/O	C-1261
O-ring, Cylinder Plug	C-0125
Touch Screen Monitor	C-0668
Pulley, Outer Mag Drive	3-0061
Thermocouple Receptacle	C-0167
Thermocouple	8-0011
Contact Pin	11-0026
Ground Pin	11-0027
Receptacle, Pot Mech Calibrator	C-0222
Backup O-ring, Cylinder Drain Plug	C-0240
Pulley, Timing Belt	C-0382
Belt, timing	C-0247
Mineral Oil	C-0248
Heater nut	C-0250
Pump, 29,000psi, PP189-VE	C-0575
Electric Motor	C-0377
Motor Controller	C-0379
Solenoid Valve, 3 way	C-0389
Air Operated Valve	C-0760
Potentiometer, motor speed control	C-0397
Resistor, motor controller	C-0398

Chapter

6

Diagrams and Schematics

This chapter contains diagrams and schematics of various assemblies and systems of the pressurized consistometer.

REVISIONS

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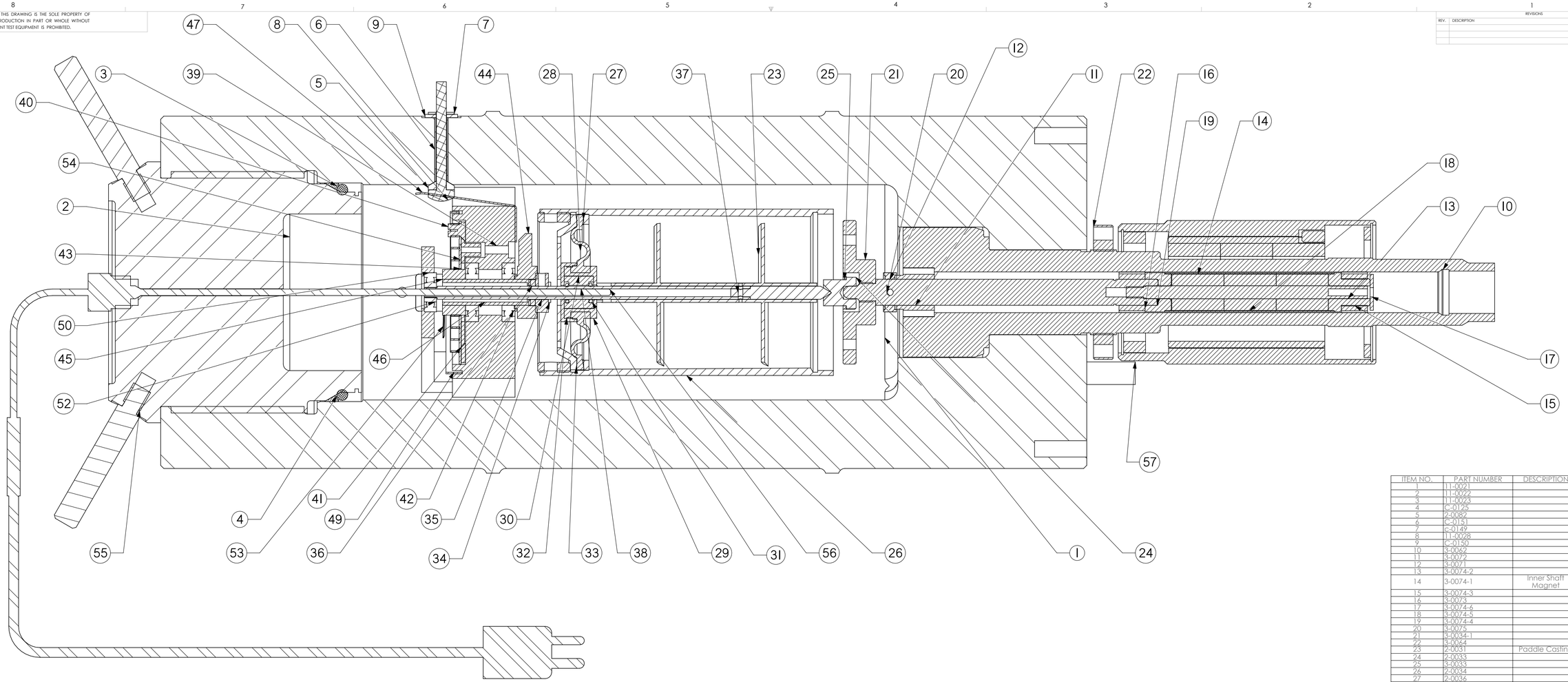

SECTION A-A
SCALE 1 : 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	11-0021		1
2	11-0022		1
3	11-0023		1
4	C-0125		1
5	2-0082		1
6	C-0151		1
7	C-0149		1
8	11-0028		1
9	C-0150		1
10	3-0062		1
11	3-0072		2
12	3-0071		2
13	3-0074-2		1
14	3-0074-1	Inner Shaft Magnet	12
15	3-0074-3		1
16	3-0073		2
17	3-0074-6		1
18	3-0074-5		1
19	3-0074-4		1
20	3-0075		1
21	3-0034-1		2
22	3-0064		1
23	2-0031	Paddle Casting	1
24	2-0033		1
25	3-0033		1
26	2-0034		1
27	2-0036		1
28	2-0041		1
29	2-0043		1
30	2-0044		1
31	C-0006		2
32	2-0042		1
33	2-0037		1
34	2-0039		1
35	2-0040		1
36	2-0038		1
37	2-0032-1		1
38	2-0032-2		1
39	2-0052		1
40	2-0053		1
41	2-0054		1
42	C-0085		2
43	2-0055		1
44	2-0058		1
45	2-0057		1
46	2-0056		1
47	2-0059-1		2
48	2-0059-2		1
49	2-0061bent		1
50	2-0064		1
51	2-0063		1
52	C-0086		1
53	2-0077		1
54	2-0060		1
55	4-0026		2
56	B-0011		1
57	3-0024		2
58	3-0025	COPPER GASKET	2
59	C-0501	RETAINING RING	1
60	03-0035	UPPER HEATER SPREADER	1
61	03-0043	LOWER HEATER SPREADER	1
62	3-0054		2
63	3-0052		1
64	3-0053		24
65	3-0055		2
66	3-0057		2
67	3-0056-1		2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ±1/32 DECIMALS .XX ±.01 .XXX ±.005 ANGLES ±1°
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RESP ENG	CCD	3-17-98
MFG ENG	CCD	3-17-98
QUAL ENG	CCD	3-17-98

CEMENT TEST EQUIPMENT, INC.

CYLINDER ASSEMBLY

SIZE D | DWG. NO. 11-0020 | REV. C
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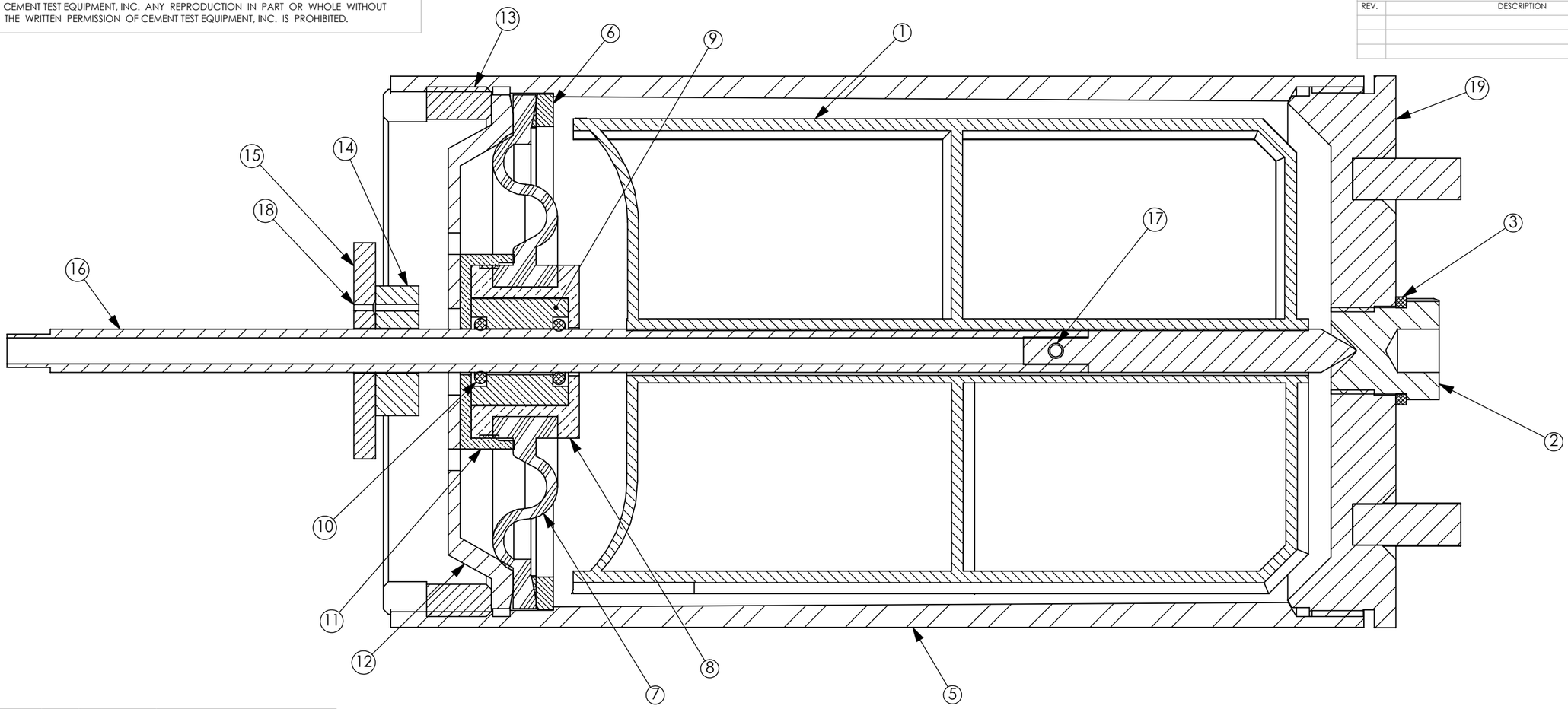

SECTION A-A
SCALE 3 : 2

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	2-0031	Paddle Casting
2	1	2-0033	CUP BASE PLUG
3	1	3-0033	PLUG GASKET
5	1	2-0034	SLURRY CUP SLEEVE
6	1	2-0036	COLLAR
7	1	2-0041	DIAPHRAGM
8	1	2-0043	DIAPHRAGM HUB
9	1	2-0044	RING
10	2	C-0006	O-RING
11	1	2-0042	HUB CAP
12	1	2-0037	DIAPHRAGM SUPPORT
13	1	2-0039	CUP LOCK RING
14	1	2-0040	DRIVE SHAFT DISC
15	1	2-0038	DRIVE SHAFT BAR
16	1	2-0032	PADDLE SHAFT
17	1	C-0007	ROLL PIN
18	1	C-0008	SHEAR PIN
19	1	2-0045	SLURRY CUP PIN BASE

NEXT ASSY	USED ON
APPLICATION	

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TOLERANCES ARE:
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±1/32 .XX+-_.01 +-_1_
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MATERIAL

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CEMENT TEST EQUIPMENT, INC.

SLURRY CUP ASSEMBLY WITH CORRUGATED DIAPHRAGM

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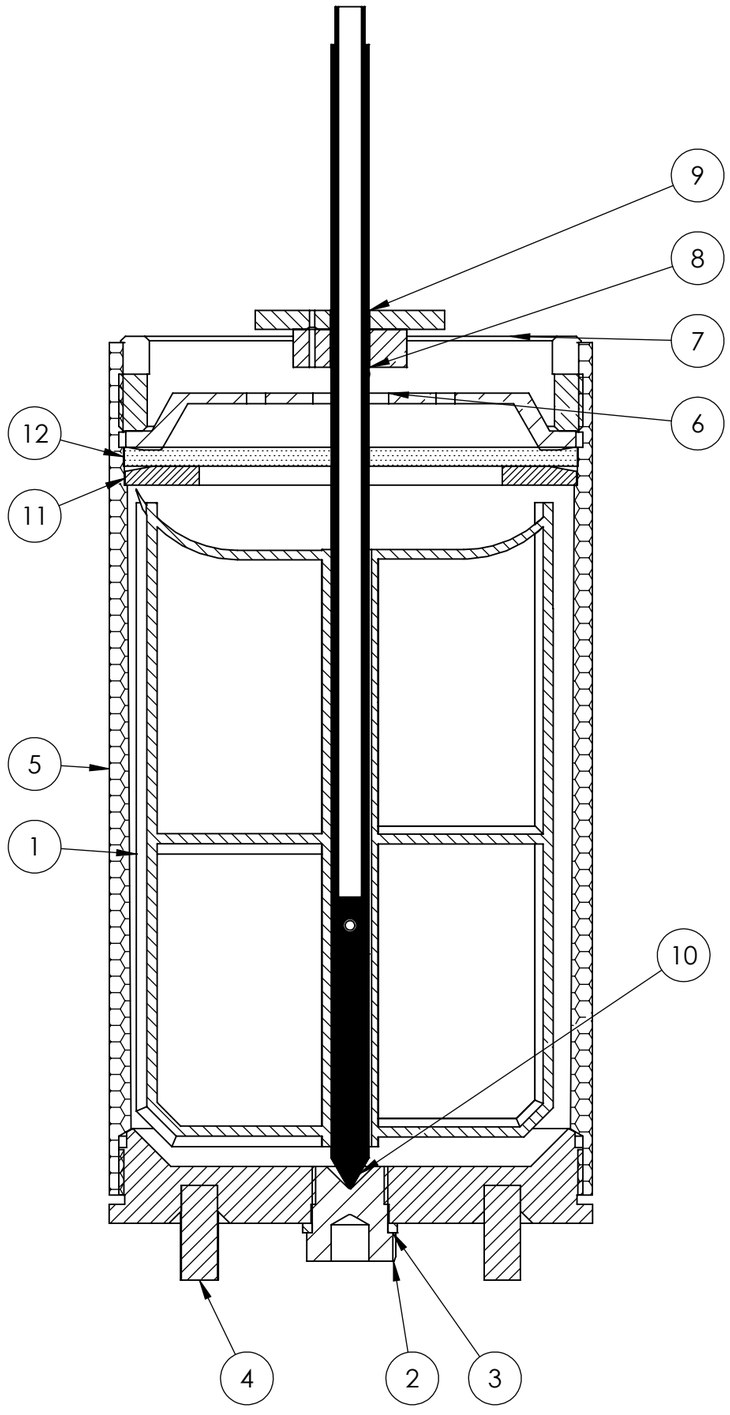

SECTION B-B

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	2-0031	Paddle Casting	1
2	2-0033	CUP BASE PLUG	1
3	3-0033	PLUG GASKET	1
4	2-0045	SLURRY CUP PIN BASE	1
5	2-0034	SLURRY CUP SLEEVE	1
6	2-0037	DIAPHRAGM SUPPORT	1
7	2-0039	CUP LOCK RING	1
8	2-0040	DRIVE SHAFT DISC	1
9	2-0038	DRIVE SHAFT BAR	1
10	2-0032	PADDLE SHAFT	1
11	2-0036-1	FLAT DIAPHRAGM COLLAR	1
12	2-0078	FLAT DIAPHRAGM	1
13	C-0007	ROLL PIN, PADDLE SHAFT	1
14	C-0008	SHEAR PIN, DRIVE SHAFT BAR	1

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: ± 1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

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CHECKED	GRH	08-22-13
ENG APPR.	GRH	08-22-13
MFG APPR.	GRH	08-22-13
Q.A.	GRH	08-22-13

COMMENTS:

Cement Test Equipment

TITLE:
SLURRY CUP ASSEMBLY FLAT DIAPHRAGM

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REVISIONS			
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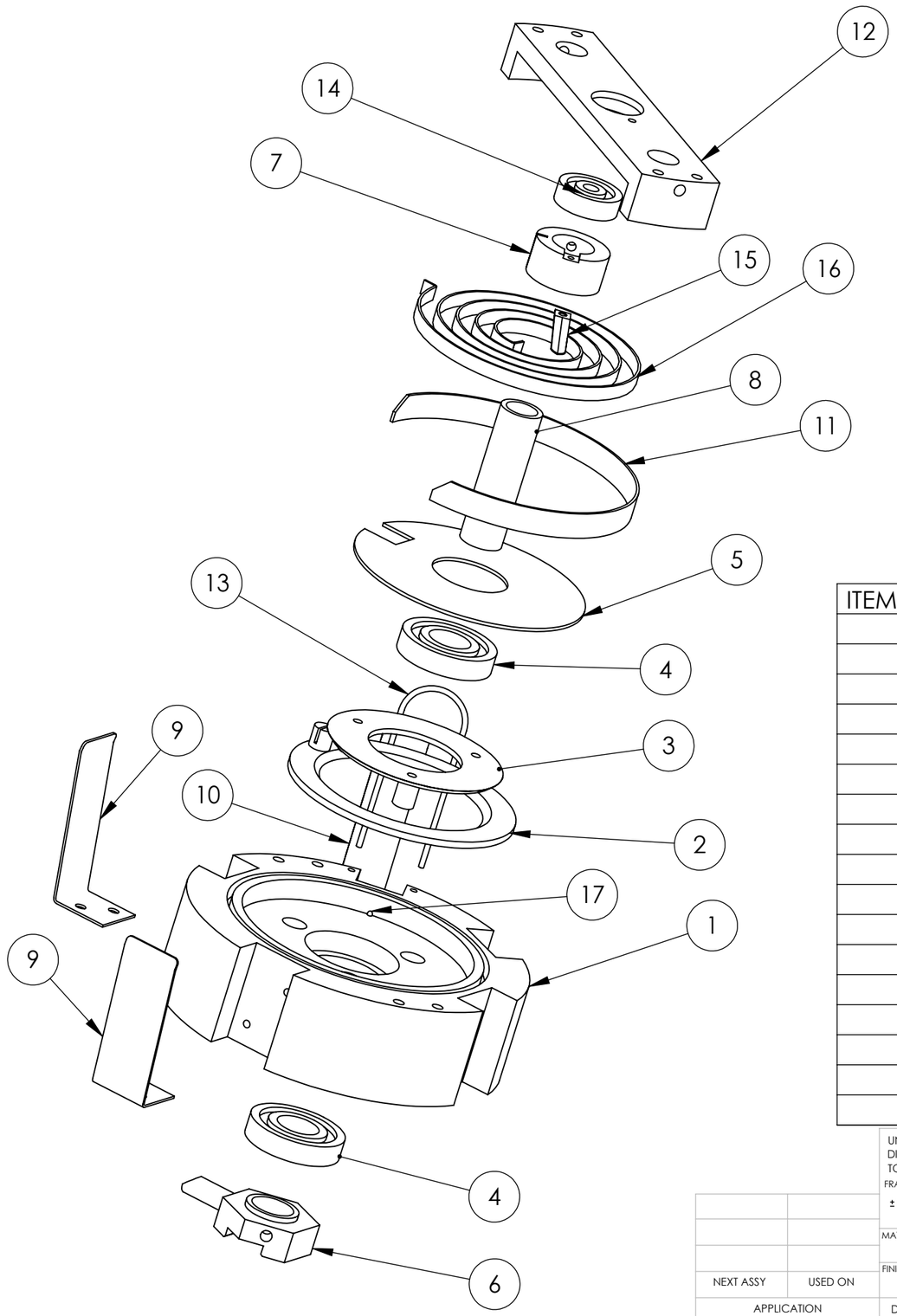

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	2-0052	TEFLON BASE
2	1	2-0053	SPRING RETAINER
3	1	2-0054	SPRING RETAINER CLAMP
4	2	C-0085	BEARING
5	1	2-0055	INSULATOR
6	1	2-0058	STOP ARM
7	1	2-0057	WIPER BASE
8	1	2-0056	SHAFT
9	2	2-0059-1	CONTACT SPRING
10	1	2-0059-2	GROUND SPRING
11	1	2-0061	RESISTOR
12	1	2-0064	BEARING HOUSING
13	1	2-0063	HANGER WIRE
14	1	C-0086	UPPER BEARING
15	1	2-0077	WIPER
16	1	2-0060	SPRING
17	1	2-	GROUND WIRE

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
±1/32 .XX ±.01 ±1
.XXX ±.005
MATERIAL
FINISH
DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

APPROVALS		DATE
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CHECKED	CCD	
RESP ENG	CCD	
MFG ENG		
QUAL ENG		

CEMENT TEST EQUIPMENT, INC.

POTENTIOMETER MECHANISM EXPLODED VIEW

SIZE	DWG. NO.	REV.
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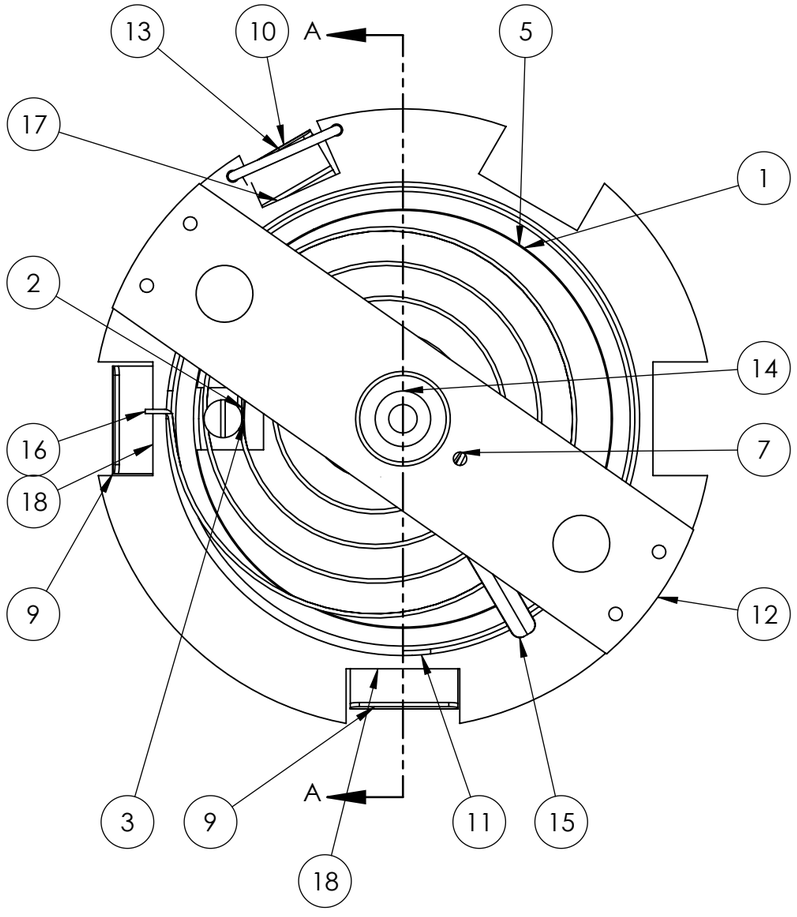
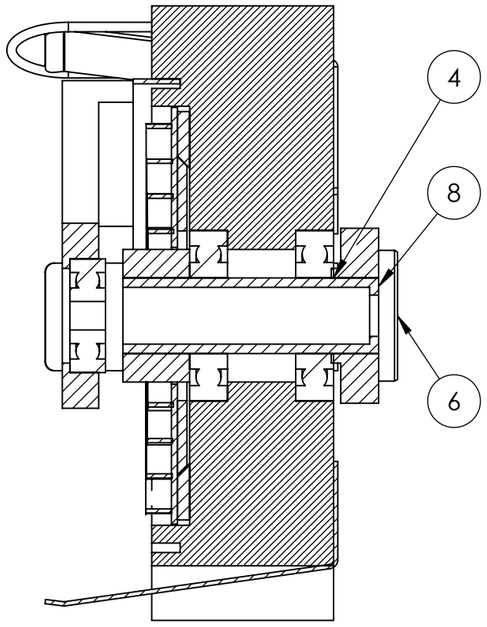
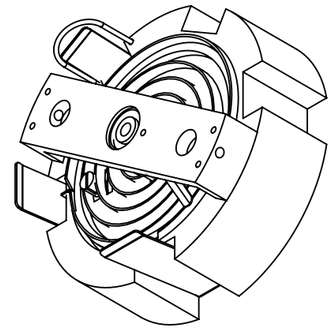
SCALE	CAD FILE:	SHEET 1 OF 1





SECTION A-A
SCALE 1 : 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	2-0052	MOUNTING FRAME, TEFLON	1
2	2-0053	SPRING ADJUSTER	1
3	2-0054	SPRING ADJUSTER CLAMP	1
4	C-0085	BEARING	2
5	2-0055	INSULATOR	1
6	2-0058	STOP ARM	1
7	2-0057	SPRING COLLAR	1
8	2-0056	SPRING SLEEVE	1
9	2-0059-1	CONTACT PIN SPRING	2
10	2-0059-2	GROUND CONTACT SPRING	1
11	2-0061	RESISTOR	1
12	2-0064	SHAFT BEARING RETAINER	1
13	2-0063	MOUNTING FRAME STOP	1
14	c-0086	BEARING (02-0065 BUSHING CAN BE USED AS REPLACEMENT)	1
15	2-0077	POTENTIOMETER SLIDER (WIPER ARM)	1
16	2-0060	SPRING	1
17	02-0066	GROUND WIRE (NOT SHOWN) FOR 02-0059-2	1
18	02-0051	CONTACT STRIP, BRASS (NOT SHOWN) FOR 02-0059-1	2

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: ± 1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
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CHECKED		
ENG APPR.	GRH	03-22-2013
MFG APPR.		
Q.A.		

COMMENTS:

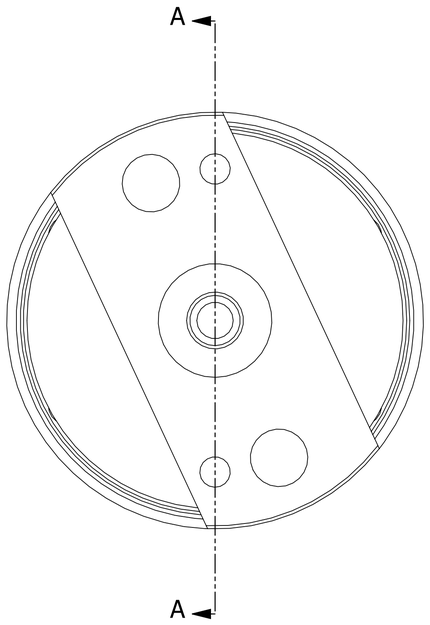
Cement Test Equipment

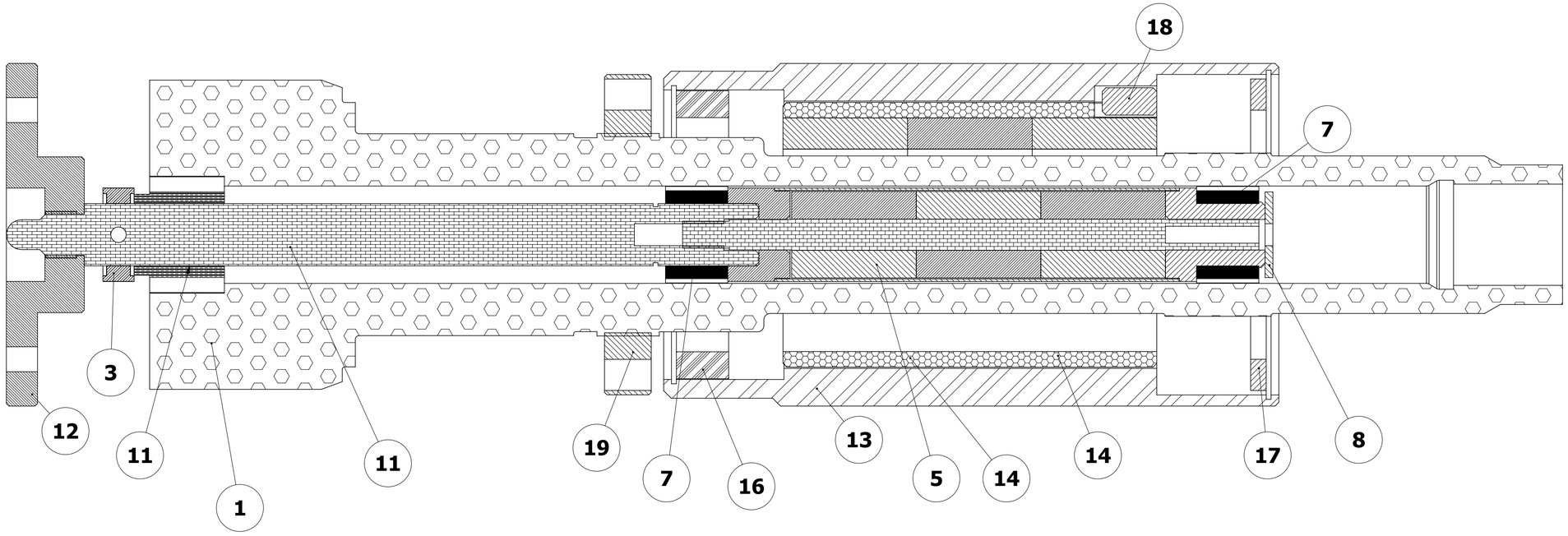
TITLE:

POTENTIOMETER MECHANISM

SIZE	DWG. NO.	REV
B	2-0050	

SCALE:1:2 | WEIGHT: | SHEET 1 OF 1





SECTION A-A

SCALE 2 : 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	3-0062		1
2	3-0072		2
3	3-0071		2
4	3-0074-2		1
5	3-0074-1	Inner Shaft Magnet	12
6	3-0074-3		1
7	3-0073		2
8	3-0074-6		1
9	3-0074-5		1
10	3-0074-4		1
11	3-0075		1
12	3-0034-1		2
13	3-0054		1
14	3-0052		1
15	3-0053		24
16	3-0056-1		1
17	3-0057		1
18	3-0055		1
19	3-0064		1

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: MACH ± 1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	GRH	06-03-2011
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

CEMENT TEST EQUIPMENT, INC

TITLE: MAGNETIC DRIVE ASSEMBLY

SIZE **D** | DWG. NO. 3-0063 | REV

SCALE: 1:2 | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

C-0389; Drain Cylinder Valve Solenoid

C-0024; Air To Cylinder Soleniod

C-0389; Pressure Release Valve Solenoid

C-0653 BULKHEAD CONNECTOR
C-0399 ANTI ROTATION BRACKET

C-0180

C-0635 NIPPLE

C-0138 PRESSURE GAUGE

C-0021 AIR REGULATOR

C-0179

C-0181 ELBOW

C-0647 SST ELBOW

C-0176 Y-CONNECTION

C-0185 TEE

C-0180 ELBOW (2)

1/8", 0.040"ID SST COIL CAPILLARY TUBING

C-0760 AIR OPERATED VALVE; PRESSURE RELEASE

C-0760 AIR OPERATED VALVE; DRAIN CYLINDER

C-0638 REDUCER

C-0051-1 TEE

C-0051-1

OUT

IN

C-0284 SST ELBOW

C-0027 ADAPTER

C-0054-1 SST ELBOW

Air Supply

AIR Exhaust

Water Supply to Cylinder 1/4" TEFLON HOSE

C-0840 ELBOW

C-0050
C-0049

11-0020 PRESSURE VESSEL ASS'Y

COOLING COIL ASSEMBLY
1/4" X 0.020" ID SST TUBING M-0045

SST COVER 11-0029
CLAMP C-0078-1

C-0034

C-0050
C-0049

C-0982 ADAPTER

C-0018

C-0022 PRESSURE TRANSDUCER

02-0071 HIGH PRESSURE FILTER ASSEMBLY

C-0191

C-0146 SAFETY HEAD
C-0285 CONNECTOR
C-0243 RUPTURE DISC (25000 PSI)

C-0018

EXHAUST LINE

C-0185 TEE

C-1351 STREET ELBOW

C-0138 PRESSURE GAUGE

C-1358 PIPE NIP

C-0021 AIR REGULATOR

C-0024 PUMP AIR SOLENOID

AIR INTO RESEVIOR

C-0181 ELBOW

C-0285

C-0050
C-0049

C-0575 PUMP

C-0181 ELBOW

C-0051-1

CHECK VALVE C-0689

C-0921 1/4" ADAPTER

C-0181 ELBOW (2)

EA P
A

C-1304 SOLENOID VALVE

C-0696

C-1358 PIPE NIPPLE

C-0840 ELBOW

3-0046 DIP TUBE

C-0540 PLUG

C-0378 CONNECTOR

C-0840 ELBOW

Water Supply to Cylinder

Water Supply LIne to Reservior

C-0024

C-0179

C-0921

C-0644

WATER DRAIN

WATER INLET

CHECK VALVE C-0689

C-0921

C-0696

03-0013 FILTER HOUSING

C-0644

C-0197 FILTER

INTERNAL COOLING COILS 1/4" M-0045

C-0543 SIGHT GLASS

C-0544 DRAIN VALVE

03-0330 OIL RESERVOIR

Water Drain Line

Water Drain Line

Water Supply to Cylinder

Air Supply

1/4 SST 0.102" ID

1/4 PLASTIC (BLACK)

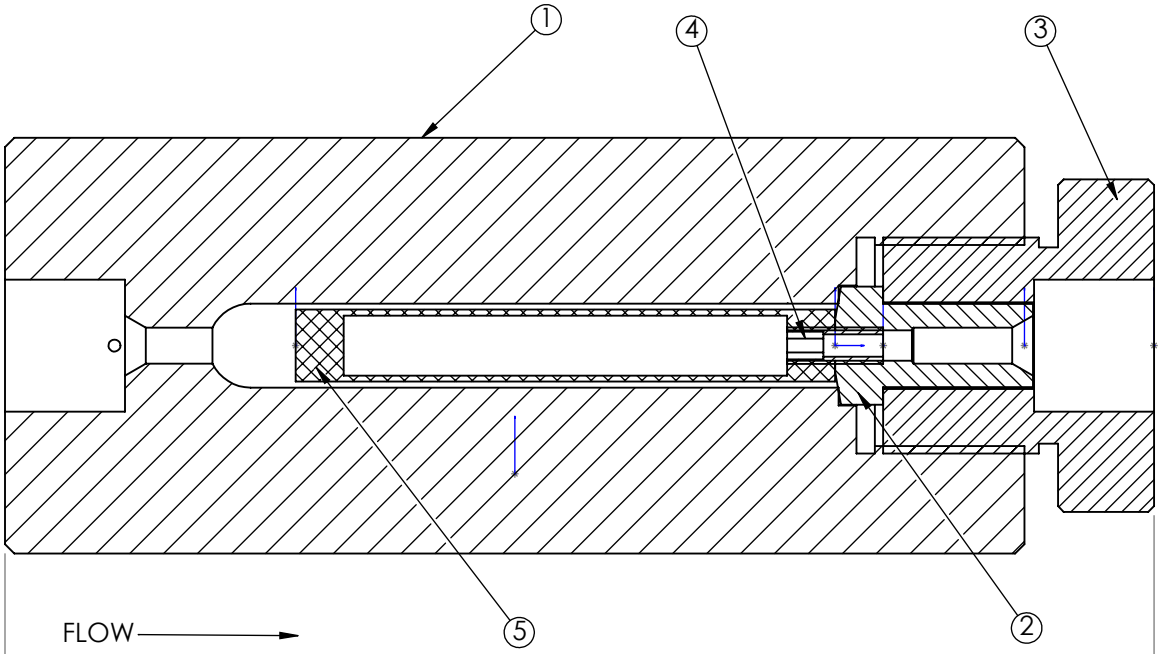
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS ARE: FRACTIONS DECIMALS ANGLES .XX ±.01 .XXX ±.005	QUI DENTIFIED DRAWING, CREATED MANUALLY UPDATE	APPROVALS	DATE
		Drawn GRH	04-23-13
		CHECKED GRH	04-23-13
MATERIAL		ENGINEERING GRH	04-23-13
FINISH		MFG APP GRH	04-23-13
NEXT ASSY / USED ON		QUALITY GRH	04-23-13
APPLICATION	DO NOT SCALE DRAWING		

CEMENT TEST EQUIPMENT, INC.

PIPING SCHEMATIC
M22-400 AUTOMATIC CONSISTOMETER

SIZE D | DWG. NO. 03-0300-PLUMBING AUTO CONNIE | REV.

SCALE | CAD FILE | SHEET 1 OF 1



SECTION A-A
Scale 1 : 1

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	2-0072	FILTER HOUSING
2	1	2-0073	FILTER SEAT
3	1	2-0074	SEAT RETAINER
4	1	2-0075	FILTER NIPPLE
5	1	2-0076	FILTER ELEMENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
+1/32 .XX +-.01 +-1
.XXX +-.005

MATERIAL NOTED

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

APPROVALS	DATE
DRAWN CCD	2-27-97
CHECKED CCD	2-27-97
RESP ENG CCD	2-27-97
MFG ENG CCD	2-27-97
QUAL ENG CCD	2-27-97

CEMENT TEST EQUIPMENT, INC.

FILTER ASSEMBLY

SIZE A | DWG. NO. 2-0071 | REV. A

SCALE 1:1 | CAD FILE: | SHEET 1 OF 1

#6 C-0024 2 WAY ATC AIR TO CYLINDER

#6 C-0389 3 WAY PR PRESSURE RELEASE

#5 C-1304 3 WAY SPOOL NC E AIR SUPPLY / EXHAUST

#4 C-0389 3 WAY PRESSURE CONTROL

#3 C-0389 2 WAY P PUMP

#1 C-0024 2 WAY C COOL CYLINDER/ RESERVOIR

C-0204
INLET POWER
230 VOLTS 30 AMPS
50/60 HZ

X - YELLOW
Y - RED
GREEN 12

12 YELLOW
12 RED

Fuse Block C-0574-1
Fuse, 6A C-0221
Fuse, 6A C-0221

Power Switch C-1337
Load Line
YELLOW
RED
Power Switch LED + -

C-0271
UPS or C-0275
C-0272

RED
YELLOW

Current Monitoring Relay C-0659
A1 11 21 B1 B2 B3 I4 I2 C 24 22 A2
Hyst
I Max
Tv
Ts
Hyst=4%
I Max=2.5 AMP
Tv=30 .
Ts=9
DIP: OFF ON ON OFF

Contactor C-0658
L N A2 A1 2 0 4 6 8

C-1349 RED ONLY
Current Xfmr
BLK
WHT
YELLOW

1 NC
3 C
2 NO
Switch C-0468

TERMINAL BLOCK JUMPERS
18 GAGE YELLOW
C-0472
C-0473
18 GAGE RED

SSR BLOCK C-1260

#4 YELLOW 9 8 8+ 9-
#3 ORANGE P 7 6 6+ 7-
#1 BROWN C 3 2 2+ 3-
C-1261

Power Outlet C-0685

CONTROL BOX
V5
04-0071-C

C-0080
C-1261
C-1261

#7 PURPLE 2 1 3+ 4-
#6 BLUE ATC 7 6 6+ PR 7-
#5 GREEN E 5 4 4+ 5-

SSR BLOCK C-1260

RED 12
YELLOW 12

SSR C-0080
SSR C-0080

WHT/BLK
WHT/RED

#10
#11

03-0023 HEATER

All Heater AC wiring is 12 gauge

All other AC wiring is 18 gauge

1 - White/Red +5
2 - White/Blue -5
3 - White/Orange +12
4 - White/Purple -12
5 - White/Black GND

C-0481 POWER SUPPLY
L3 L2 L1
+5-5
-5-2
+12-3
-12-1
COM-4
white/orange
white/black

C-0763

USB C-1334

INSTRUMENT BACK PANEL

12V for C-0096
24V for C-0022

A-GREEN
B-WHITE
C-BLACK
D-BROWN
A B C D
C-0022 TRANSDUCER

R100K C-0451

D7 41 D6 42 D5 43 D4 44 D3 45 D2 46 D1 47 D0 48
MEASUREMENT COMPUTING C-1181
ALL DIO GROUNDS TO 49
35 34 V1
37 V0 GREEN
38 WHITE
USB C-1189
TOH 3
TOL 4
T2L T2H

CYLINDER
2-BLACK
FRONT
3-YELLOW
1-BLUE
C-0222

YELLOW
BLACK
TO COM
TO +5V
C-1165 AC

C-0565
L1 L2
W/R
P3 P2 P1
W/O WP
SPEED POT
BRACKET = 02-0102

BLUE A+
BROWN A-
C-0377 MOTOR

RED -
WHITE +
C-0167 FRONT PANEL THERMOCOUPLE CONNECTOR

C-0022 Transducer for 22K & 40K units
C-0096 Transducer for 20K units

CURRENT SENSOR DIAGNOSTICS
RED LED ON: OVERCURRENT
RED LED FLASHES: UNDERCURRENT
YELLOW LED LONG FLASHES: OUTPUT RELAY LATCHED
YELLOW LED SHORT FLASHES: OUTPUT RELAY OFF
GREEN LED ON: CONTROL VOLTAGE APPLIED
GREEN LED SHORT FLASHES: START UP DELAY
GREEN LED LONG FLASHES: TRIP DELAY

REV A 12.13.10 JPB
REV B 04.22.13 GRH
REV C 07.29.13 CAW

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

APPROVALS		DATE
DRAWN	GRH	05-26-09
CHECKED	GRH	05-26-09
RESP ENG	GRH	05-26-09
MFG ENG	GRH	05-26-09
QUAL ENG	GRH	05-26-09

CEMENT TEST EQUIPMENT, INC.
WIRING SCHEMATIC
CONSISTOMETER V5
FULLY AUTOMATIC
SIZE D DWG. NO. 03-0300-2 ELECTRIC REV. C
SCALE CAD FILE: SHEET 1 OF 1

OUTPUTS

0-HEATER
1-COOL CYLINDER
2-COOL RESEVOIR
3-PUMP
4-PRESS. CONTROL
5-OIL FILL/EXHAUST
6-AIR 2 CYLINDER/PRESS DUMP
7-MOTOR

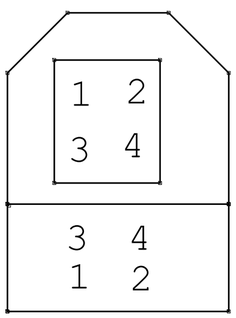
INPUTS

TOH - T/C
TOL
V0 TRANSDUCER
V1 CONSISTENCY
V2 MOTORSPEED

PIN OUTS C-1183

1-WHITE/RED
2-WHITE/BLUE
3-WHITE/ORANGE
4-WHITE/VIOLET
5-WHITE/BLACK

PIN OUTS C-1190



1-WHITE
2-RED
3-GREEN
4-BLACK

MEASUREMENT COMPUTING BOX

OUTPUTS

DIO 0 +48 WHT/RED
DIO 0 -49 WHT/BLK
DIO 1 +47 BROWN
DIO 1 -49 BLACK
DIO 2 +46 RED
DIO 2 -39 BLACK
DIO 3 +45 ORANGE
DIO 3 -39 BLACK
DIO 4 +44 YELLOW
DIO 4 -33 BLACK
DIO 5 +43 GREEN
DIO 5 -33 BLACK
DIO 6 +42 BLUE
DIO 6 -30 BLACK
DIO 7 +41 PURPLE URPLE
DIO 7 -30 BLACK

INPUTS

To H +4 WHITE **CYLINDER T/C J TYPE**
To L -3 RED

Vo H +38 GREEN **PRESSURE**
Vo L -37 WHITE

V1 H +35 YELLOW **CONSISTENCY**
V1 L -34 BLACK

REVISION	DESCRIPTION		
		NEXT ASSY	USED ON
		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± 1/32 .XX ± .01 ± 1°
.XXX ± .005
MATERIAL
FINISH
DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

APPROVALS		DATE
DRAWN	GRH	05-26-09
CHECKED	GRH	05-26-09
RESP ENG	GRH	05-26-09
MFG ENG	GRH	05-26-09
QUAL ENG	GRH	05-26-09

CEMENT TEST EQUIPMENT, INC.

WIRING SCHEMATIC
CONSISTOMETER v5

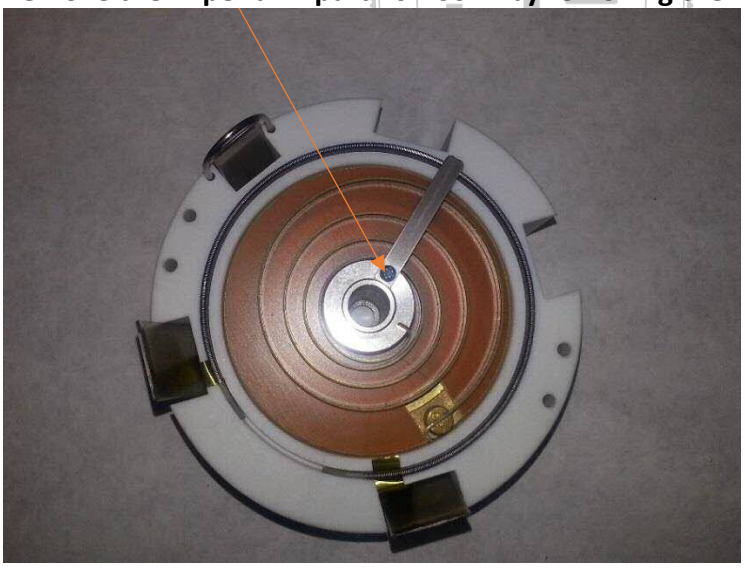
SIZE D | DWG. NO. 03-0300-Ev5 | REV.
SCALE | CAD FILE: | SHEET 2 OF 2

Potentiometer Disassembly and Reassembly Instruction Manual

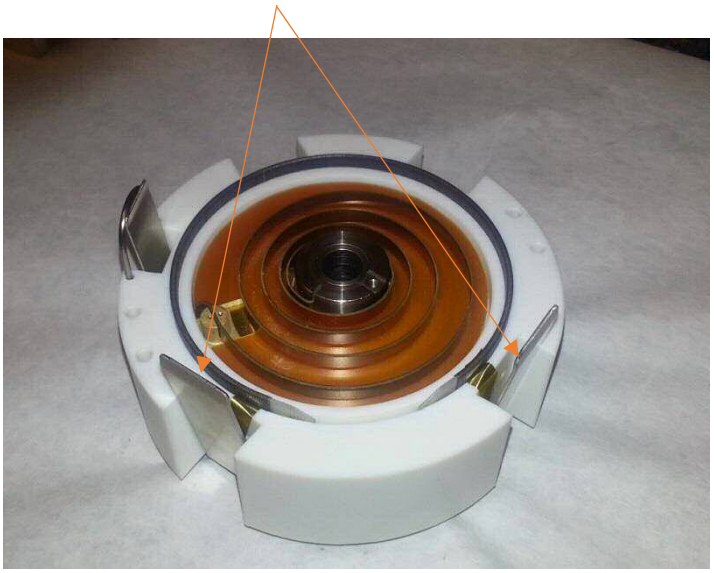
Part 1: Disassembly

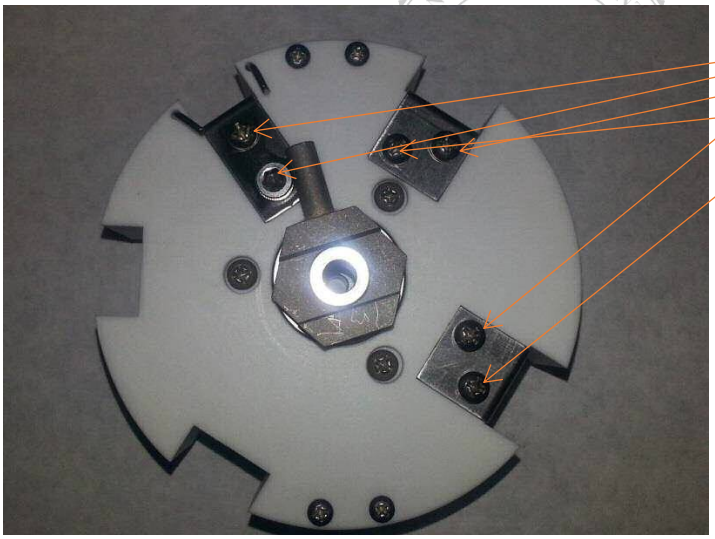
1) **Remove the shaft bearing retainer part# 02-0064 by removing the four 4-40 x 1.5” SST bolts. The shaft bearing C-0086 is kept in place with a #6 X .25” flat head screw.**

2) **Remove the wiper arm part# 02-0077 by removing the 4-40 x .25” screw.**



3) Remove contact pin springs and ground spring.

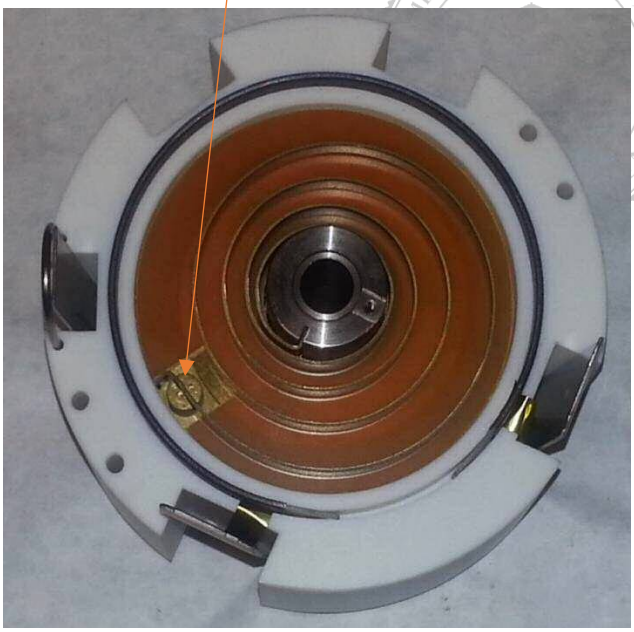




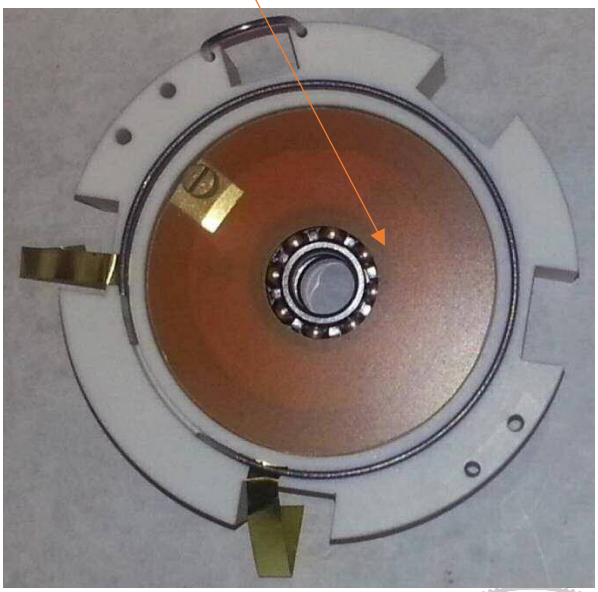
REMOVE THE 5 #6 x .5" SST SHEET METAL SCREWS AND 10-32 x 0.5" CAP SCREW

4) **Remove the stop arm/drive bar attachment part# 02-0058 by removing the #8 - .25" set screws.**

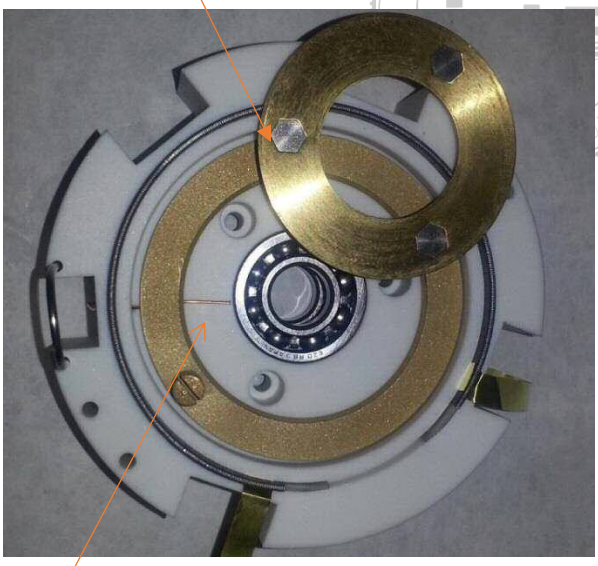
5) **Remove the calibration spring carefully using pliers to pull it from the spring adjuster part# 02-0053.**



6) **Remove the insulator disk part# 02-0055.**



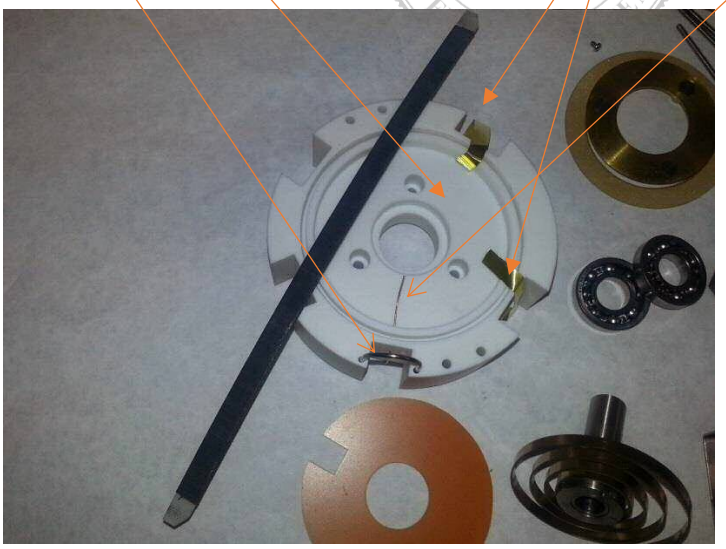
7) **Remove spring adjuster clamp part# 02-0054 and spring adjuster part# 02-0053. To do this, remove the three 6-32 x .75" SST screws from the bottom of the potmech.**



Notice the position of the ground wire. It is held in place by the spring adjuster and spring adjuster clamp. The ground wire is fed through a small hole in the wall.

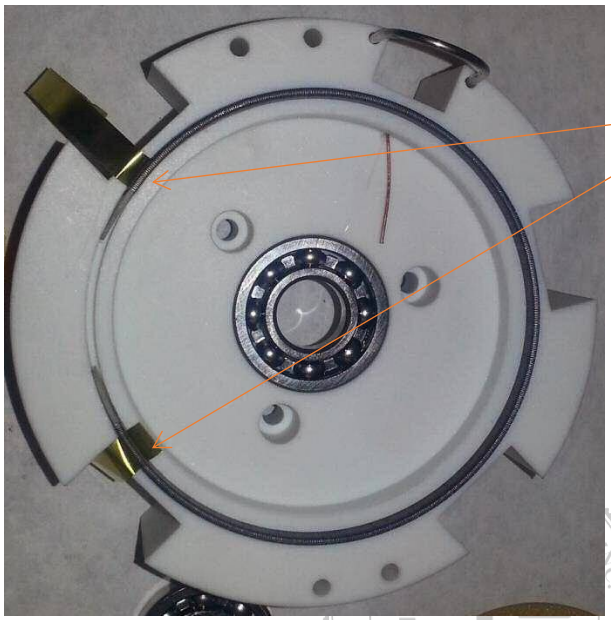
8) **Remove the top and bottom bearings part# C-0085.**

9) **Remove resistor 02-0061, brass strips 02-0051, ground wire 02-0066, mounting frame stop 02-0063 .**

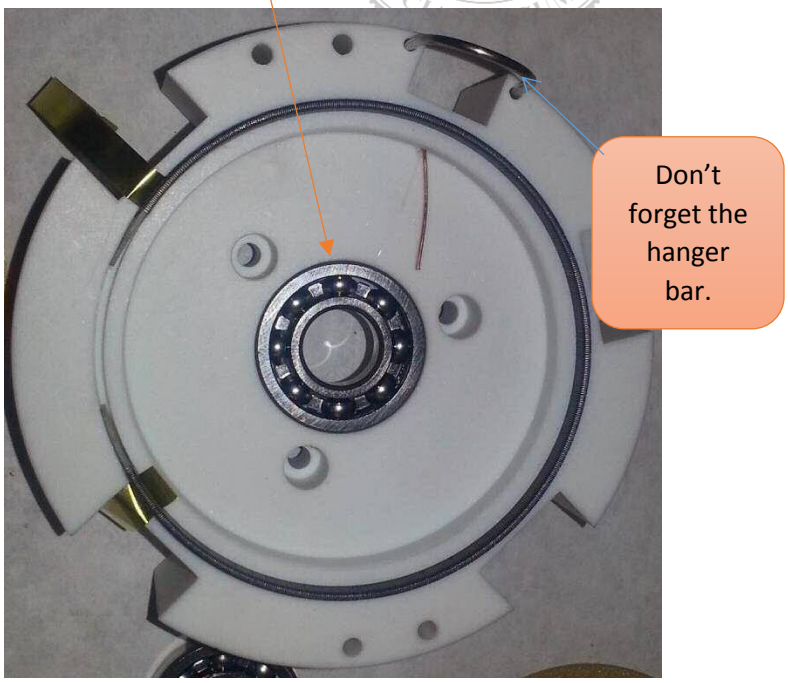


Part 2: Reassembly

1) **Place just enough of the Brass Strips over the grove and make sure that the strips are placed at the end of the resistor when pushing the resistor into the grove.**

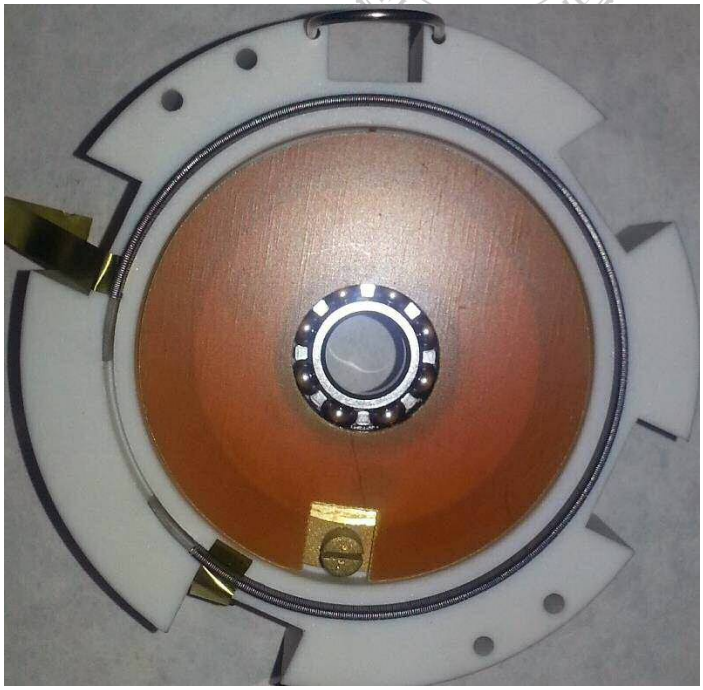


2) **Place the Top Bearing back into its indention.**



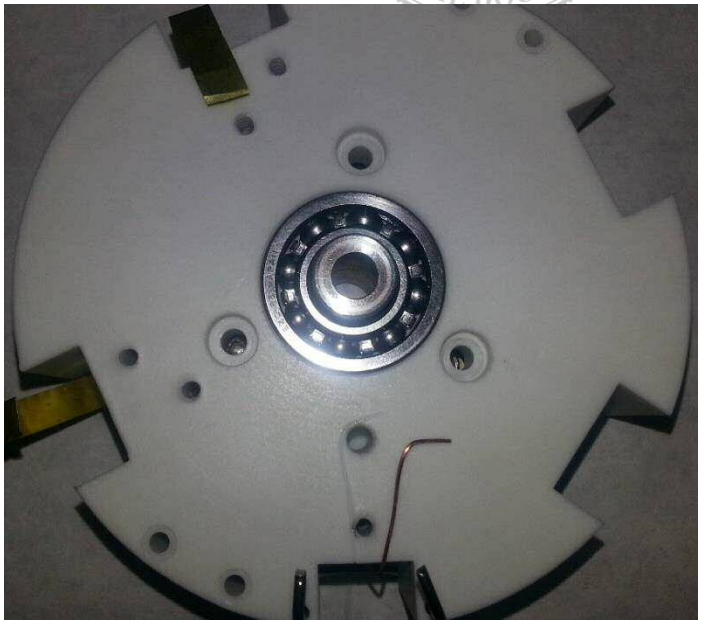
3) **Place the spring adjuster and spring adjuster clamp back into the potmech.**

4) **Place the insulating disk on top of the clamp and adjuster just screwed into place.**

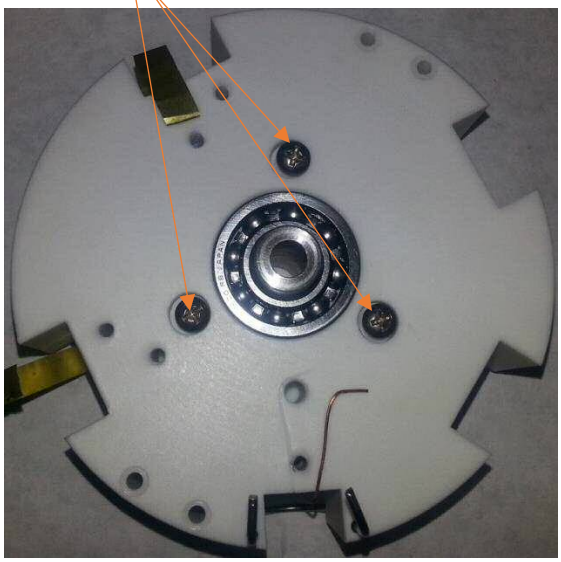


5) **Place the spring and spring sleeve assembly into center of disk.**

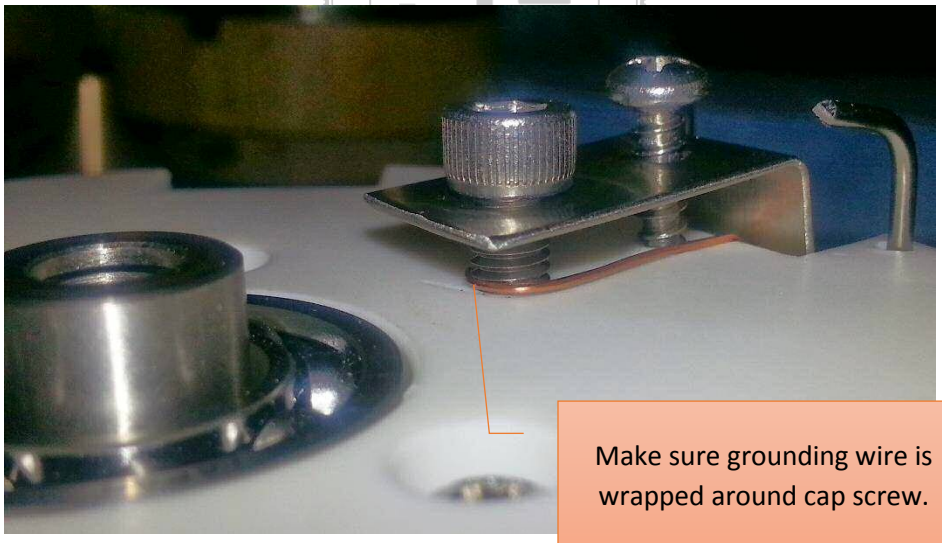
6) **Place the bottom bearing into its indention.**



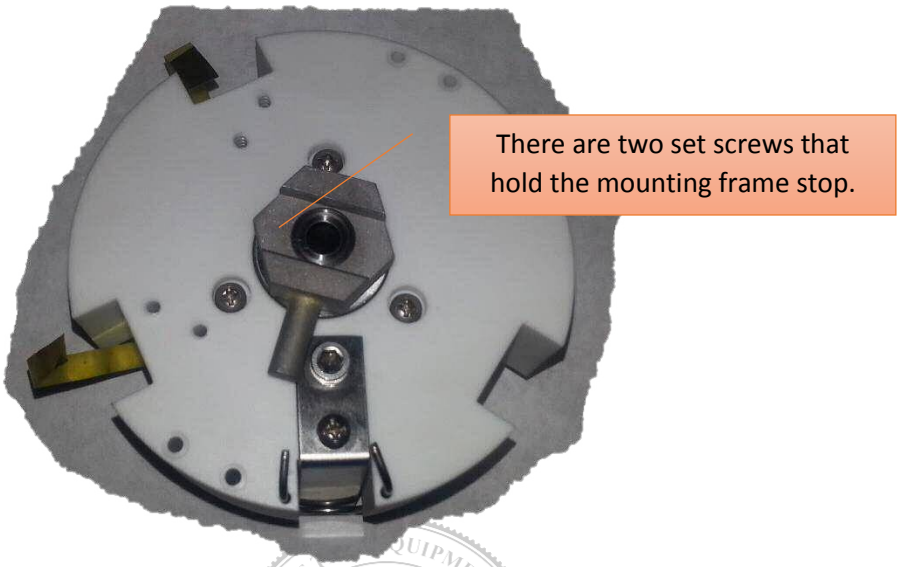
7) **Add 6-32 x .75" screws to hold the spring adjuster and spring adjuster clamp.**



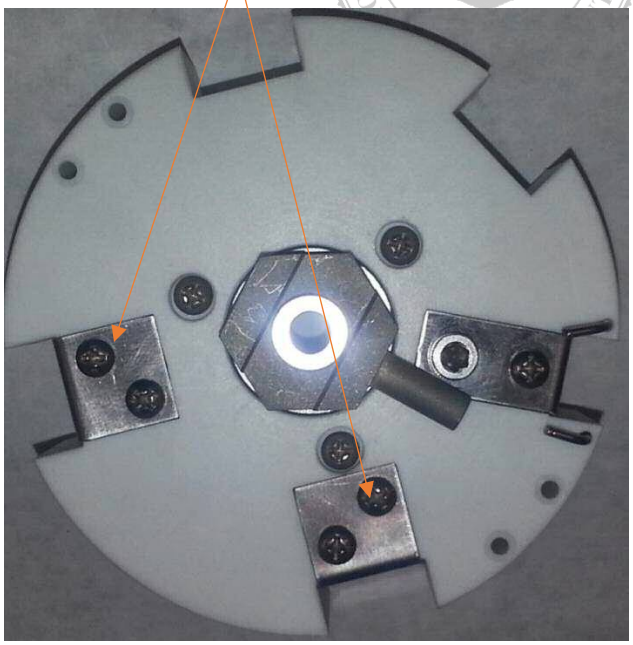
8) **Screw Grounding Spring back into place part# 02-0059-2.**



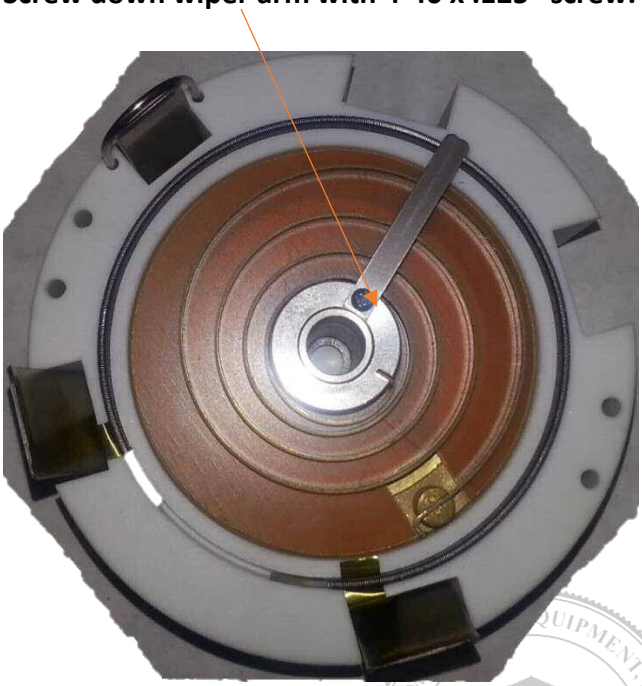
9) **Screw down the mounting frame stop. This keeps the spring assembly from falling out when the potmech is turned upside down.**



10) **Screw contact springs onto potmech.**



11) Screw down wiper arm with 4-40 x .125” screw.



12) Screw down shaft bearing retainer.

13) Loosen and then tighten the three spring adjuster screws to adjust wiper arm position as shown in the following picture.

To adjust the wiper arm and spring assembly, loosen the three screws holding the spring adjuster clamp in place and rotate the spring and shaft assembly to this position.

14) Adjust the stop arm and tighten the two 8-32 x .5" set screws. Position stop arm again caps screw as shown.

6-32x.75" bolts

4-40x1.5" screws

15) **Using a multimeter check the potentiometer's overall resistance (ohms) and make sure the slider/wiper arm makes good contact with the resistor along the entire length. There should not be any dead spots.**