PROBE MATERIAL ANALYZER

MODEL PMA-2000

OPERATING INSTRUCTIONS

CHEMINSTRUMENTS

510 COMMERCIAL DRIVE

FAIRFIELD, OHIO 45014

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PRODUCT DESCRIPTION

Congratulations on the purchase of your new ChemInstruments Probe Material Analyzer. This versatile, user-friendly, carefully designed instrument allows you to characterize various materials including viscoelastic polymers, adhesives and compounds through the insertion, dwell, and retraction of custom probe sensors.

WARNING: This equipment can cause injury if not used properly. It is the operator's responsibility to observe all safety rules and warnings.

The unit has the following features:

- Over 9 inches of available probe travel distance.
- User selectable data acquisition area.
- Control speed, dwell and distance parameters.
- Measures in tensile and compression simultaneously.
- Separate speed control for all three test parameters (insertion, dwell & retraction).
- Determine insertion test parameter by force or distance.
- Current test status and data collection constantly displayed.
- Automatic overload protection.
- Preset jog speed of 15 inches per minute.
- Selectable units of measure: Kilograms, Grams, Newtons, Pounds, and Ounces.
- Works with the EZ-Data System software.

SPECIFICATIONS

Electrical	120/240 VAC, 50/60 Hz, 2 amps
Operating Temperature	32 – 150 degrees Fahrenheit (0 – 70 degrees Celsius)
Humidity	0 – 55% relative humidity
Speed	0.02 – 90 inches/minute (0.01 IPM increments) 0.05 - 225 centimeters/minute (0.05 CPM increments)
Start Force	5 – 50 grams (1 gram increments)
Test Force (2 lb load cell)	5 – 900 grams (1 gram increments)
Test Force (5 lb load cell)	5 – 2000 grams (1 gram increments)
Test Force (10 lb load cell)	5 – 4000 grams (1 gram increments)
Test Force (25 lb load cell)	5 – 5000 grams (1 gram increments)
Insertion Distance	0.025 – 4 inches (0.025 inches increments) 0.05 – 10 centimeters (0.05 centimeters increments)
Dwell Time	0 – 60 seconds (1 second increments)
Retraction Distance	0.025 – 4 inches (0.025 inches increments) 0.05 – 10 centimeters (0.05 centimeters increments)
Physical Dimensions	Width: 13 inches (33 centimeters) Depth: 16 inches (41 centimeters) Height: 23 inches (58 centimeters) Weight: 30 pounds (14 kilograms)

UNPACKING

ChemInstruments has made every effort to ensure that the PMA-2000 arrives at your location without damage. Carefully unpack the instrument and check for any damage that may have occurred during shipment. If any damage did occur during transit, notify the **carrier** immediately.

The ChemInstruments PMA-2000 consists of the following parts:

- The test frame, which includes the motor/drive mechanism and the data acquisition system.
- An envelope with this manual.
- Power cord.

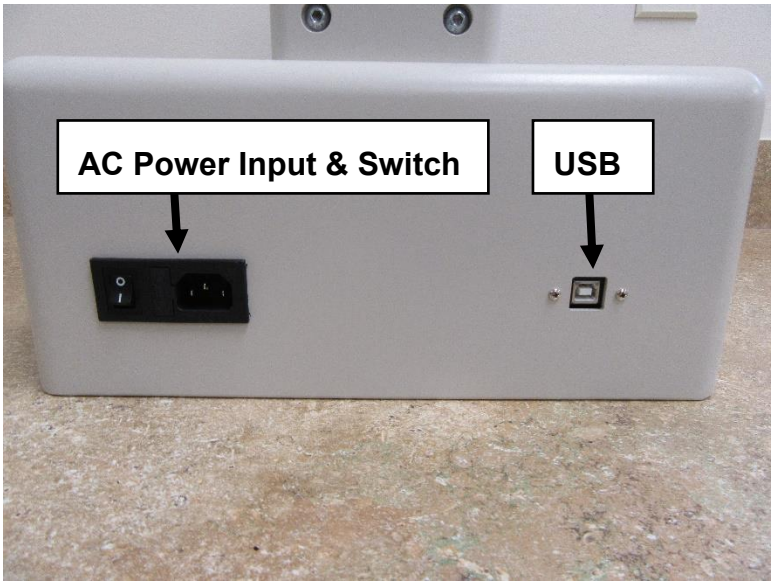
Make sure all of these components are present before discarding packaging material.

ASSEMBLY

Carefully remove the test frame/data acquisition assembly from the packaging and set it on a sturdy bench top. Check the physical dimensions listed previously for the space required for the instrument. As with any precision piece of laboratory equipment, it is preferable to locate the PMA-2000 in an area where temperature and humidity are controlled to standard conditions of 72 ± 2 degrees Fahrenheit and 50 ± 5% relative humidity.

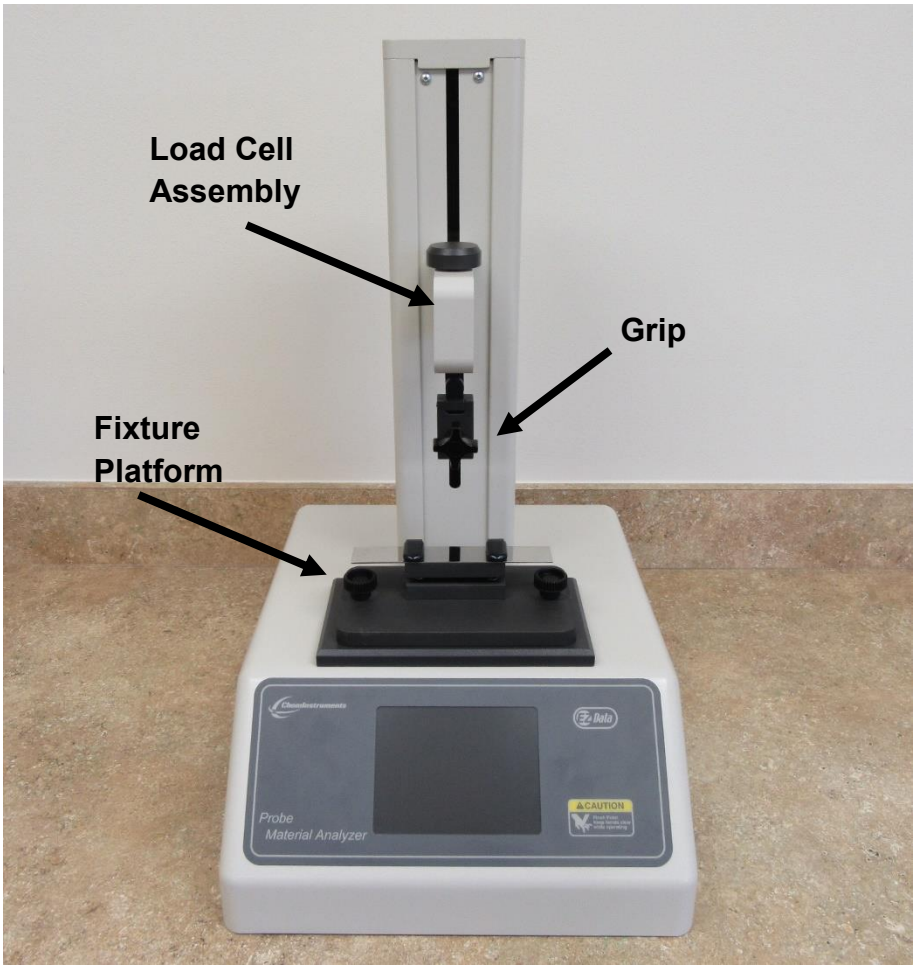
WARNING: Damage will occur if this unit is plugged into the incorrect power supply. This is a dual voltage machine. Connect either 120 or 240 VAC.

Connect the power cord to its receptacle on the backside of the control cabinet. Complete the connection by inserting the male end of the power cord into an appropriate AC outlet. Notice that the on/off power switch is located directly beside the power cord receptacle on the backside of the test frame.



KEY COMPONENTS

- **POWER SWITCH** is located on the back panel of the control cabinet directly beside the power cord connection.
- **USB CONNECTION** is located on the back of the control cabinet.
- **LOAD CELL ASSEMBLY** consists of the mounting bracket for the load cell and the probe.
- **FIXTURE(S)** used to secure test samples directly below the probe or grip.
- **PROBE/GRIP** various types available to attach to the Load Cell Assembly.



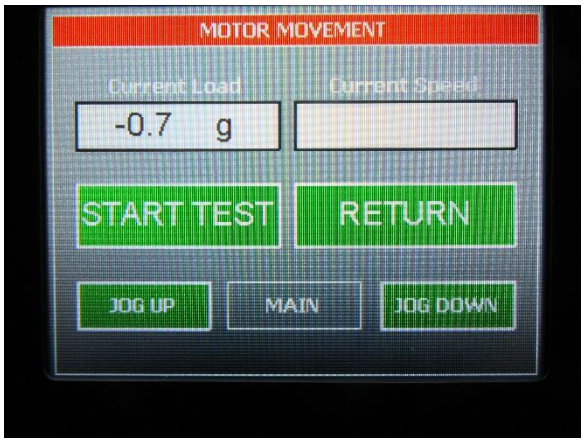
TOUCH SCREEN FORMAT

MAIN SCREEN

- **Current Load** – displays the force currently measured by the load cell.
- **Current Speed** – displays the speed that the motor is currently running.
- **Head Movement** – will open another screen for controlling the movement of the machine.
- **Setup** – will display all setup options.
- **Graph** – will display the graph, minimum, maximum, and average values of the last test.
- **Statistics** – will display the minimum, maximum, average, variance, standard deviation, and work of the last test.

MOTOR MOVEMENT

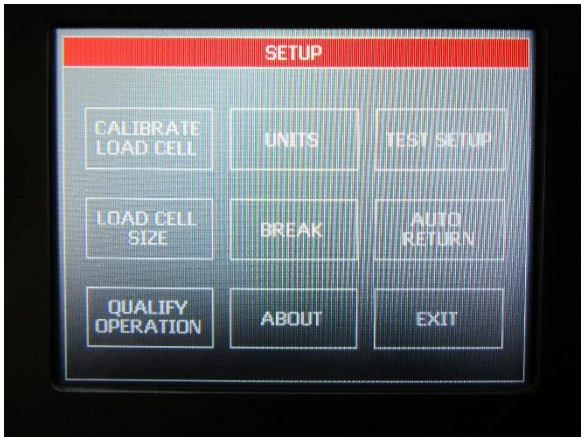
- **Start Test** – will run a test.
- **Return** – will return to the starting location of last test.
- **Jog Up** – will move the head in the upward direction. Press it once to start moving. Press the STOP JOG button to stop motion.
- **Jog Down** – will move the head in the downward direction. Press it once to start moving. Press the STOP JOG button to stop motion.
- **Main –** will return to the main screen.



SETUP SCREEN

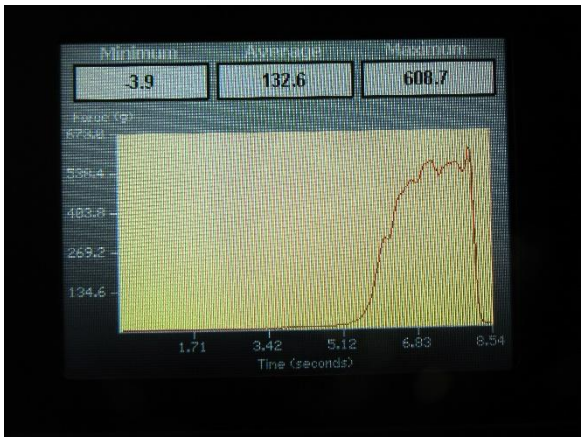
- **Calibrate Load Cell** – allows the user to calibrate the load cell.
- **Units** – change the force units and/or the speed units.
- **Test Setup** – allows the user to set start force, test method and parameters, dwell time, and retraction parameters.
- **Load Cell Size** – sets the size of the load cell – 2, 5, 10, or 25 pounds.
- **Break**– sets the break mode. If break mode is on, then the system will stop a test when a break has been detected.
- **Auto Return**– sets the auto return mode. If auto return mode is on, then the system will automatically return to the test's start point upon completion of a test. If a break is detected during a test, the system will not auto return.
- **Qualify Operation** – is used to verify some of the hardware functions with the PMA-2000.
- **About** – retrieve the machine's software version and control board's hardware revision.
- **Exit** – go back to the main screen.

If there are 30 seconds of no screen activity when in any of the setup screens except the qualify operation screen, then the machine will exit the setup screen and return to the main screen.



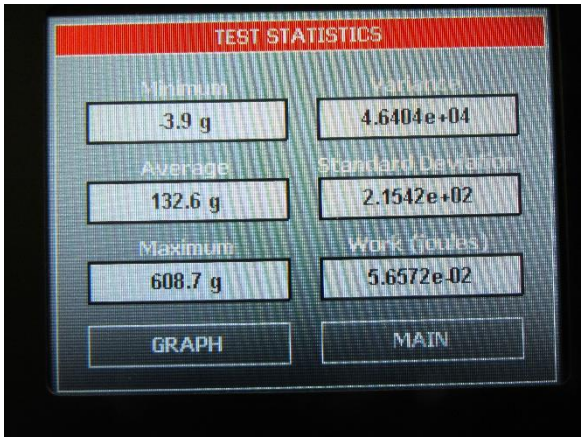
GRAPH SCREEN

The graph screen will display the graph, minimum, maximum, and average values of the last test. Touch anywhere on the screen to exit the graph screen and return to the main screen.



STATISTICS SCREEN

The statistics screen will display the minimum, maximum, average, variance, standard deviation, and work of the last test.



THEORY OF OPERATION

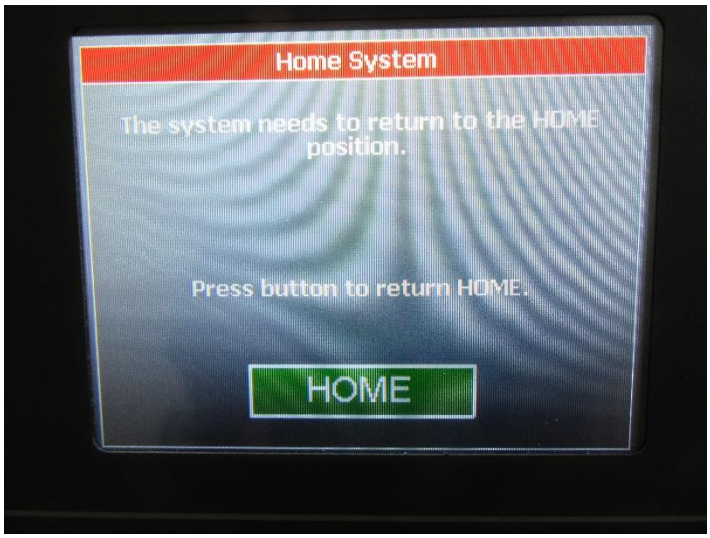
This system can operate using force or distance as the control parameter and measures forces during operation in both tensile and compression. By controlling the speed and distance of the vertical probe, we are able to record the unique signature of the test sample.

POWER UP

Turn on the master power switch located on the back panel of the control cabinet next to the power line receptacle. The power indicator light will be illuminated when power is on.

WARNING: Operating temperature for this equipment is 32 to 150 degrees Fahrenheit (0 to 70 degrees Celsius). The equipment needs to be completely free of condensation, inside and out, before applying power.

If the load cell assembly is not at the home switch on power up, the following message will appear. The system must establish the location of the home switch on power up.



LOAD CELL OVERLOAD PROTECTION

The PMA-2000 has numerous safety features incorporated into its design and operation.

The first feature is a negative overload protection for the load cell. If the load cell senses a negative force of greater than -100 grams, the crosshead will stop and an error message is displayed. This is true if the crosshead is moving in the downward direction during a JOG or RETURN. However, the negative overload force will increase depending on load cell size if the crosshead is moving down during the test force or test insertion part of a test sequence.

The second feature is a positive overload protection for the load cell. If the load cell senses a force 10% greater than its maximum rating, the crosshead will stop and an error message is displayed.

If the either overload occurs during a test, the test will be aborted.

PROBE AND FIXTURES

There are numerous options to select for probes. In general, all probes will screw into the load cell assembly extension. Please take care when attaching probe. Do not put pressure on the extension of the load cell. Load cell damage can be caused by applying excessive force or torque on this apparatus.

LOAD CELL CALIBRATION

It is important to calibrate the load cell to ensure that reliable data will be gathered. A calibration procedure is built into the software of the Probe Material Analyzer. This procedure should be followed upon first use of the PMA-2000 and whenever necessary thereafter. The following is the step-by-step procedure for calibrating the load cell.

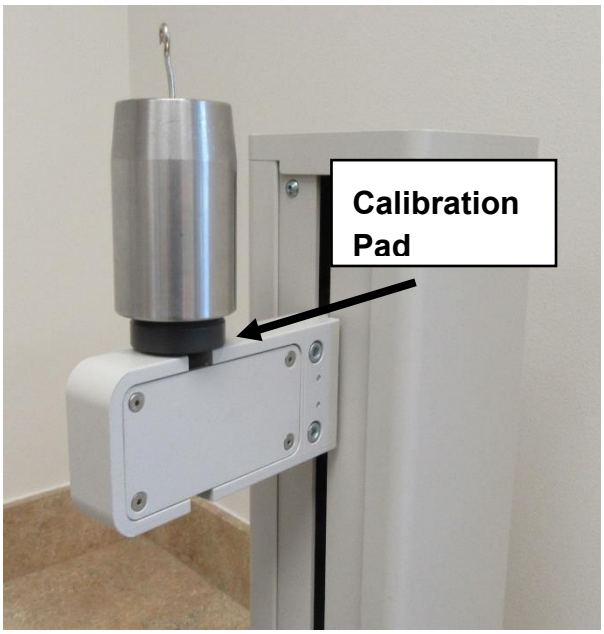
Make sure that the PMA-2000 has been powered on for 30 minutes before proceeding with calibration.

The calibration sequence defaults to grams as the unit of measure. Make sure that your calibration weights and entries are in grams.

LOAD CELL CALIBRATION PROCEDURE

1. Move the load cell assembly with probe attached to the midpoint of the mast.
2. Select SETUP from the main screen.
3. Select CALIBRATE LOAD CELL from the setup screen.
4. The first screen in the calibration process describes the 2 point calibration process. Select OK to continue.
5. The next screen measures the low calibration value (typically 0). Make sure that you do not have a weight setting on the calibration pad and select OK.
6. The next screen measures the high calibration value. This weight should be close to the maximum rated load cell value. Set the weight on the calibration pad.
7. Set the high calibration value by selecting CHANGE and entering the value of the weight in grams and select ENTER. Select OK to continue.
8. The display will show the main screen and the current reading of force will be displayed under CURRENT LOAD.
9. Verify the calibration by setting a different calibration weight on the calibration pad.

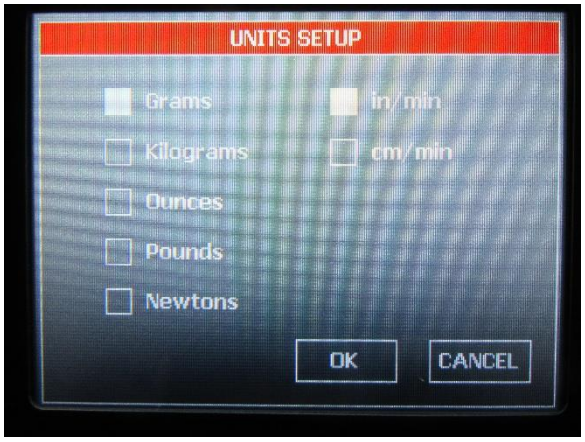
10. Repeat the calibration procedure if necessary.



FORCE AND SPEED UNITS

Force and speed units can be changed with the following procedure.

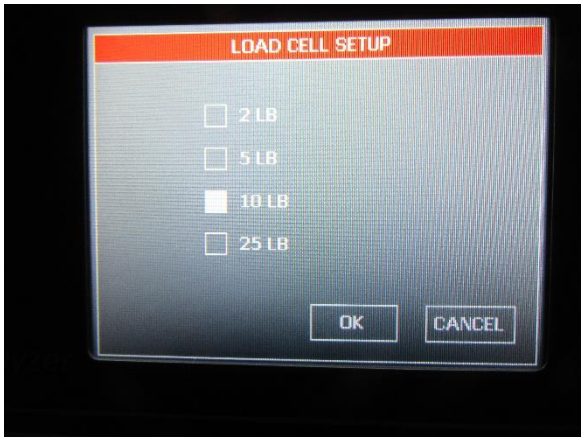
1. Select SETUP from the main screen.
2. Select UNITS from the setup screen.
3. Select the desired units. Select OK to confirm the entered units.



LOAD CELL SIZE

The load cell size will change the range of test force values that can be selected.

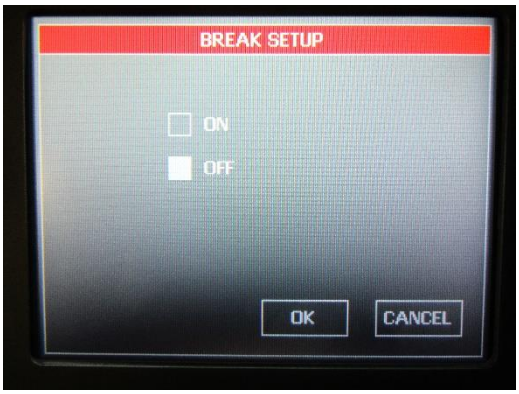
1. Select SETUP from the main screen.
2. Select LOAD CELL SIZE from the setup screen.
3. Select the installed load cell size. Select OK to confirm.



BREAK

Setting break on will terminate a test once the load cell reading drops to 0 grams.

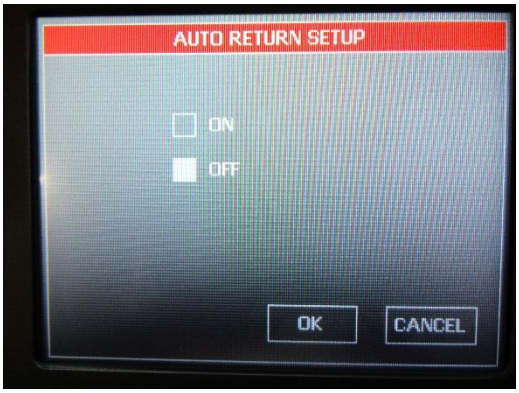
1. Select SETUP from the main screen.
2. Select BREAK from the setup screen.
3. Select the desired break setting. Select OK to confirm.



AUTO RETURN

Setting auto return on will automatically send the upper grip back to the test's starting position after a test is complete.

1. Select SETUP from the main screen.
2. Select AUTO RETURN from the setup screen.
3. Select the desired auto return setting. Select OK to confirm.



TEST SETUP

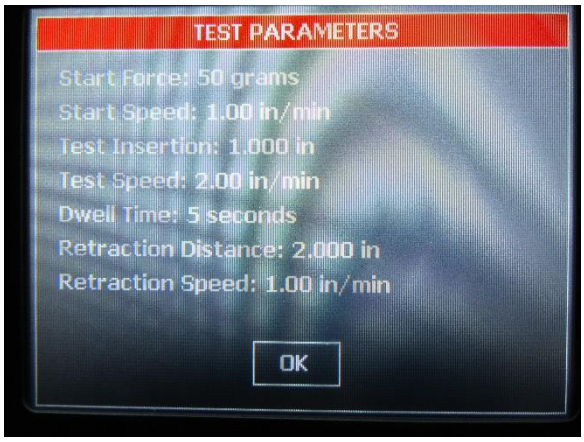
The test parameters control the operation of the test. The machine will operate in either force or distance mode.

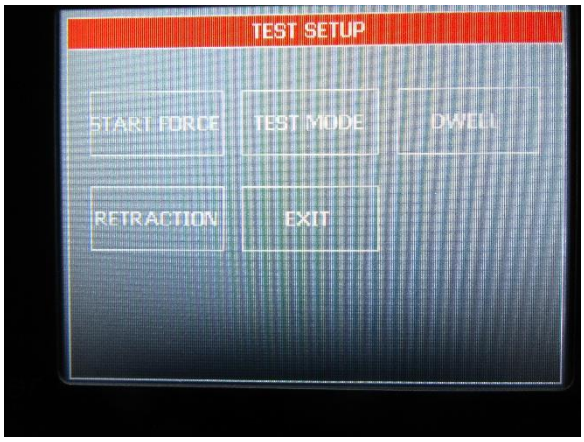
In force mode, the probe is inserted into the test substrate until a test force is measured. The probe is then retracted from the substrate.

In distance mode, the probe is inserted into the test substrate until a distance has been reached. The probe is then retracted from the substrate.

The parameters include start force, test force or insertion distance, dwell time, and retraction distance.

1. Select SETUP from the main screen.
2. Select TEST SETUP from the setup screen.
3. A summary of the test parameters will be displayed. Select OK to continue.

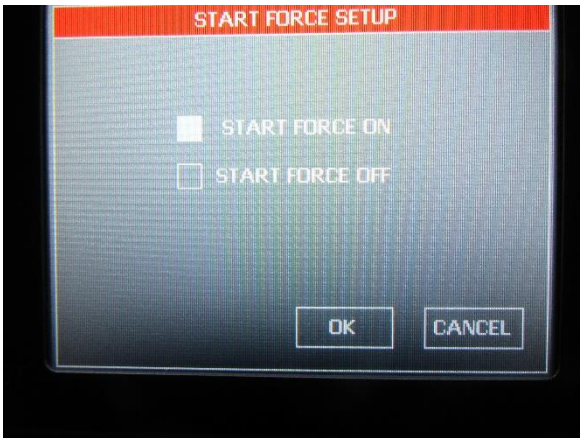


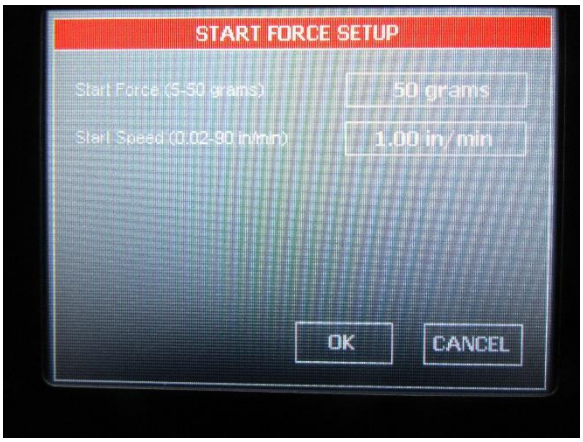


START FORCE

Start force mode can be turned ON or OFF. If ON, a test will start by moving at the START SPEED until the START FORCE is measured by the load cell. None of this data will be saved with the test.

1. Select SETUP from the main screen.
2. Select TEST SETUP from the setup screen.
3. A summary of the test parameters will be displayed. Select OK to continue.
4. Select START FORCE. At this point, start force mode can be ON or OFF. Select OK to continue.
5. If START FORCE is ON, then the START FORCE SETUP will allow you to set the start force and start speed.

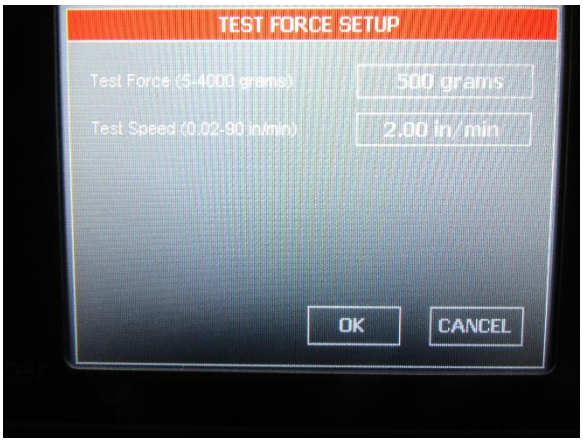


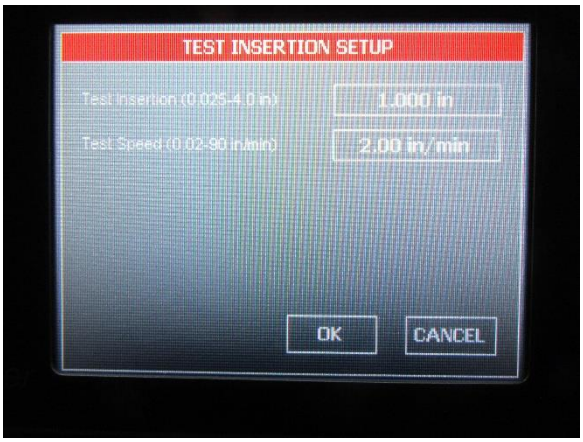


TEST MODE

Test mode can be either force or insertion. In force mode, the probe is inserted into the test substrate until a test force is measured. In distance mode, the probe is inserted into the test substrate until a distance has been reached. Test data is stored during this part of the test.

1. Select SETUP from the main screen.
2. Select TEST SETUP from the setup screen.
3. A summary of the test parameters will be displayed. Select OK to continue.
4. Select TEST MODE. At this point, test mode can be FORCE or INSERTION. Select OK to continue.
5. If TEST MODE is FORCE, then the TEST FORCE SETUP will allow you to set the test force and test speed. If TEST MODE is INSERTION, then the TEST INSERTION SETUP will allow you to set the test insertion distance and test speed.





DWELL

The dwell time is the amount of time that the material will stay in contact with the probe before it is pulled away. Test data is stored during this part of the test.

1. Select SETUP from the main screen.
2. Select TEST SETUP from the setup screen.
3. A summary of the test parameters will be displayed. Select OK to continue.
4. Select DWELL.
5. Select CHANGE and using the arrow buttons, enter the desired dwell time and select OK. Select OK again to confirm the entered dwell time.

RETRACTION

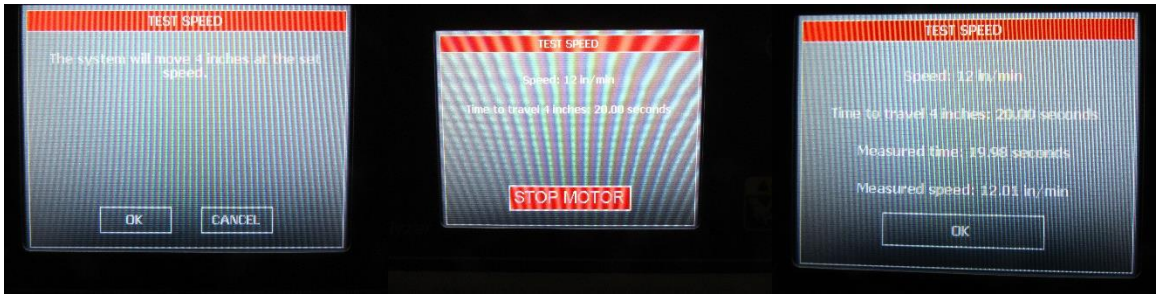
Retraction is the last part of the test. The speed and distance can be set. Test data is stored during this part of the test.

1. Select SETUP from the main screen.
2. Select SETUP from the main screen.
3. Select TEST SETUP from the setup screen.
4. A summary of the test parameters will be displayed. Select OK to continue.
5. Select RETRACTION.
6. Set the required retraction distance and speed. Select OK to confirm.

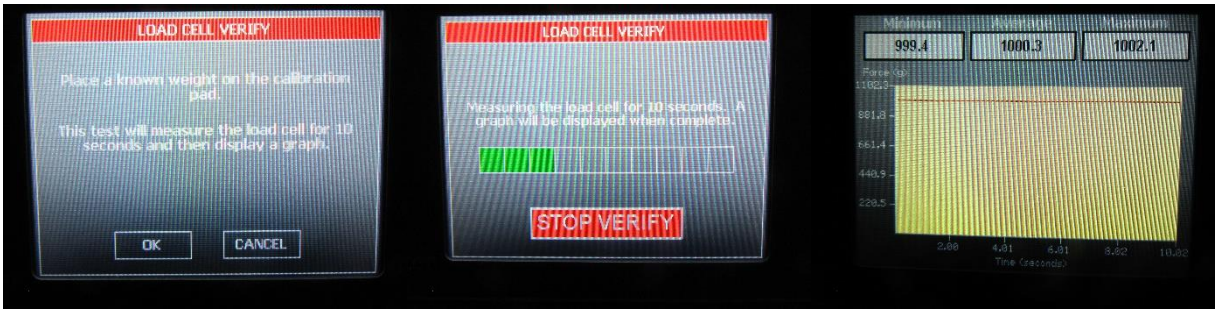
QUALIFY OPERATION

Some of the hardware functions of the PMA-2000 can be verified with the qualify operation screen.

- **Current Load** – displays the force currently measured by the load cell. It will be displayed in the selected units.
- **Current Speed** – displays the set speed of the test platform.
- **AD Reading** – displays the hardware counts measured on the control board from the load cell interface. Pulling on the load cell grip will display values greater than 32000. Pushing on the load cell grip will display values less than 32000.
- **Test Speed** – is a method of verifying the speed of the test platform. The test platform will move 4 inches at the set speed and measure the amount of time that it takes to travel 4 inches.



- **Verify Load Cell** – will sample the load cell data for 10 seconds. A test can be simulated with a weight sitting on the calibration pad to verify the load cell calibration if necessary. The test platform will not move, the system will simply measure the load cell and display a graph along with the statistics when the 10 seconds is complete.


LOAD CELL VERIFY
Place a known weight on the calibration pad.
This test will measure the load cell for 10 seconds and then display a graph.
OK
CANCEL
LOAD CELL VERIFY
Measuring the load cell for 10 seconds. A graph will be displayed when complete.
STOP VERIFY
999.4
1000.3
1002.1

RUNNING A TEST

Test data is collected at a rate of 400 Hz. Eight samples are measured every 2.5 milliseconds and averaged as a single data point every 20 milliseconds.

A maximum of 26,000 data points can be saved with any given test.

NOTE: Make sure the load cell has been calibrated before conducting a test.

TEST OPERATION

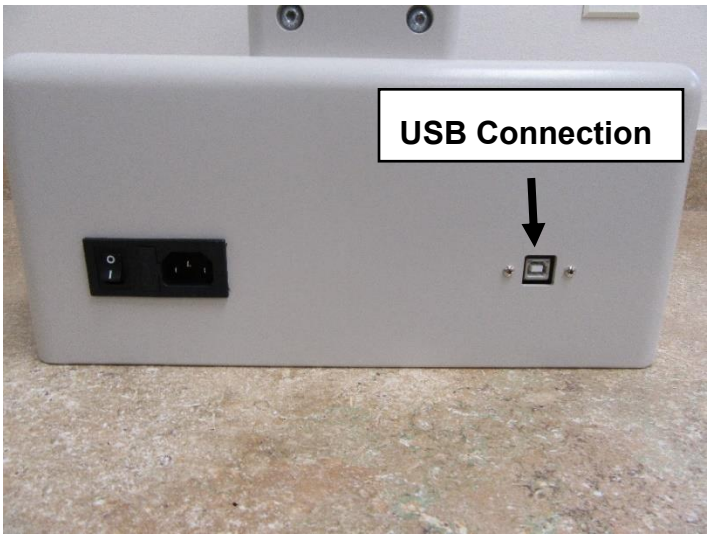
The following is a summary of the test operation sequence.

1. START TEST is pressed from the HEAD MOVEMENT SCREEN.
2. If looking for a “Start Force”, the system will move down at the “Start Force Speed” until the “Start Force” is measured.
3. The system will continue moving down, looking for either the “Test Force” or “Insertion Distance” and moving at the “Test Speed”.
4. The system will stop the motor and dwell for the “Dwell Time”.
5. When the “Dwell Time” is complete, the motor will reverse direction and move up the distance specified by “Retraction Distance”. The motor will move at the “Retraction Speed” during this movement.
6. Test data is collected during all three periods of the test.

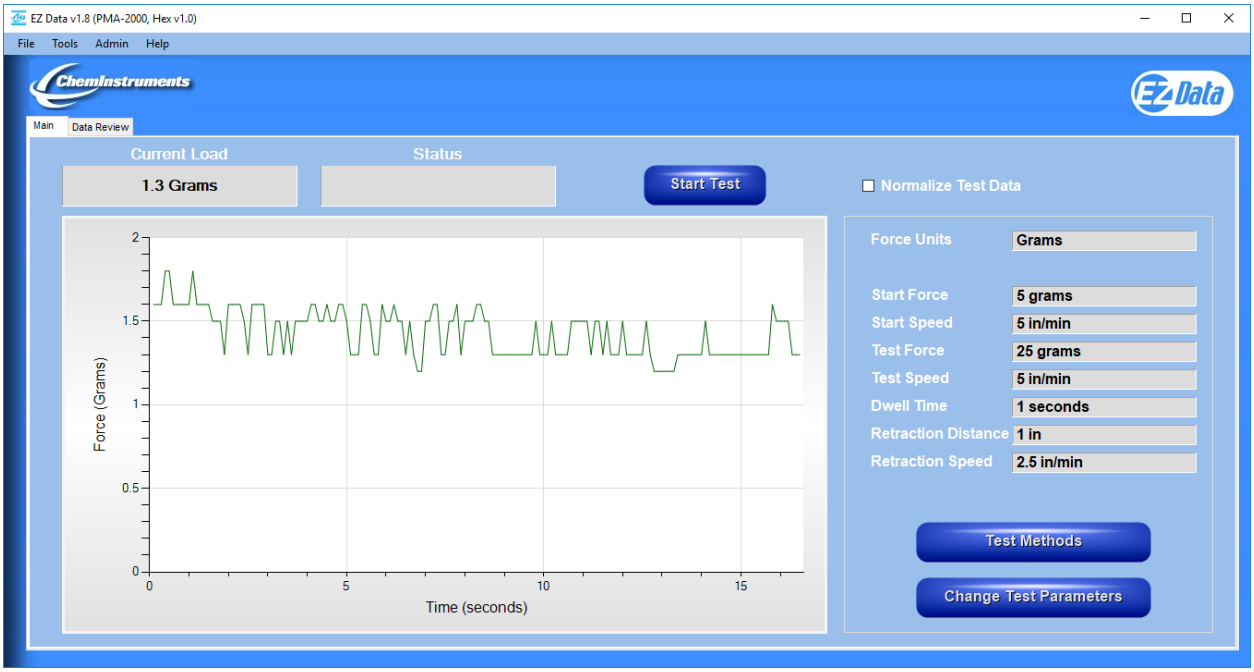
EZ DATA SOFTWARE SYSTEM

EZ Data is a ChemInstruments program that runs on your computer and will allow you to interface to your ChemInstruments machine in order to save test data files, save raw test data to excel, graph and crop test data, tabulate test data files, and overlay test data files. Please refer to the EZ Data manual for specific information on how to use the EZ Data software system.

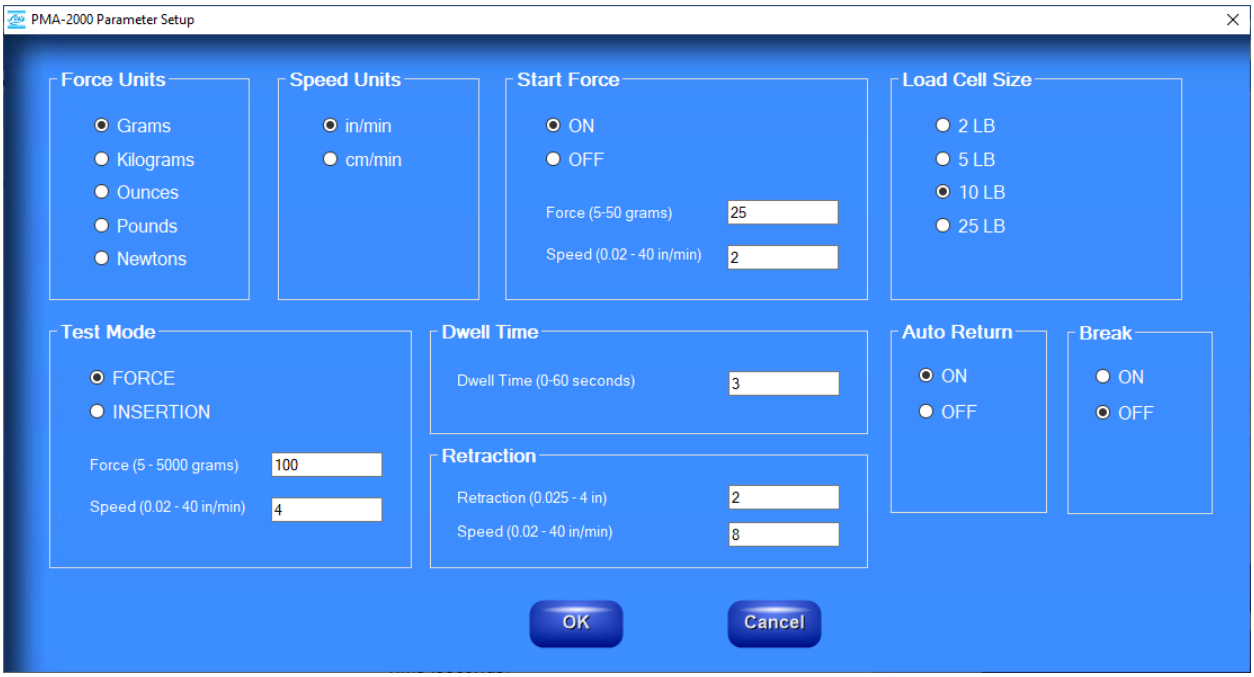
The PMA-2000 can be connected to your computer with a Type A-B, Revision 2.0 Compliant, USB cable.



The following picture is the main screen of EZ Data with a PMA-2000 connected. This screen will show the current load as a value and a real time graph as data is collected from the load cell. It shows the test setup parameters. It will also allow you to change the test parameters.



The following picture shows the PMA-2000 parameter setup.



MAINTENANCE

TROUBLESHOOTING

The troubleshooting chart describes some problems that may occur over time. After determining the problem, follow one of the following maintenance procedures.

Table 1 – Troubleshooting Chart

Problem	Possible Cause	Procedure
No data collected	Not in Run Menu	Refer to running a test
Load Cell Assembly does not move during a test	Motor is not allowing the assembly to move	Replace motor
Data measurement consistently low/high	Improper calibration	Check calibration
	Bad calibration	Refer to load cell calibration
Calibration drifts	Bad or damaged load cell	Replace load cell

MAINTENANCE PROCEDURES

As with any precision equipment it is important to provide care and maintenance to ensure proper performance and long life. General cleaning and care will ensure accurate test and trouble free performance.

CLEANING THE TOUCH SCREEN

It’s important to realize the touch panel is sensitive to chemicals.

Specific Cleaning Information: Use a soft, lint-free cloth. The 3M Microfiber Lens Cleaning Cloth is especially recommended for cleaning touch panels without requiring liquid cleaner. The cloth may be used dry or lightly dampened with a mild cleaner or Ethanol. Be sure the cloth is only lightly dampened, not wet. Never apply cleaner directly to the touch panel surface; if cleaner is spilled onto touch panel, soak it up immediately with absorbent cloth. Cleaner must be neither acid nor alkali (neutral pH). When using cleaner, avoid contact with the edges of the film or glass, and with the flex tail. Wipe the surface gently; if there is a directional surface texture, wipe in the same direction as the texture. Never use acidic or alkaline cleaners, or organic chemicals such as: paint thinner, acetone, tolulene, xylene, propyl or isopropyl alcohol, or kerosene. Suitable cleaning products are commercially available pre-packaged for use; one example of such a product is Klear Screen™ or commercially available off-the shelf retail brands such as Glass Plus® Glass and Surface Cleaner made by Reckitt-Benckiser. Use of incorrect cleaners can result in optical impairment of touch panel and/or damage to functionality.

Note: Most products contain 1-3% Isopropyl Alcohol by volume, which is within acceptable limits for Resistive Touch Panel cleaning use.

Caution: Many products contain Ammonia, Phosphates, and/or Ethylene Glycol, which are NOT ACCEPTABLE; check product content label carefully.

LOAD CELL REMOVAL

The load cell assembly can be removed to send back for recertification. Carefully remove the two large screws. Make sure that you support the load cell assembly with one hand while removing the screws so that the load cell does not fall. After the two screws are removed, gently pull the assembly back, exposing the connector. Disconnect the connector. Be careful not to tug on the wires.