

Fullam Tester Series

Tensile Stage with Servo Control Acquisition

Control and Acquisition Model 8000-0014, 8000-0082

Load Frame Models 8000-0009, 8000-0019, 8000-0027, 8000-0032, 8000-0050, 8000-0010, 8000-0075

User's Manual



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Revision History

Rev 1.0	Initial Release	June 5, 2012
Rev 1.1	DoC becomes separate DoC, Add 2000# Stage	January 23, 2013
Rev 1.2	ECN 3980 (add 8000-0027 stage)	July 8, 2013
Rev 1.3	ECN 4953	August 5, 2015
Rev 2.0	ECN	August XX, 2017
Rev 2.1	ECN	April 3, 2019



WARRANTY

Seller warrants to the Purchaser that equipment to be delivered hereunder which is of Seller's own manufacture will be free from defects in material or workmanship and will be of the kind and quality designed or specified in the contract. Any parts of the equipment which have been purchased by Seller are warranted only to the extent of the original manufacturer's warranty.

This warranty shall apply only to defects appearing within 1 year from the date of shipment by Seller. If the equipment delivered hereunder does not meet the above warranty, and if the Purchaser promptly notifies Seller, Seller shall thereupon correct any defect, including nonconformance with the specifications, either, at its option, by repairing any defective or damaged parts of the equipment, or by making available at Seller's plant necessary repaired or replacement parts. No allowance will be made for repairs or alterations made by others without Seller's written consent or approval. Seller assumes no responsibility for damage caused by improper installation or by operation in violation of its rated operating condition, intentional or otherwise, or by improper handling or maintenance. The liability of Seller under this warranty (except as to title), or for any loss or damage to the equipment, whether the claim is based on contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of the warranty period of all such a liability shall terminate. The foregoing shall constitute the exclusive remedy of the purchaser and the exclusive liability of the Seller.

The foregoing warranty is exclusive and in lieu of all warranties, whether written, oral, implied or statutory (except as to title). There are no warranties which extend beyond those expressly stated in this contract.

FCC NOTICES

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the manufacturer's instruction manual, may cause interference with radio and television reception. This equipment has been designed as a Class A digital device of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Relocate the instrument with respect to the other device.
- Plug the instrument into a different outlet so that the instrument and the other device are on different branch circuits.

If necessary, consult a representative of 522 Systems. You may find the following booklet helpful: *FCC Interference Handbook*, 1986, available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00450-7.

Information in this manual is subject to change without notice.

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SAFETY WARNINGS

Warning Symbol Definitions



Hand Pinch/Moving Parts Hazard.



Hand Entanglement/Rotating Gears Hazard.



Electrical Shock/Electrocution Hazard.

WARNING: HAND PINCH/MOVING PARTS HAZARD

This equipment is capable of exerting a pinch/clamping force in excess of 10,000N (2000LBF). Do not make adjustments while the unit is energized. The operator must lock out the energizing mechanism prior to making adjustments.

WARNING: HAND ENTANGLEMENT/ROTATING GEARS HAZARD

This equipment has exposed rotating gears. Do not make adjustments while the unit is energized. The operator must lock out the energizing mechanism prior to making adjustments.

WARNING: ELECTRICAL SHOCK/ELECTROCUTION HAZARD

The control mechanism for this equipment is connected to AC mains power. There are no user serviceable parts within the controller box. Do not attempt to open the controller box or insert foreign objects into the box vent openings.



DISCLAIMERS

Language Requirements

DISCLAIMER: EU LANGUAGE REQUIREMENTS

This is the Original Instructions version of the User Manual. It is illegal to operate this equipment in a European Union (EU) Member State unless the manual is written in an official language of the Member State. Contact 522 Systems for the availability of translated manuals.

Safe Operation Requirements

DISCLAIMER: OPERATIONAL RISK

This equipment has moving parts and can produce forces in excess of 10,000N (12000LBF). The end user must use a calibrated load readout and establish a control loop whereby the system is controlled to be within its design limits. The end user should not rely on intrinsic safety devices such as shear pins and limit switches as the primary means to maintain operation within design limits.

DISCLAIMER: PERSONAL PROTECTIVE EQUIPMENT

This equipment is designed to create large compressive and tensile forces on sample materials. As such, conditions can exist during normal operation which may result in flying projectiles or debris. Protective devices such as barriers and/or face shields should be used during operation.

SAFETY FEATURES

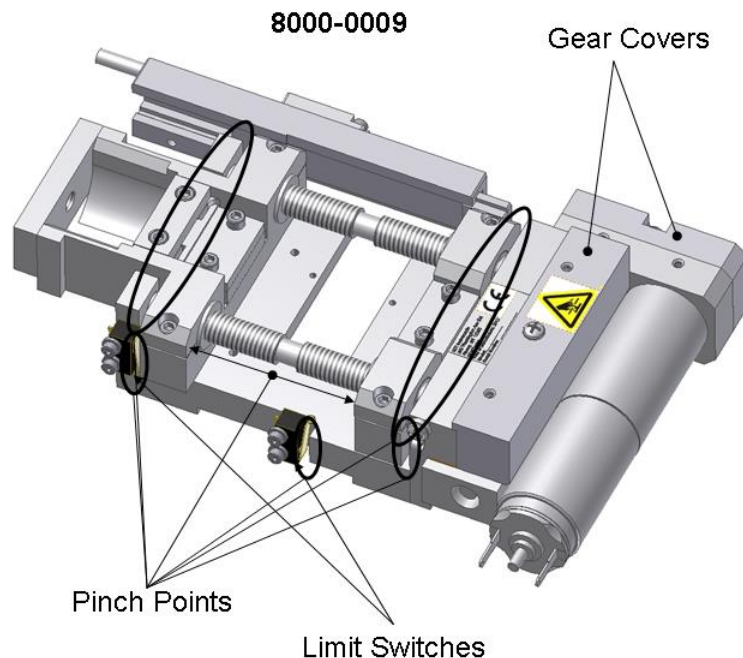
Shear Pins – The final drive gears of the 522 Fullam Tester Series Tensile Load Frame has been fitted with shear pins. The pins are chosen such that they will shear if the applied force exceeds both the nameplate rating of the frame and the maximum safe rating of the frame. The control system of the 522 Fullam Tester should not allow the system to exceed the nameplate rating of the load frame, thus these pins should not shear. The shear pins are not user replaceable. In the event one or both shear pins is damaged, contact 522 Systems or their authorized representative.

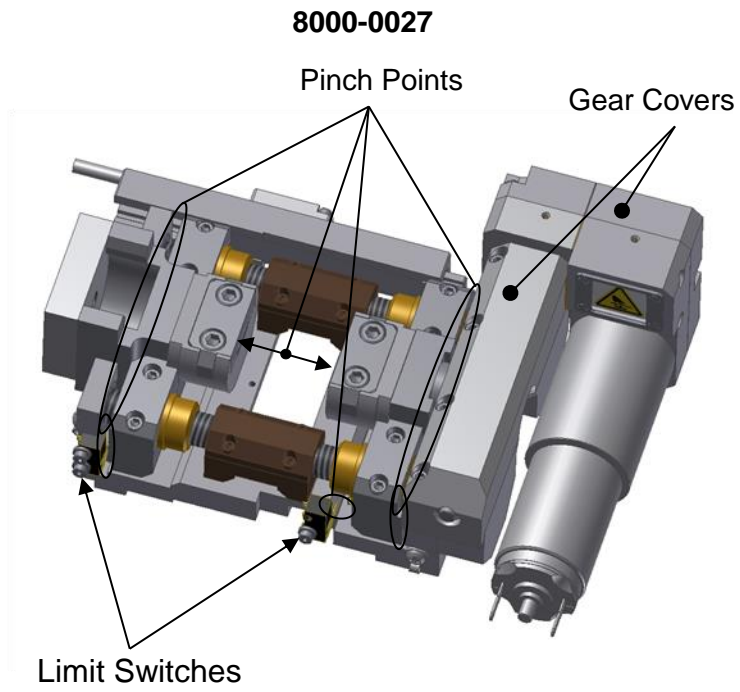
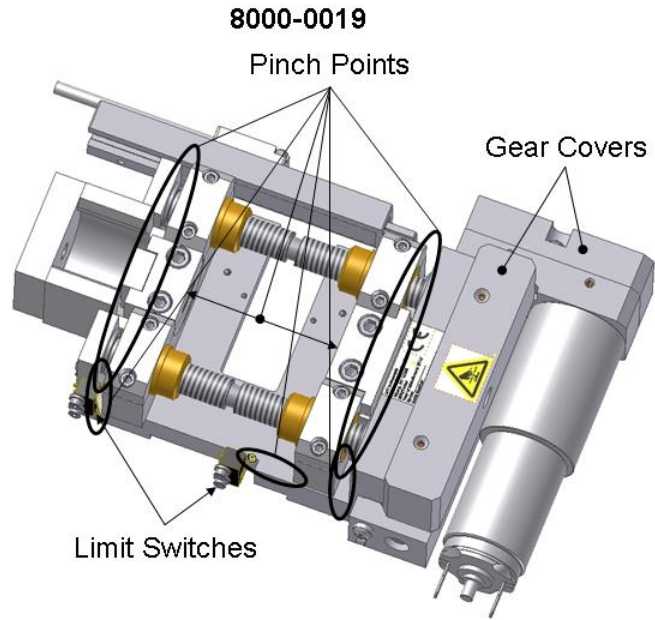
Limit Switches – End limit switches are provided for both directions. The control system should monitor these switches and cut power to the system in that direction. Exceeding the intended system range can risk damage to both the switches and the load frame. These switches and their calibration are not user settable. Should the limit switches become problematic contact 522 Systems or their authorized representative for assistance.

Gear Covers – Where possible, 522 Systems has provided gear covers. The intent of these gear covers is to prevent gear entanglement injuries. Do not operate the tensile stage without these gear covers installed.

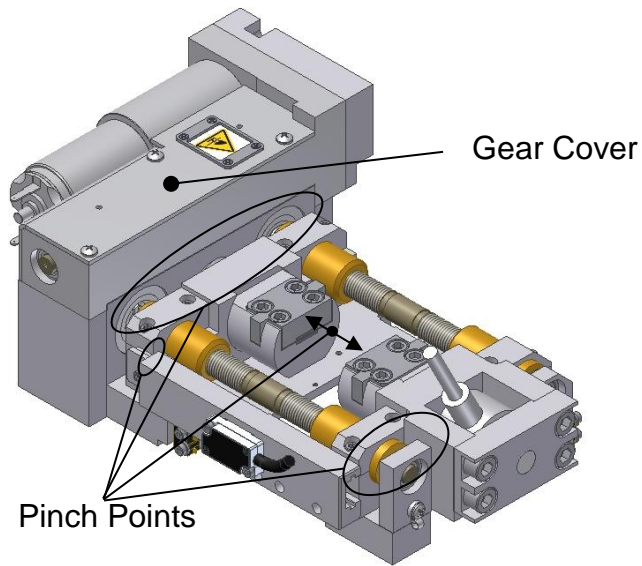
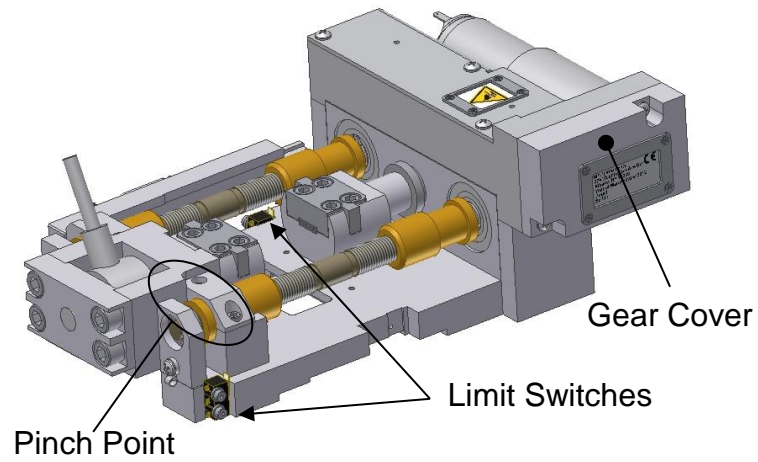
Noise Level – Under normal operational conditions, this product does not exceed 70dB(A)

Danger Zones – see following diagrams:

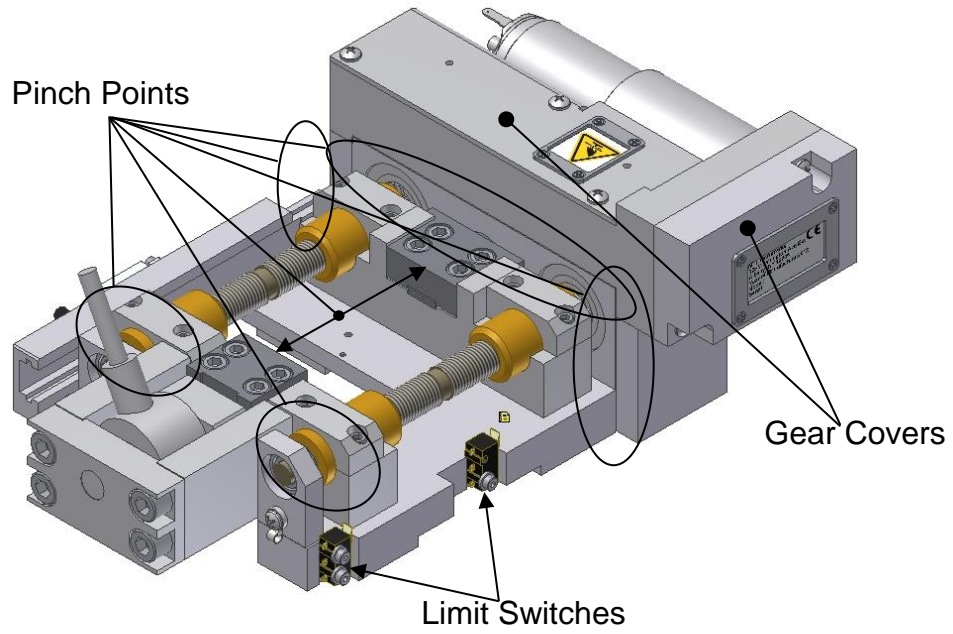




8000-0032



8000-0050



8000-0010

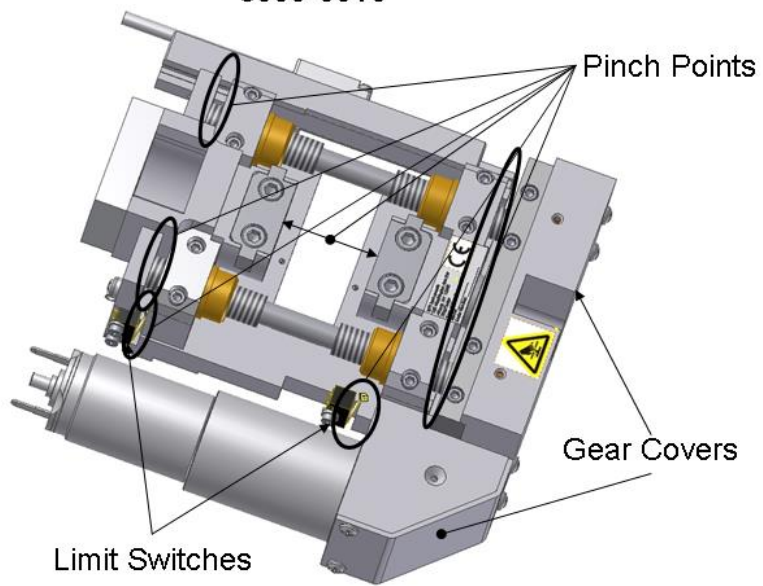




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1 INTRODUCTION

1.1 522 Fullam Tester Series System Description

The 522 Fullam Tester Series of Tensile Stages consist of a load frame and a control mechanism. These may be purchased separately or factory mated. While it is possible for the end user to construct a control mechanism or buy one from a third-party, it is highly recommended that they be purchased as a mated pair from 522 Systems. Use of a non-522 Systems provided control mechanism may result in undesirable operation and could void any warranty.

The 522 Fullam Tester Series of Tensile Stage can be configured as a bench top tensile stage for use with standard light microscopes. With proper fixtures, the device can also be installed in some electron microscopes.

The 522 Fullam Tester Series of Tensile Stages are designed to exert tensile or compressive loads of up to 10kN (2000LBF) on a suitable test specimen. The maximum force that can be exerted varies from model to model.

Recommended control is provided by the 522 Fullam Tester Control Box. The 522 Fullam Tester Control Box will take inputs from the load cell, the Linear Encoder, and the limit switches and will control the motor based on a specified set of parameters. The user interface is designed for the Windows operating system and interfaces to a user supplied PC through an available USB 2.0 port. The 522 USB flash drive contains the Windows application, called MTEST Quattro, to run the Control Box. It may also contain sample parameter files that are helpful with initial setup. The user operation files for the software are contained in the software's HELP tab.

Other clamping jaws, port covers, and other accessories may be available for your product. 522 Systems may also be able to offer custom designs for your application. Please contact 522 Systems or their authorized representatives for details.



1.2 Receiving Inspection Procedure

The 522 Fullam Tester Series products are shipped from 522 Systems assembled and packed in a cardboard carton with foam supports to guard against shipping damage. Upon receipt, perform the following procedure before using the unit to perform dimensional measurements:

1. Inspect the exterior of the shipping carton. Note any obvious damage. If shipping damage is evident, file a claim with the carrier.
2. Inspect each item as it is removed from the shipping carton. Note any obvious damage. Reference the included Bill of Materials and immediately report any missing items to 522 Systems or their authorized representative.
3. If any problems were found with the contact 522 Systems or their authorized representative immediately.

1.3 Return Shipment Procedure

Requests for returning shipments may be initiated by contacting 522 Systems to get a Return Material Authorization (RMA) request form. Contact information is on the 522 Systems website at: <http://522systems.com/>.

522 Systems may refuse acceptance of any package which does not follow the RMA procedure noted above.

2 INSTALLATION INSTRUCTIONS

2.1 Physical Setup

The load frame will be shipped with the mounting dovetail adapter attached. In some cases, an additional dovetail is supplied to adapt the unit for use on a different scope. To mount the stage, follow the SEM manufacturer's instructions on how to attach accessories to the dovetail. If possible, try to balance the weight of the stage so that it is evenly distributed on the dovetail. If the product is being used in bench top operation, the dovetail or mounting adaptor may be removed.

Place the port cover on an available port. Make sure the gasket is making a proper seal. For customers that ordered adapter plates for alternate applications, there may also be multiple port covers. Use caution when selecting the port cover, as some port covers have similar sizes, shapes, and bolt patterns.

Find a location for the acquisition control box. The box is designed to sit on a bench top. The box should be placed so that the user has direct access to the ON/OFF switch. The location of the controller must be within the USB cable length to the Windows PC that will be controlling the stage.

2.2 Electrical Connections

The 522 Fullam Tester Control Box utilizes AC Mains power. Refer to the nameplate label on the controller for the specific AC requirements. An example of the label is shown in Figure 1: Controller Nameplate Example.



Figure 1: Controller Nameplate Example

Do not provide AC power until all the DC connections are established.

The DC Connections to the system utilized keyed connectors. Differentiation is ensured by utilizing connectors with different pin counts. To make the DC connections, simply match the male connectors with female connectors that have identical pin counts.

The port cover (if equipped) is simply a pass thru item. Therefore, the connection scheme and coding follows the same methodology as the controller to load frame connection.

Do not connect the USB connection to the PC until the application software has been installed.

2.3 Driver Installation

The Tensile Stage is shipped with two USB flash drives. The first is the Admet MTEST Quattro Controller Software Installation flash drive. The second flash drive contains copies of the calibration files for the stage, the calibration certificate for the Load Cell, and a copy of this User's Manual. The software is intended to run on a minimal installation of Windows 7, 64 bit, or newer.

- 2.3.1 Do not connect the 522 Controller USB cable to the PC until the Software installation has been completed. Drivers for the USB interface are loaded into the Admet folders during the installation.
- 2.3.2 To install the software insert the 522 Systems USB flash drive into the computer that will be connected to the 522 Control Box. If the MTEST Quattro software installation does not begin immediately, navigate to the flash drive and run the Setup.exe file. The installation software will request a destination directory to install the software. It is recommended the default directory be chosen. Choosing the default will install the MTEST Quattro Controller Software in an ADMET Folder on the C: drive of the PC.
- 2.3.3 When the software installation completes, turn on the MTI Controller using the power switch on the top of the controller and plug the USB connector into your PC. The PC will determine whether it requires the drivers for the USB interface. If it does require drivers it will open a Found New Hardware Wizard window, (Figure 2: Found New Hardware Wizard) below, and ask where to find the drivers. Choose the "Install from a list or specific location" option and click on the Next button.

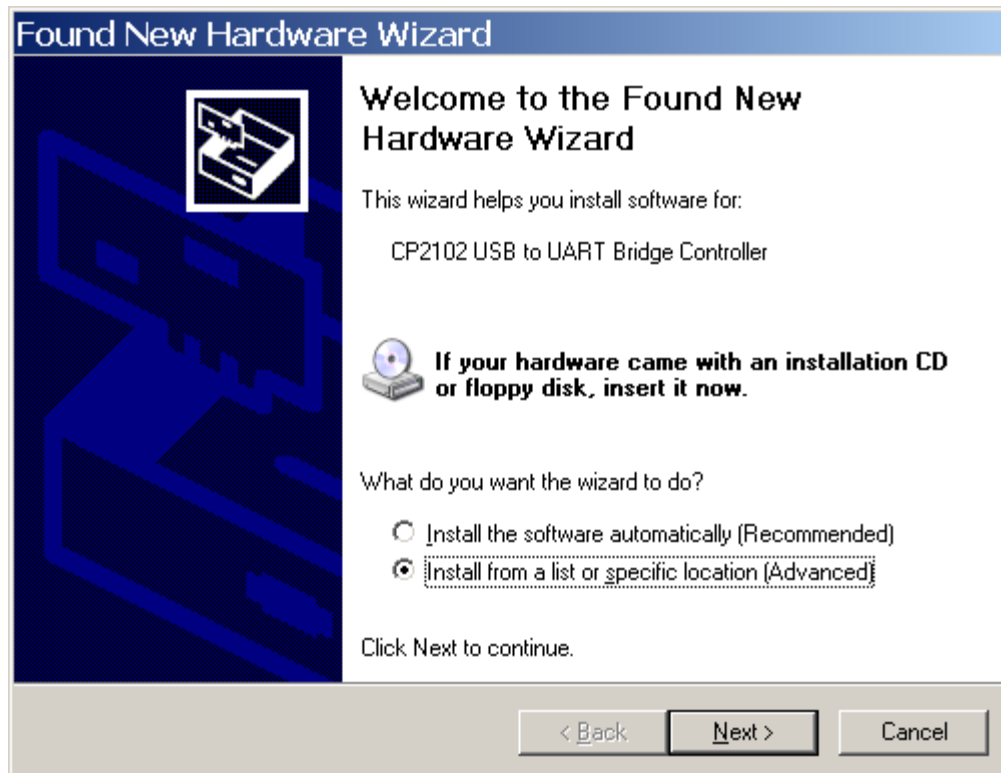


Figure 2: Found New Hardware Wizard

2.3.4 A new window will be displayed (Figure 3: Found New Hardware Wizard). Select the “Search for the best driver in these locations” option and check the “Include this location in the search” check box as shown. Either enter the folder where the drivers are stored in the edit box as shown, or click the Browse button to navigate to the driver folder. If Browse was chosen, navigate to the location shown in Figure 4: Browse For Folder.

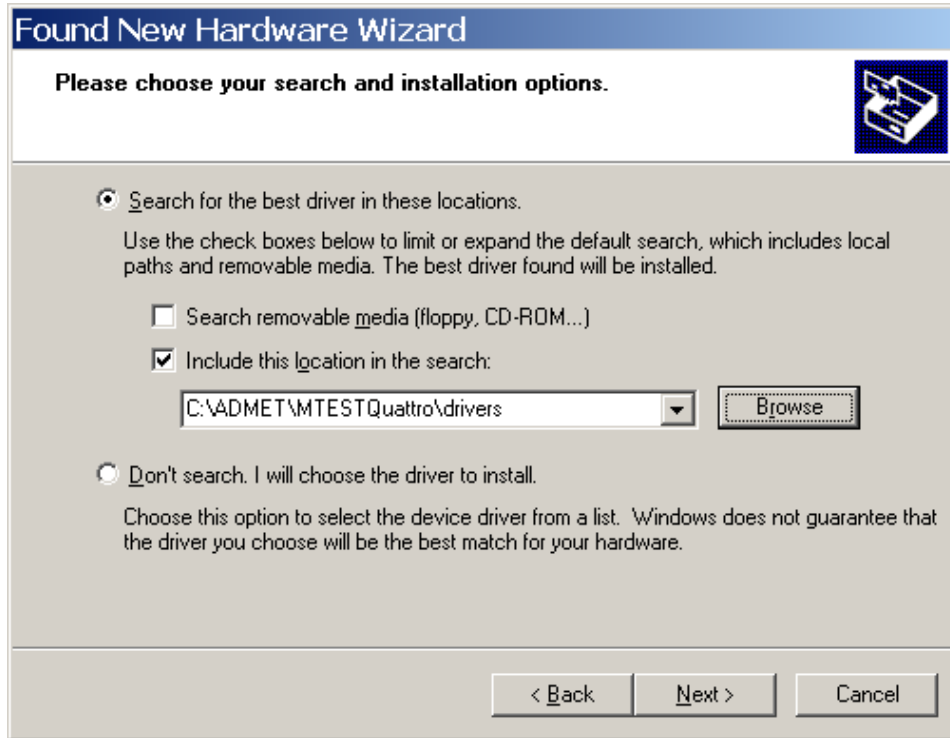


Figure 3: Found New Hardware Wizard

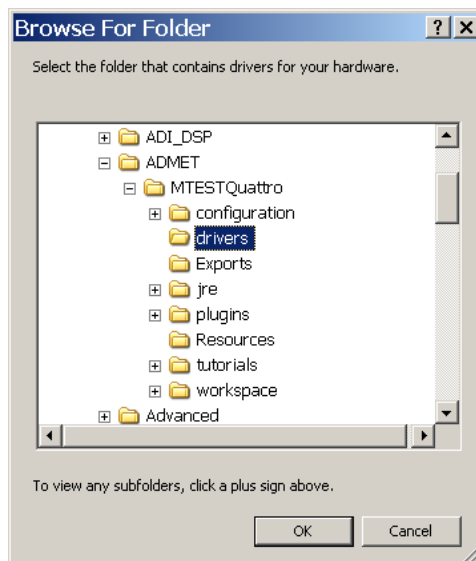


Figure 4: Browse For Folder

2.3.5 With the appropriate driver location selected, click on the Next button to start the driver search and install (Figure 5: Found New Hardware Wizard).

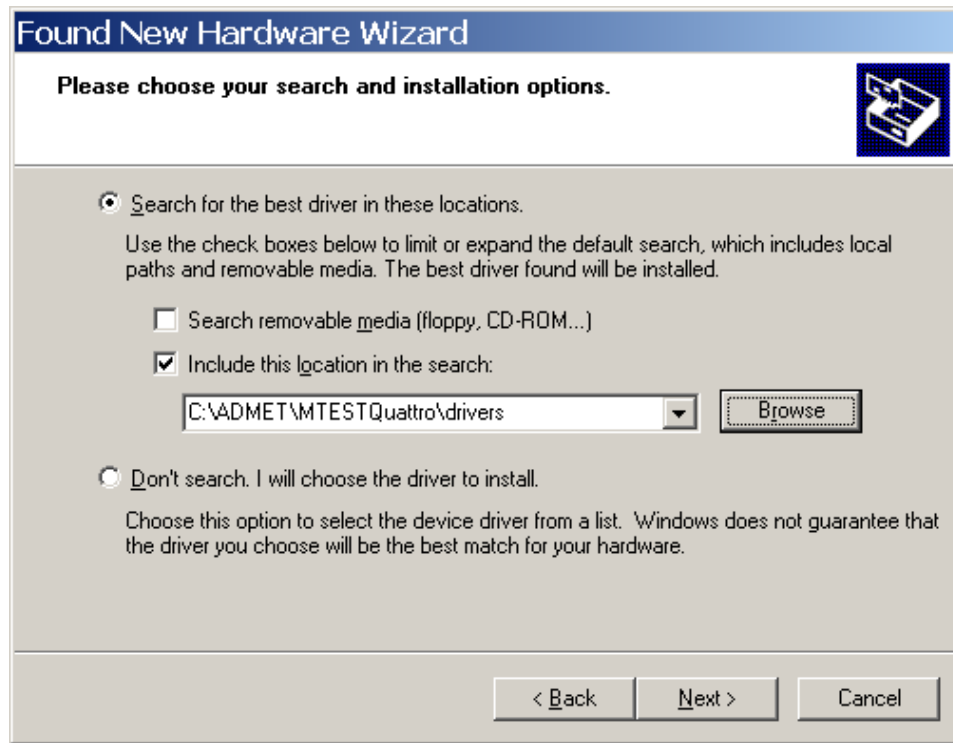


Figure 5: Found New Hardware Wizard

2.3.6 The Found New Hardware Wizard search window will open and the magnifying glass will oscillate while the Bridge Controller driver is found and loaded into Windows.

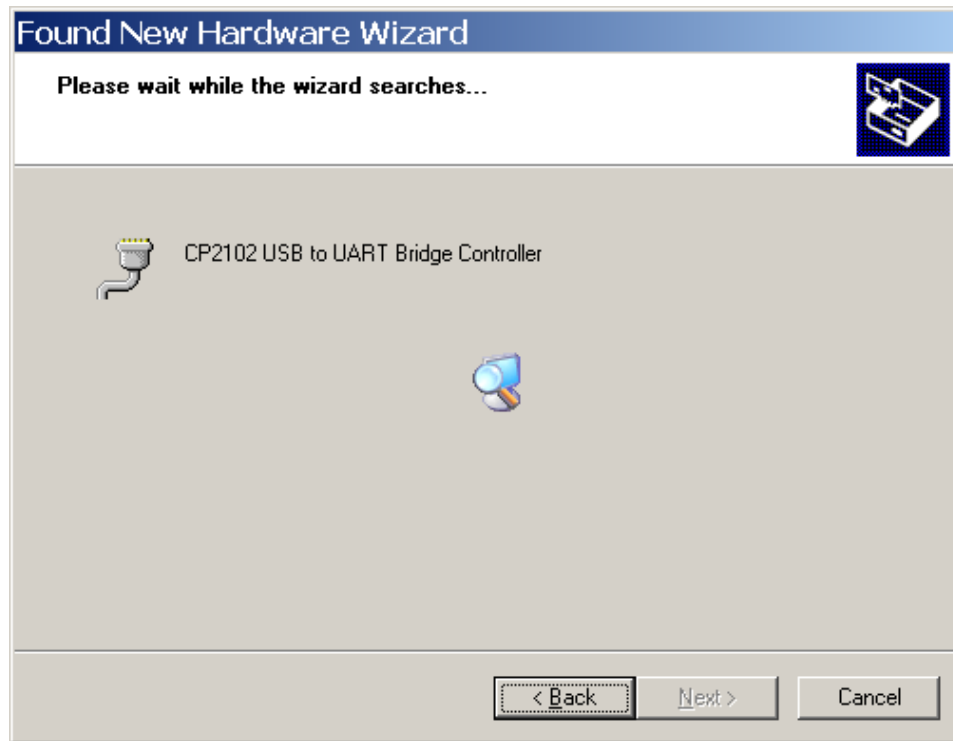


Figure 6: Bridge Controller

2.3.7 After a short time the Completing Found New Hardware window will appear. Click on the Finish button.

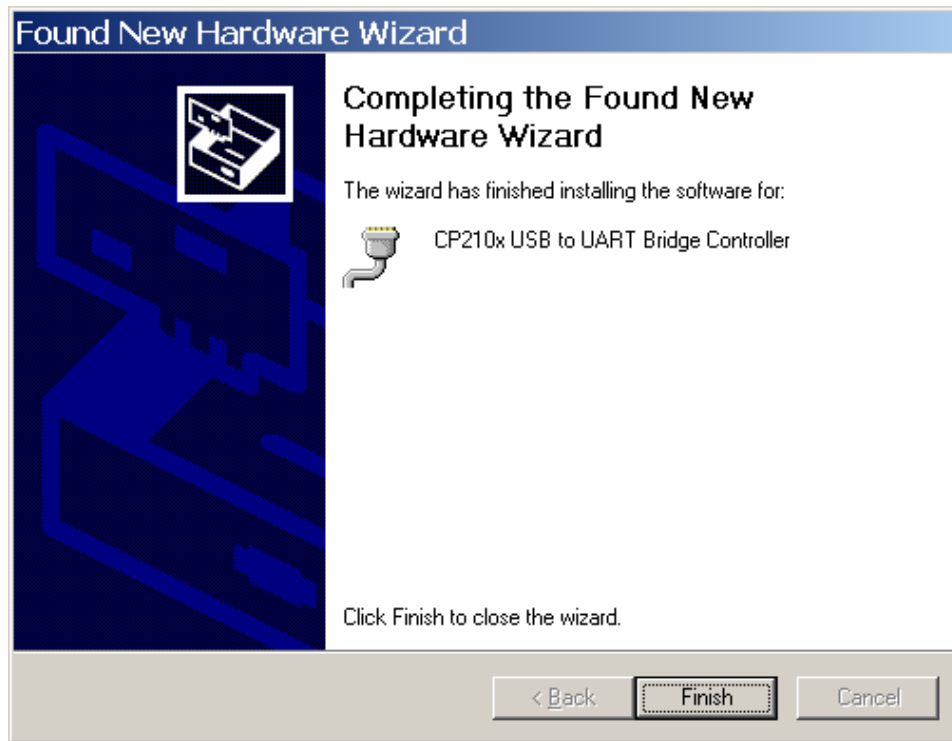


Figure 7: Found New Hardware Wizard Complete

2.3.8 A short time later the Completing the Add Hardware Wizard window will appear. Click the Finish button. The Windows drivers for the USB Bridge Controller are now installed.

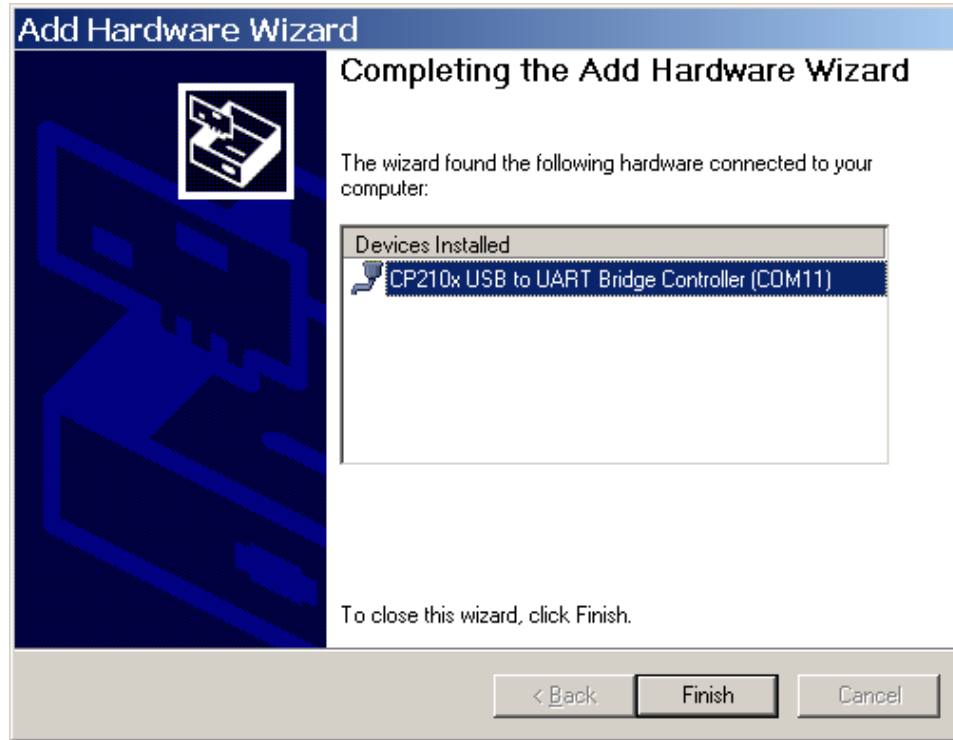


Figure 8: Add New Hardware Wizard Complete

2.3.9 Once the Drivers are installed the factory calibration and setup files must be copied to the PC from the 522 Systems USB flash drive. Make sure the flash drive is still inserted into the PC and copy the files from the Calibration Folder “ADMET\MTESTQuattro\Resources” to the “ADMET\MTESTQuattro\Resources” folder where the software was installed on the PC in step 1 above. Check to see that the files were copied correctly. This completes the Software Installation.



2.4 Load Cell Installation

522 Fullam Tester Series of Tensile Stages are designed to work with Sensotec Model 31 or equivalent load cells. Depending on the nameplate capacity of the load cell, threaded adapters may be needed. Note that even though a larger load cell capacity may physically fit within your particular 522 Fullam Tester model, it is critical that the control system is not exceeding the rated operational load range of the frame. Do not rely on the built-in safety devices, such as shear pins and limit switches, as the primary means to maintain the system within the rated capacity of the load frame.

To install the load cell:

- 2.4.1 Remove the 4 screws holding the cross bar at the back of the load cell pocket.
- 2.4.2 Remove the long socket head cap screw (if installed) from the rear cross bar and load cell adapter.
- 2.4.3 Remove the entire rear jaw fixture.
- 2.4.4 Screw the load cell into the rear jaw fixture, leaving 1-3 threads exposed.
- 2.4.5 Screw the rear cross bar into the other end of the load cell and tighten to the rear crossbar using jam nut supplied.
- 2.4.6 Drop the jaw-load cell-rear cross bar back into position on the tensile frame.
- 2.4.7 At this dry fitting point, observe the movement of the jaw assembly while the rear cross bar is flush against the rear of the tensile stage. Ideally, the front edge of the jaw will be flush with the front edge of the frame carriage while the rear cross bar is against the rear of the frame. Adjust the distances by screwing the cell farther into either the rear cross bar or the jaw assembly.
- 2.4.8 Replace the screws in the rear cross bar and replace the bar/screws above the rear jaw fixture.
- 2.4.9 Verify again that the jaw assembly can be made flush with the front of the carriage. The assembly might be loose.

2.5 Calibration

The 522 Fullam Tester Series of Tensile Frames and Controllers are calibrated at the factory. The calibration files for each supplied load cell are in the Resources directory. Contact 522 Systems or their authorized representative for calibration assistance.



3 OPERATIONAL INSTRUCTIONS

3.1 Loading a Sample

Ensure that the load frame is not energized when loading a sample. 522 Systems has many different types of bending and clamping fixtures available, including custom fixtures. Contact 522 Systems or their representatives regarding different options for securing samples.

The sample clamp on the plain (non-load cell) jaw is retained by a large socket head screw. This screw is accessible through the hole between the brass gears in the head frame. Loosen the screw with its hex wrench, tilt the clamp as desired, and tighten the screw. The clamp should be rigidly secured during a test. Conversely, the clamp on the load cell must be free to move in order to transfer the load to the cell.

A test sample has been shipped in place on the substage to demonstrate proper sample loading. To load a sample, remove the four cap screws on each jaw clamp. Lift out the test sample, taking care not to lose any of the four clamp wedges. These are hardened steel wedges with a smooth taper on the back side and gripping serrations on the side facing the sample. The back sides of all four wedges are lubricated with vacuum grease. Make sure a wedge is in each of the four tapered slots, with the serrations facing the sample. The small end of each wedge should be flush with the shallow end of its slot. Place the sample on the two lower wedges, taking care that it is aligned with the axis of the threaded rods, and install the clamp plates. The cap screws should be tightened evenly, so that the clamps do not tilt to one side. The wedges provide a self-energizing feature, which increases the clamping force as the tensile load is applied.

3.2 Using the Controller

Note: The Default Password on the calibration file is “quattro”.

Power on the 522 Systems Control Box first, and then launch the application. The main power switch is on the back of the Controller Box next to the AC power line. The orange LED on the front panel indicates that the control circuitry is on and running. The red button on the top of the Controller Box is an emergency stop switch and should be in the “up” position for normal operation. If the emergency stop switch is pushed, twist it to let it pop up and reset.

When the MTEST Quattro software is running, the “Jog” switch can be used to open and close the jaws of the tester. The speed of the jog movement is set in the software.

The MTEST Quattro manual is on the USB flash drive. It runs in Adobe Acrobat, which is also on the flash drive. To get to the manual, click on “Start”, go to “Programs” and open Windows Explorer. Navigate to the MTESTQuattro Folder and click on the Tutorials folder. You will see a list of all the various tutorials-installation etc. The calibration files are on the flash drive in the Resources folder. These files load when the program is installed. The default setups on the MTEST Quattro flash drive are for cyclic tests. The setup on the second flash drive is labeled “Open Test 710” for single function tests.

If a new load cell is added, a calibration will have to be entered for the load cell. Open the Calibration file and enter a name for the new cell. **Note: When installing a new load cell, care must be taken during setup to define the Cell Overload Range to protect the system from asserting forces in excess of the load cell rating. This is especially critical for cells with maximum forces limits less than 100 lbs.** Also, choose positive (tension) or negative (compression) loading. The Live Count window will display a random 4 or 5 digit number. Enter this number as a zero load reading with no load or stress on the cell.



3.3 Load Cell Calibration

The Load Cell Calibration procedure can be used to check or to update the calibration. This procedure, if needed, involves determining the count value at two points, a) No load, and b) at the simulated calibrated load with the shunt inserted. To calibrate the cell without a deadweight or known-load test, proceed as follows:

3.3.1 Refer to the Certificate of Calibration provided with the load cell. (Make sure the serial no. on the cell matches the one on the certificate). The certificate will give:

- a. Load Cell Capacity (lb)
- b. Load Cell Calibration Factor (mV/V)
- c. Load Cell Shunt Calibration Factor (mV/V)

3.3.2 The shunt resistor of controller is 59k Ω 0.01% to match the Manufacturer's Calibration Resistor

From this, the simulated load on the cell with the shunt applied can be calculated as follows:

$$\text{Pounds with Shunt (lb)} = \left(\frac{\text{Load Cell Shunt Calibration Factor (mV/V)}}{\text{Load Cell Calibration Factor (mV/V)}} \right) \times \text{Load Cell Capacity (lb)}$$

Shunt Calibration Load Calculation Formula

3.3.3 Remove all load from the system. This is accomplished by removing any sample from the stage jaws.

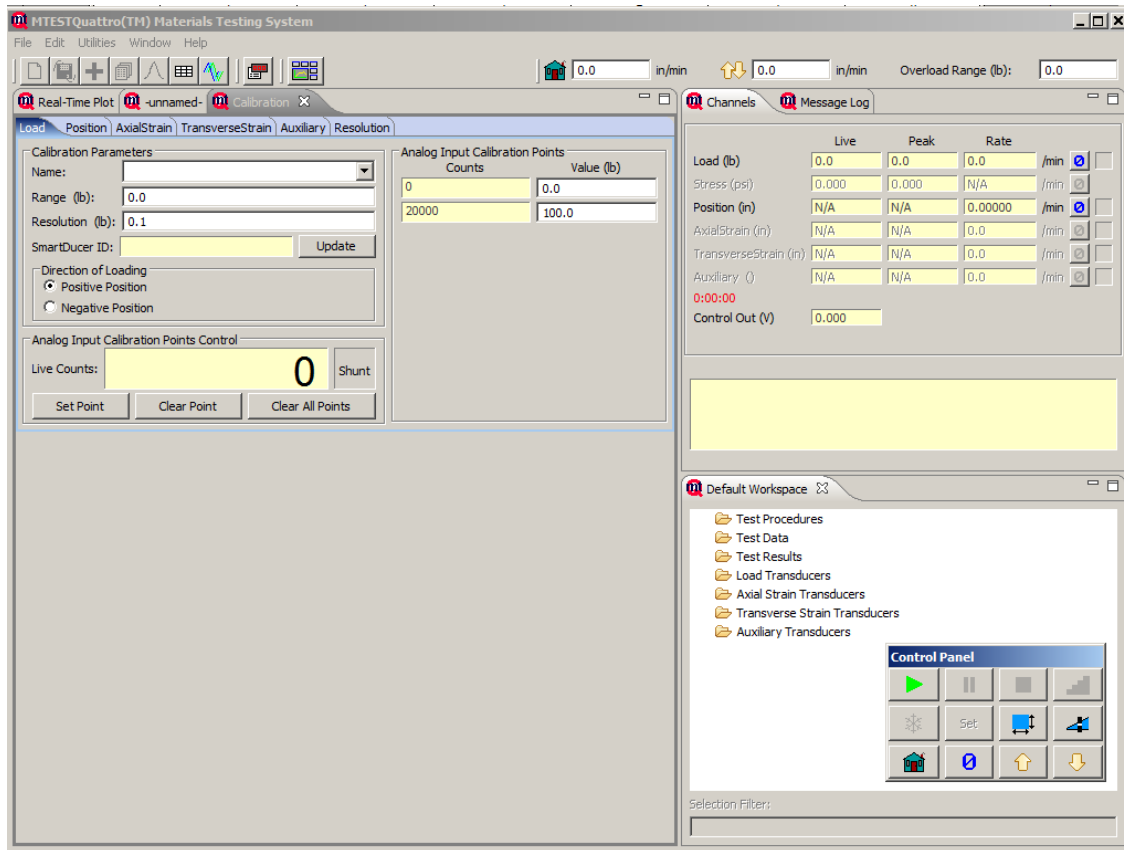



Figure 9: MTEST Quattro Software Main Screen

3.3.4 Click the Calibration button  on the MTEST Quattro Software Main screen shown in Figure 9 above.

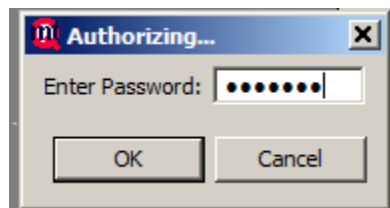


Figure 10: Password Request Window

3.3.5 The window in Figure 10 will appear. You need to enter the password “quattro” and click the OK button to get access to the calibration screens.

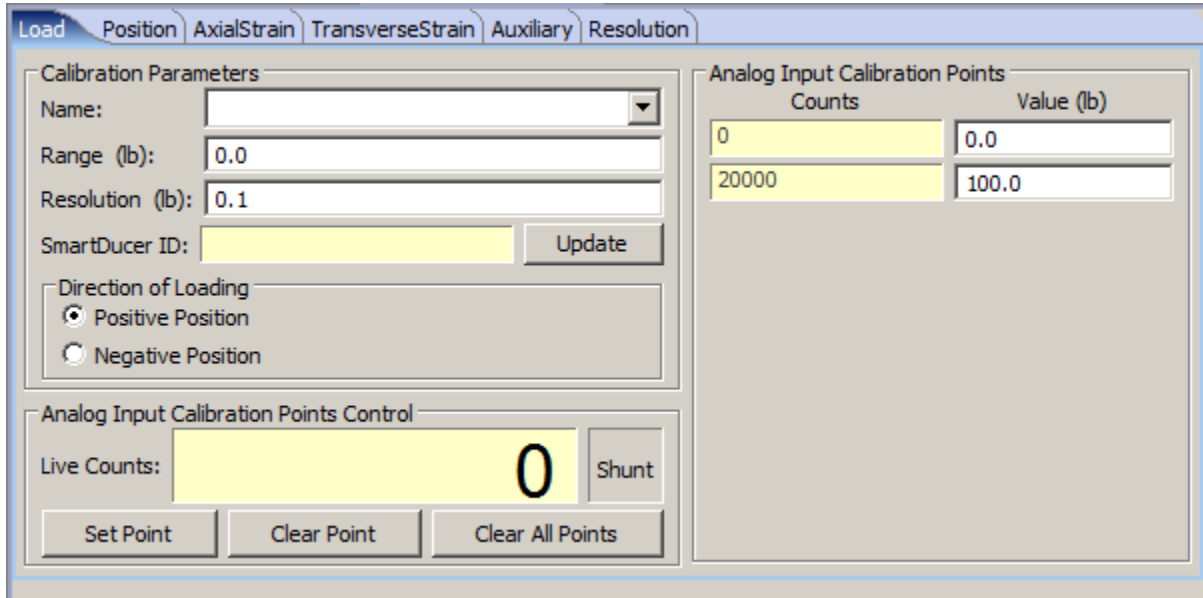


Figure 11: Load Calibration Setup Window

- 3.3.6 The Load Calibration window should be displayed after the password is entered. If another tab is highlighted click on the Load tab to access the Load Calibration Setup. You will need to enter the range and resolution of the load cell in the provided boxes. You will also need to click on the selection for Positive Position.
- 3.3.7 Click the Clear All Points button to start the calibration process. The points shown on the upper right side of the screen will disappear. The box showing the Live Counts should be displaying a series of numbers related to the no load Analog input from the load cell. Typically the number is a low value, less than 2000 counts. The box labeled Shunt should be gray, as shown in Figure 11.
- 3.3.8 Press “Set Point” button. A point will be added to the right side with the latest Live Count in the left box of the new point. This is the point for no load, since the loads were taken away in step C above. Leave the default value of 0 pounds for this point.
- 3.3.9 Press the “Shunt” button. The Shunt Button will turn RED, which indicates the shunt has been added to the circuit. You will also notice that the Live Counts will rise to a significantly higher value than when the Shunt was not applied. Putting a shunt in the circuit simulates a load being added to the load cell. The value of the load is the Pounds with Shunt value calculated using the formula and Cal Certificate values above.
- 3.3.10 Press “Set Point” button. A second point will be added to the right side with the latest Live Count in the left box of the new point. This is the point for the shunted load. Enter the calculated Pounds with Shunt value in the right box of the second point.
- 3.3.11 Move the mouse to the lower Gray area below the Load Cal Setup area. Right Click and then select the Save As option in the widow that appears. The “Save Transducer As” window shown in Figure 12 will open. Enter a name for the transducer that will identify it for future tests. It is recommended that the name include the serial number and capacity of the cell, at a minimum to ensure the correct cell is chosen in multiple cell installations. After entering the Transducer name click on the OK button to save the calibration parameters.

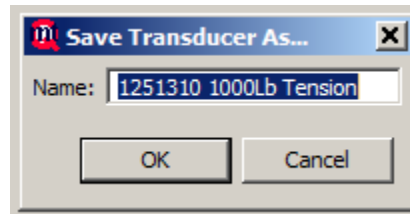


Figure 12: Load Calibration Setup Window

Setups are done using the test setup file. Existing setup files can be accessed by double clicking on the Test Procedures in the Default Workspace window. With the setup completed and the sample loaded, click on the Real-Time Plot tab to bring up the test graph. Click on the blue zero near the position readout, then on the green arrow to start the test.

The test can be terminated by clicking on the red Abort Test square on the Control Panel. Clicking on the Pause icon will stop the stage motor but will not terminate the test. The motor is restarted by clicking on the green arrow.

3.4 Running a Test

A detailed tutorial showing the steps to set up and run a test is provided in the following folder:

C:\ADMET\MTESTQuattro\tutorials\RunningATest

Included in the folder is the tutorial that guides the user through the steps required to set up and run a test. The tutorial is provided in several formats including an executable .exe application, HTML, and .pdf forms to allow the user to choose how the tutorial is viewed.

The tutorial will show the user:

- 3.4.1 How to enter the sample geometry into the program
- 3.4.2 How to set the Report Parameters
- 3.4.3 How to choose the Acquisition Parameters including the logging and test saving options
- 3.4.4 How to add selected additional analyses to the test report
- 3.4.5 How to set up the graphical plot displayed while the test is in progress
- 3.4.6 How to choose the load cell used for the test
- 3.4.7 How to setup the Servo Control general preload and limits
- 3.4.8 How the set up the actual control profile that defines the test

Note 1: It is recommended that the user start with one of the provided test to create any new test procedures because they will have some default values, including load cell limits, PID parameters, and Load Cell choices predefined. This will lower the chance of errors in setting limits beyond the capabilities of the Load Cell and help with smoother motion control setup.

Note 2: PID Gains setting requires significant understanding of how a PID control system works. It is recommended that the parameters used in the tests supplied with the unit, stored in the resources



directory on the Image CD, are used to run the system. The parameters have been chosen by running the tests, also supplied in the resources directory, on your specific stage. The parameters have been empirically chosen to provide solid performance of the stage. The test results provided in the resources directory show results of several load and position based tests run on your stage to confirm its performance before it was shipped.

4 MAINTENANCE

4.1 Controller Maintenance

There are no user serviceable parts within the controller. Particularly after the system or other proximate equipment has been moved, the connectors and wires of the controller should be inspected for damage.

4.2 Load Frame Maintenance

The load frame is expected to provide years of trouble free service. The frame should be inspected daily for signs of wear and damage such as metal shavings or parts that do not appear parallel/perpendicular. The moving parts (gears and drive screws) should have a coating of grease on them. Under normal use, the covers over the gears should be removed and the gears lubricated two times per year. The recommended grease is DuPont Krytox LVP vacuum grease.

Lubricating the gears and main shafts:

- 4.2.1 Turn off the entire system, including the controller
- 4.2.2 Disconnect all wires from the load frame
- 4.2.3 Remove the covers over the gears
- 4.2.4 Inspect for signs of wear such as metal flakes
- 4.2.5 Apply a thin coat of approved grease to the gears using an applicator
- 4.2.6 Replace the gear covers
- 4.2.7 Apply a thin coat of grease to the exposed drive screws
- 4.2.8 Reconnect the load frame
- 4.2.9 Repower the system
- 4.2.10 Spread the grease by exercising the system back and forth using the controller software
- 4.2.11 Power down the system
- 4.2.12 Clean excess grease from the drive screw area
- 4.2.13 Repower the system



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