APPLIED TEST SYSTEMS

Instruction Manual

THE MARK OF RELIABILITY

WinCCS Lever Arm Tester

Series 2140-M, 2320-M, 2330-M, 2330-CC, 2410-M, 2410-CC

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Preface

Unpacking

Retain all cartons and packing materials until the unit is operated and found to be in good condition. If damage has occurred during shipping, notify Applied Test Systems (ATS) and the carrier immediately. If it is necessary to file a damage claim, retain the packing materials for inspection by the carrier.

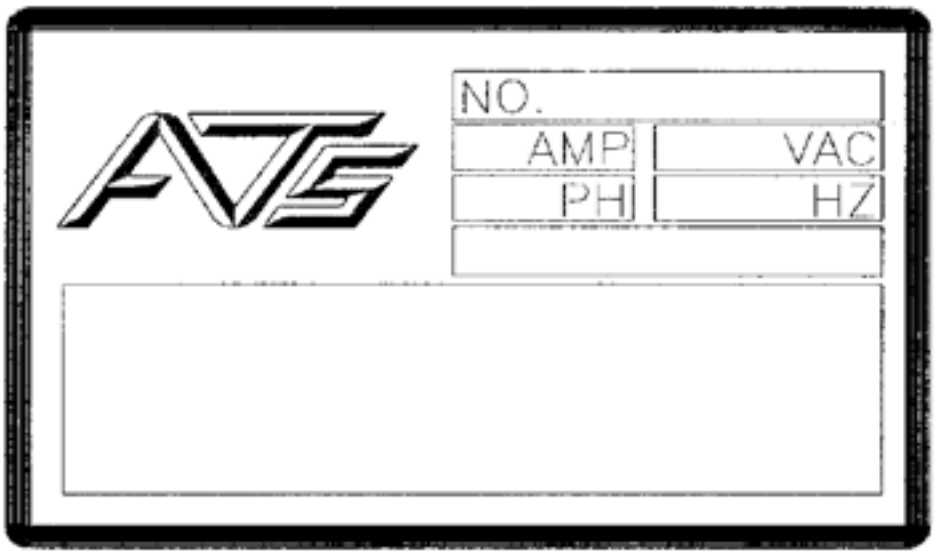
Warranty

All new ATS systems are shipped with a warranty. Units have a warranty against defective parts and workmanship for one full year from date of shipment. Please see Appendix D of this manual for complete details on the warranty.

NOTE: Please see the warranty information included with the computer. It details information that will ensure proper transfer of the computer warranty from ATS to the appropriate company.

After-Sale Support

If there are any questions concerning the operation of the unit or software, contact the ATS Service Department at +1-724-283-1212. Before calling, please obtain the software revision number and the serial number from the unit's data tag . A sample data tag is shown below and can be completed with the unit's information for easy reference. Please be prepared to give a complete description of the problem to ATS Service Engineers.



Terms

Please note the following terms used throughout this manual.

1. Extensometer frame: the hardware attached to the specimen that measures creep
2. Extensometer: displacement transducer or encoder attached to the bottom of the extensometer frame
3. °F: this symbol is used to note degrees Fahrenheit
4. °C: this symbol is used to note degrees Celsius

Also note that this manual uses both the United States customary units of measurement and the International System of Units (SI or metric) in this manual.

Section 1: Introduction

1.1 General Description

The Applied Test Systems (ATS) WinCCS system combines proprietary hardware and software with a direct load or lever arm tester to provide computer automation of the entire test process. Using archived test specifications, the system will:

- control furnace temperature
- apply the appropriate load
- collect creep, load, and temperature data
- archive test results in a logical format.

Constant stress and stress relaxation testing is accommodated on some models . The system is supplied with new ATS frames as well as retrofitted into existing frames made by ATS and other manufacturers.

SERIES

	2140	2320	2330	2410	2430	2510
MM	X	X	X	X	X	X
MS	X	X	X	X	X	X
CCM	X	NA	X	X	X	X
CCS	X	NA	X	X	X	X
SRM	NA	NA	X	NA	NA	NA
SRS	NA	NA	X	NA	NA	NA

X This model fits this category.

NA Not applicable on this model.

MM WinCCS Modular Controls Main Tester

MS WinCCS Modular Controls Secondary Tester

CCM WinCCS Classic Controls Main Tester

CCS WinCCS Classic Controls Secondary Tester

SRM WinCCS Classic Controls Main Tester with Stress Relaxation Capabilities

SRS WinCCS Classic Controls Secondary Tester with Stress Relaxation Capabilities

NOTE: All Secondary Testers (Modular and Classic) must be paired with a Main Tester.

NOTE: Only one Secondary Tester can be connected to a Main Tester.

1.2 Computer Specifications

Minimum computer specifications include the following:

Processor: 2.8 GHz or better

Operating System: Microsoft® Windows® 7 Professional, 32 bit

Memory: 2GB or better

Hard Drive: 250GB or better

DVD Drive: 16x or better

RS422 Card, Dual Port

NOTE: Each RS422 port is capable of connecting up to 64 test frames (or 32 pairs of frames). A computer with a Dual Port RS422 card is capable of connecting up to 128 test frames (or 64 pairs of frames).

1.3 WinCCS System Overview

1.3.1 Test Specifications

The test specification contains all the details of the test. The system is designed to follow guidelines for several regulating agencies. Users can set specifications according to either these guidelines or their own configurations. A test specification is saved in the system each time that set of parameters is appropriate.

1.3.2 Test Specimens

The test specimen is specific to one item and therefore must have a unique specimen name for archival purposes. Associated with the specimen name is all data, including physical size, materials, etc. specific to that particular item.

1.3.3 Sequence of Events

The test is performed in the following sequence of events:

1. Select or create a specification to be used to control the test.
2. Create a specimen using the software process.
3. Select an Idle test frame and follow the Start a Test routine.
4. The Running Test state will change to the Post Test state when the test is complete or stopped manually.

NOTE: The Post Test state allows the operator to restart the test or enter appropriate data, such as elongation information, onto the test comments. The test data is then automatically archived, and this test is now classified as a Previous Test.

5. Test results can be viewed either before or after the Post Test procedure.

NOTE: All of the above functions are described in detail in this manual.

Section 2: Safety

All ATS equipment is designed to be operated with the highest level of safety. This manual and ATS endeavor to educate the operator about safety issues surrounding certain parts of the machinery by using equipment labeling. See page 13 of this manual for the location of safety labels.

2.1 For Owners, Operators, and Maintenance Personnel

Read and understand all instructions and safety precautions listed in this manual before installing or operating the unit. If there are any questions regarding operation of the unit or the instructions in this manual, contact the ATS Service Department at +1-724-283-1212.

In addition to the safety warnings listed on the equipment, warnings are posted throughout this manual. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, personal injury, or death.

2.2 Warnings

The following statements are warning statements. Unlike caution statements, warning statements alert the operator to conditions that may injure personnel. Operators must be aware of these conditions in order to prevent injuries that may occur while operating this equipment.

WARNING: Disconnect power prior to performing maintenance. Turn off the unit and disconnect and lock out before performing any maintenance procedures.

WARNING: Hot/Burn surface, use personal protective gear when operating equipment and handling materials associated with the testing procedure.

WARNING: Pinch hazard.

WARNING: Do not open the panel.

WARNING: Unpack and operate on a stable surface.

2.3 Cautions

The following statements are caution statements. These statements alert the operator to conditions that may damage equipment. Operators must be aware of these conditions in order to ensure safe operation of this equipment.

CAUTION: Installation of electrical devices must be accomplished by competent personnel and done in accordance with any current local and national codes. Equipment grounding is a MUST for both safety and proper operation.

CAUTION: Before energizing the electrical power to the equipment, turn off all power switches and place all controls in an OFF position. Check that the power source is surge-protected and is of the appropriate voltage and amperage. Use appropriate power adapters for the region.

Section 3: Equipment Setup and Installation

Read and understand all instructions and safety precautions listed in this manual before installing or operating the unit. For questions regarding unit operation or installation, contact the ATS Service Department at +1-724-283-1212.

In addition to the safety information listed here, there are cautions and warnings throughout this manual. Failure to follow these instructions could result in permanent damage to the unit, significant property damage, personal injury, or death.


Read Operator's Manual


General Danger


Protective Earth (Ground)


Burn Hazard (Hot Surface)


Electrical Shock/Electrocution


Hand Crush Force From Above


European Directive CE Mark


No Access for Unauthorized Persons

3.1 Safety Instructions

1. Read and follow all warning and caution statements in all related equipment manuals before attempting to operate this machine. If in doubt about any statement or sequence, contact ATS Service.

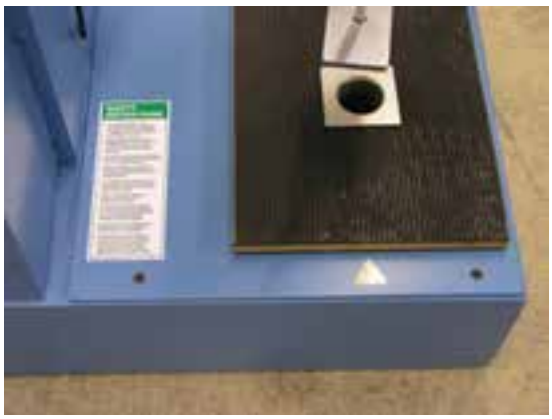
2. Installation of electrical devices must be accomplished by competent personnel and done in accordance with any current local and national codes. Equipment grounding is a MUST for both safety and proper operation.

3. Before supplying electrical power to the unit, turn all power switches and controls in an OFF or NEUTRAL position.

4. Match all serial numbers on test frames, support blocks, and lever arms when assembling multiple testers.

5. Alternate weight slots at 180 degrees to prevent tip-over when stacking weights.

3.2 Location of Safety Labels


WARNING
Burn hazard.
Hot surface.
Do NOT touch.


SAFETY INSTRUCTIONS

3.3 Unpacking Equipment

Carefully unpack the equipment and inspect it for damage during shipment. Retain all cartons and packaging materials until the unit is operated and found to be in good condition. If damage has occurred during shipping, notify the carrier and ATS immediately. If it is necessary to file a damage claim, retain the packing materials for inspection by the carrier.

Unpacking and Setup

1. Carefully remove the shipping crate and packing materials. Do not discard the packing materials until all items on the invoice have been accounted for.

2. Use an overhead crane or forklift to remove the test frame and control console from the pallet and position it in the desired location.

NOTE: Use moving blankets between unit components, and follow accepted moving practices to avoid damage to the tester.

NOTE: Position the test frame and console to allow ample room for maintenance.

3. If casters are supplied with the unit, install them in the cabinet base when it is lifted off the pallet.

4. Adjust the isolator mounts on the test frame to approximately level, ensuring even support.

CAUTION: Do not allow the isolator mount pads to slide on the floor while moving the tester. They are not designed to accept side loading. Damage to the pads may result.

5. If applicable, connect the cables between the load frame and the control console.

6. Connect electrical power to the customer power terminal block. Proper grounding is a MUST.

NOTE: Follow all local and national codes, and be sure to use the correct voltage and amperage. Refer to equipment data tag for the individual unit information.

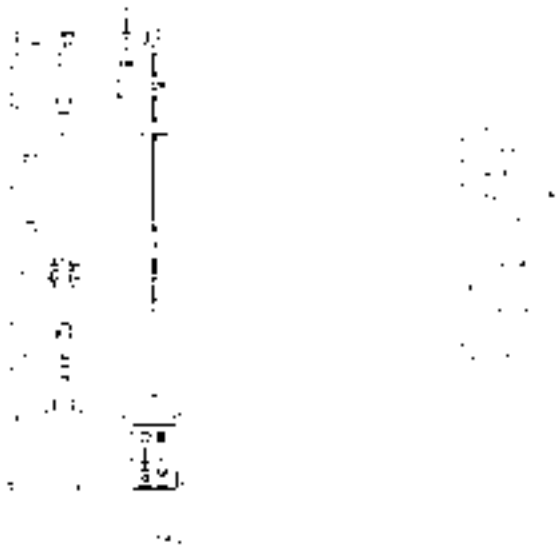
CAUTION: Turn all power switches to OFF and place all controls in a neutral position before supplying power to the machine.

3.4 Specifications

Environmental Conditions

1. Indoor use only.
2. Maximum altitude of 2000 meters.
3. Storage temperature of 5 degrees to 40 degrees Celsius.
4. Operating temperature of ±3 degrees Celsius at the time of force application.
5. Relative humidity no more than 80 percent at 31 degrees Celsius, 50 percent at 40 degrees Celsius.
6. Main Supply ± 10 percent of 230 VAC or ± 10 percent of 115 VAC, depending on the unit.
7. 1 P rating: 1PXO.

Series 2320 Tester

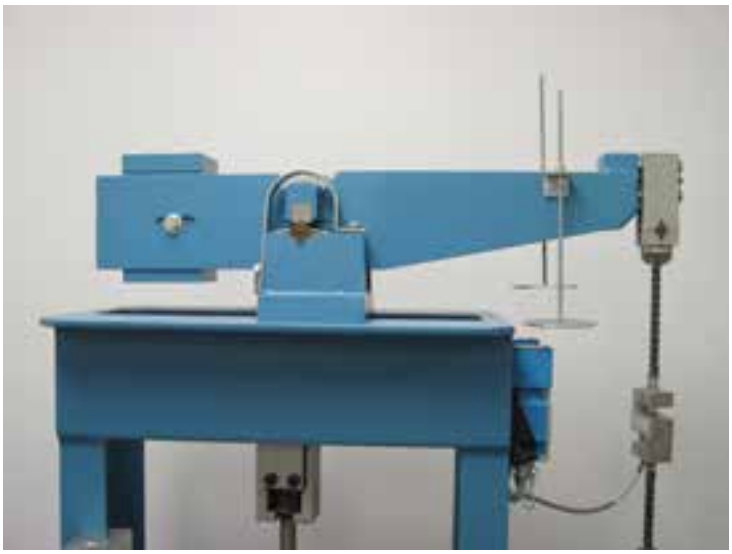


3.5 Hardware Installation

All hardware is built at the ATS factory. If hardware installation is required on site, please contact the Service Department. ONLY PERFORM THOSE OPERATIONS THAT APPLY TO THE UNIT RECEIVED.

NOTE: ELECTRICAL POWER MUST BE CONNECTED PRIOR TO ARRIVAL OF ATS SERVICE.

3.5.1 Lever Arm Assembly Installation



1. Position the knife-edge support block assembly on top of the test frame so that the serial number on the block is facing the weights.
2. Install the locating dowels.
3. Install bolts and tighten.

CAUTION: Match the serial numbers on the test frames with the support blocks and lever arms when assembling multiple testers.

4. Remove or pivot the lever arm safety guards to the side.
5. Check that the knife-edge and V-block mating surfaces are free of dirt or rust.
6. Install the lever arm to the tester with the V-blocks mated to the knife-edges.

NOTE: Take care not to damage knife-edges or proximity switch.

7. Ensure that the lever arm V-blocks are centered on the pedestal block knife-edges front to back. The lever arm should pivot freely.
8. Install the safety guards and tighten bolts.

9. Check position and operation of the proximity switch actuator (or shutdown switch actuator, if equipped).

10. For automatic beam leveling on tester drawheads:

a. Attach the automatic beam level floating actuators to the lever arm above the proximity switches.

NOTE: The switch at the front of the machine is known as the main switch, while the switch at the back of the machine is the intermediate. These switches are pre-installed by ATS.

b. Adjust the nuts above the main proximity switch until the red light on the switch goes out, which signals that the arm is level. The red light will illuminate ONLY when the lever arm is low on the weight pan side.

c. To set the intermediate switch, adjust the nuts above until the red light goes out. This should be when the weight pan sits on the base and there is about 1-2cm of slack in the chain. The red light will illuminate ONLY when the lever arm there is excessive slack in the chain.

NOTE: A green light shows that the switches are level.

3.6 Software Installation

All software is installed on the computers at the ATS factory. If software installation is required on site, please contact the Service Department.

3.7 Setup

Please have all of the equipment unpacked and placed in the location desired before setup. It is recommended to have this equipment installed by ATS Service. Electrical power should be connected to the tester by a local electrician to adherence to local and national codes.

NOTE: ELECTRICAL POWER MUST BE CONNECTED PRIOR TO ARRIVAL OF ATS SERVICE.

3.8 Assistance/Field Support

If there are any problems while setting up any ATS equipment, please contact the ATS Service Department at +1-724-283-1212.

Section 4: Manual Operation

4.1 Overview

While in most instances the frame is controlled by the system during testing, it is necessary to provide full manual control for test setup and for troubleshooting purposes.

There are two basic versions of the WinCCS hardware, Modular and Classic. Manual control is accomplished in various ways depending on the version of WinCCS hardware used .

In addition, manual control is provided through the computer under the maintenance routine.

NOTE: When under manual control via computer, most safety interlocks are disabled. This is necessary to allow for troubleshooting purposes.

If an operator is not thoroughly familiar with the use of these controls, consult ATS at +1-724-283-1212 prior to attempting this operation.

4.2 Drawhead Operation

Applied Test Systems drawheads are used for the initial loading of a specimen, keeping the lever arm level. They are designed to maintain lever arm positioning, even during specimen elongation, providing more accurate test results.

4.2.1 Automatic Drawhead Controls

1. Jog Up: Used to jog the drawhead up in manual mode.

   NOTE: System must be in Idle state to switch to manual mode.

2. Jog Down: Used to jog the drawhead down in manual mode.

   NOTE: System must be in Idle state to switch to manual mode.

3. Drawhead Speed: Used to vary the speed of the drawhead.

   NOTE: The drawhead is typically set at or near zero during tests and set at higher speeds when jogging.

4.2.2 Drawhead Cautions


Observe all cautions listed in the testing machine instruction manual.


Observe lever arm when loading. Do not allow counterweight end of arm to bottom out on the frame.

4.2.3 Drawhead Maintenance

Refer to the drawings on page for part names and numbers.

1. Lubricate the jack screw when the grease becomes dirty or dried out.

   NOTE: Remove the limit switch on the bottom of the jack screw to permit the drawhead to travel past the limit switches. Remember to reinstall the actuator after servicing.

   a. Remove the jack screw:

      i. Slide guide rollers back from jack coupling.

      ii. Operate drawhead in the up (unload) direction until the screw comes out.

   b. Clean and apply multipurpose lithium grease.

   c. Replace the jack screw.

   d. Reassemble and adjust the limit switch.

2. Lubricate jack worm gear annually with multipurpose lithium grease.

3. Lubricate drive chain annually with chain lubricant.

4. Check the gear reducer oil level annually. Refill if necessary per manufacturer's instructions.

5. If there are issues with the motor speed control, contact ATS Service at +1-724-283-1212.

4.3 Manual Frame Controls, Classic Version

The drawhead and weight elevator can be jogged up and down when the frame is in the Idle state.

NOTE: Weight elevators are an optional feature and are not typical.

4.4 Manual Frame Controls, Modular Version

The drawhead can be jogged up and down when the frame is in the Idle state.

4.5 Manual Control via Computer

This function is used for troubleshooting only. Contact ATS at +1-724-283-1212 before attempting this.

Section 5: Assigning User Names, Privileges, and Passwords

5.1 Assigning User Names

Other than certain viewing functions, no operation of the system is possible unless a user possessing the appropriate assigned privileges has logged in. User names and passwords should be assigned by a System Administrator prior to testing. It is important to set up and use individual user accounts if more than one operator uses the tester. This will deny unauthorized access to specific functions of testing, allowing for greater accountability and accuracy of testing data.

5.1.1 Initial User Account Setup

When the system first arrives, ATS will walk the administrator through the setup process. It is important to first create a user name and password for the administrator.

1. The log-in information upon initial setup is “username” for both the user name and password.

NOTE: Do not use quotations when typing in this user name and password.

2. Once logged in, the administrator should follow the steps in 5.1.2 to create his/her own user name and password.

NOTE: Be sure to assign all of the privileges for this initial user name. This will give the administrator all rights and privileges in the system.

3. Log out of the username account and log in under the new administrator user name and password.

4. Follow the steps in 5.1.3 to delete the “username” account from the system, ensuring that no unauthorized access is available to operators.

5. Create operator accounts, with the appropriate privilege designations, according to the steps in 5.1.2.

5.1.2 Adding a New User

To add a new user to the system,

1. Select Privileges from the User Menu.
2. Select the Add button.
3. Enter the new user name or operator name and click OK.
4. The administrator will be returned to the User Information screen with the new user or operator name displayed.
5. Enter the password and check boxes for all the privileges assigned to this user. The administrator can also enter any account information at this time.
6. Click OK to save all changes.

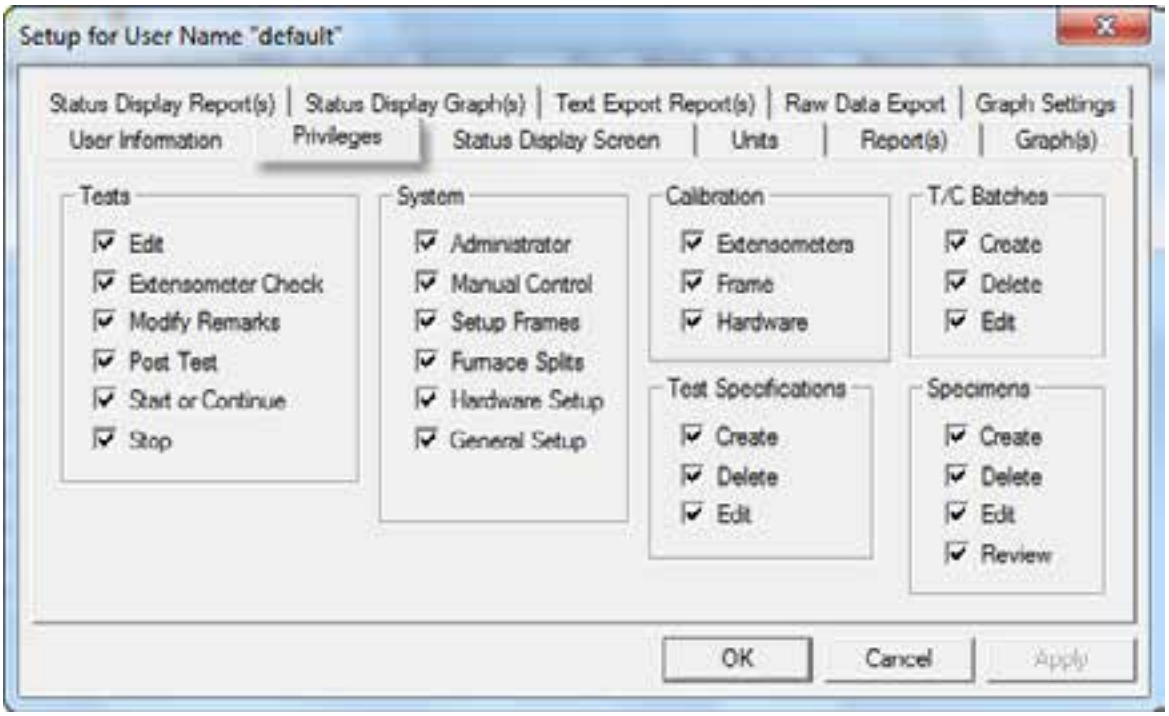
5.1.3 Deleting a User

To delete a user from the system:

1. Select Privileges from the User menu.
2. Choose the user for deletion from the User name pull-down menu.
3. Click Delete.
4. Ensure the named user is the one marked for deletion and click OK.

5.2 Privileges

Privileges are the specific tasks an operator is allowed to employ when working with the software. One administrator with full privileges is necessary. Normally, the ATS Service Department assigns an administrator login with full privileges.



To assign user privileges:

1. Select Privileges from the User Menu.
2. Select the Privileges tab.
3. Check the appropriate box to assign a privilege.
4. Click OK to save the changes.

To modify user privileges,

1. Select Privileges from the User Menu.
2. Click on the Privileges tab.
3. Enter the name of the user in the User Name pull-down list.
4. Make the appropriate changes by checking or unchecking the boxes.
5. Click OK to save the changes.

5.3 Passwords

To change the password of an existing user:

1. Select Account Information from the User Menu.
2. Enter the new password.
3. Click OK to save the changes.

5.4 Miscellaneous Functions

There are additional options available for customization under the Setup for User Name window. The user can:

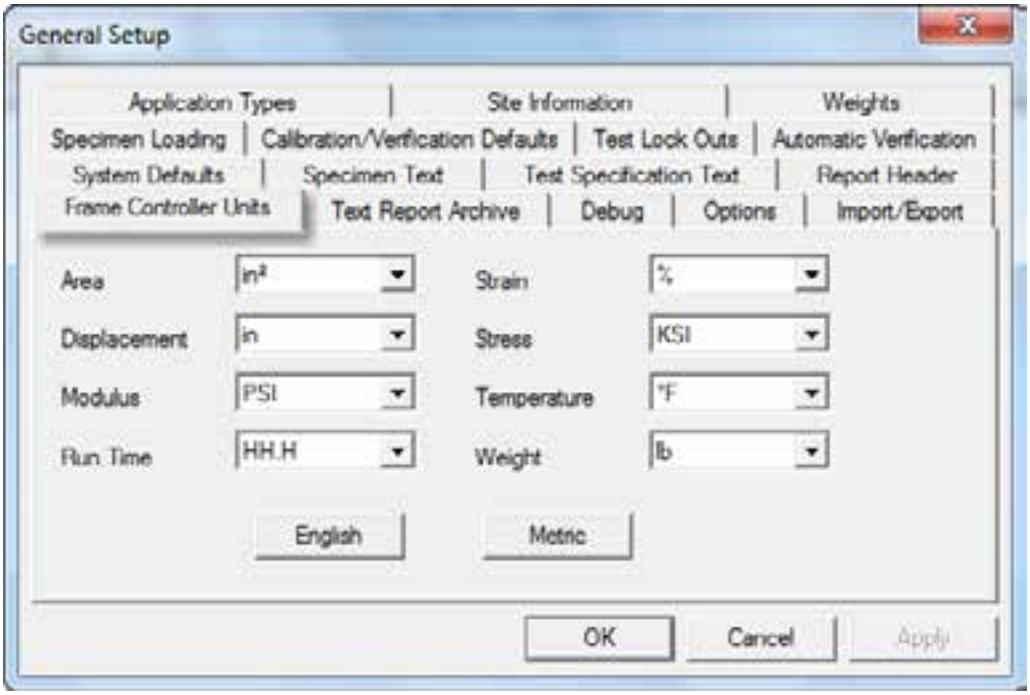
1. Change the units displayed on the screen by clicking on the Units tab. For example, one operator can choose to view data in metric units while another can view data in English units. Each unit can be chosen on an individual basis if necessary.
2. Modify the status display screen by clicking on the Status Display Screen tab.
3. Select the preferable status display graph by clicking on the Status Display Graph(s) tab.
4. Adjust graph line sizes to fit the screen or to fit printer requirements by clicking the Graph Settings tab. The typical default value for the screen is one pixel, and the printer default value is three pixels.

Section 6: System Setup

6.1 Setting System Units

System units of measurement can be easily set or changed at any time:

1. From the System Menu, select General Setup.
2. Click on the Frame Controller Units tab.



3. Choose the desired unit of measurement for each of the eight choices. To use all English or all Metric units, click the appropriate button.
4. Click OK to save the choices and close the screen.

NOTE: These steps apply to the units shown on the Classic WinCCS Console or the Portable Display Module. The units displayed on the computer screen are set under the Units tab in User—Privileges.

6.2 Frame Setup

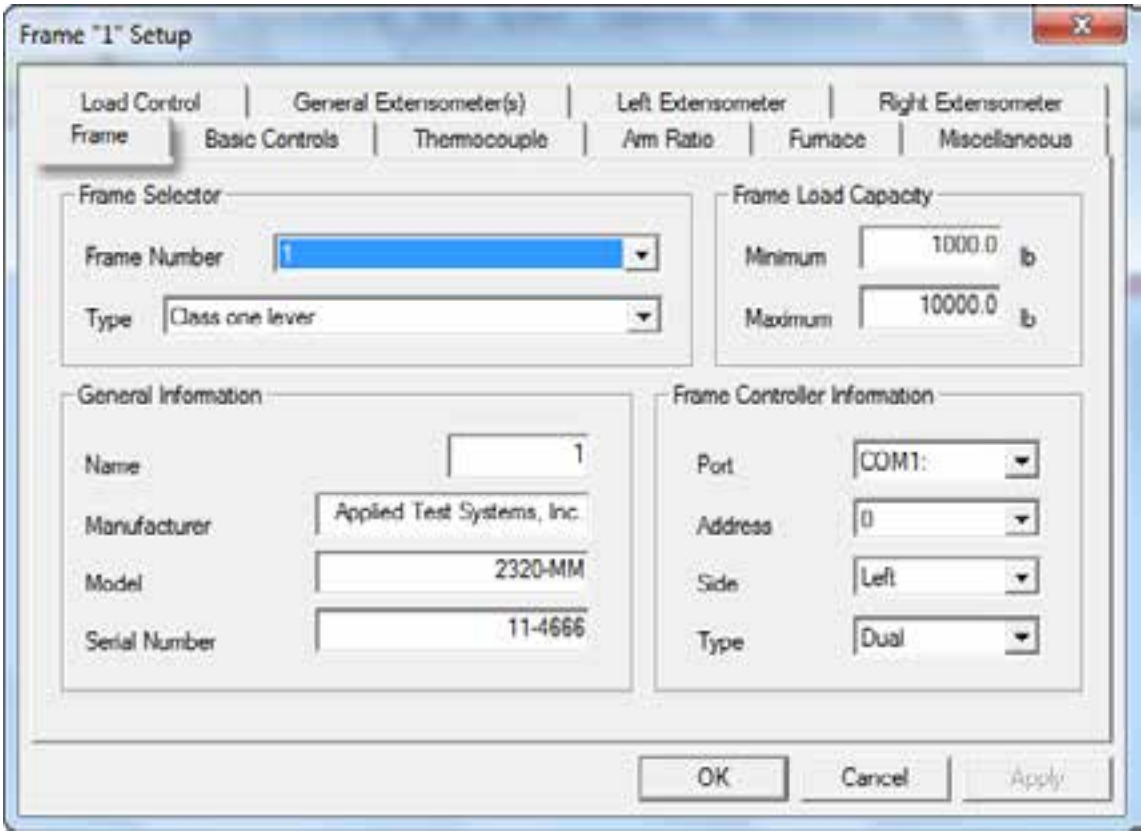
The following options allow the user to set up individual frame information.

6.2.1 Accessing Frame Setup

From the System Menu, select Frame Setup. The Frame tab will appear. Another option is to double-click the status line of a frame while holding down the shift key.

1. Indicate the frame to be set up by entering the frame number/name in the Frame Number pull-down list.

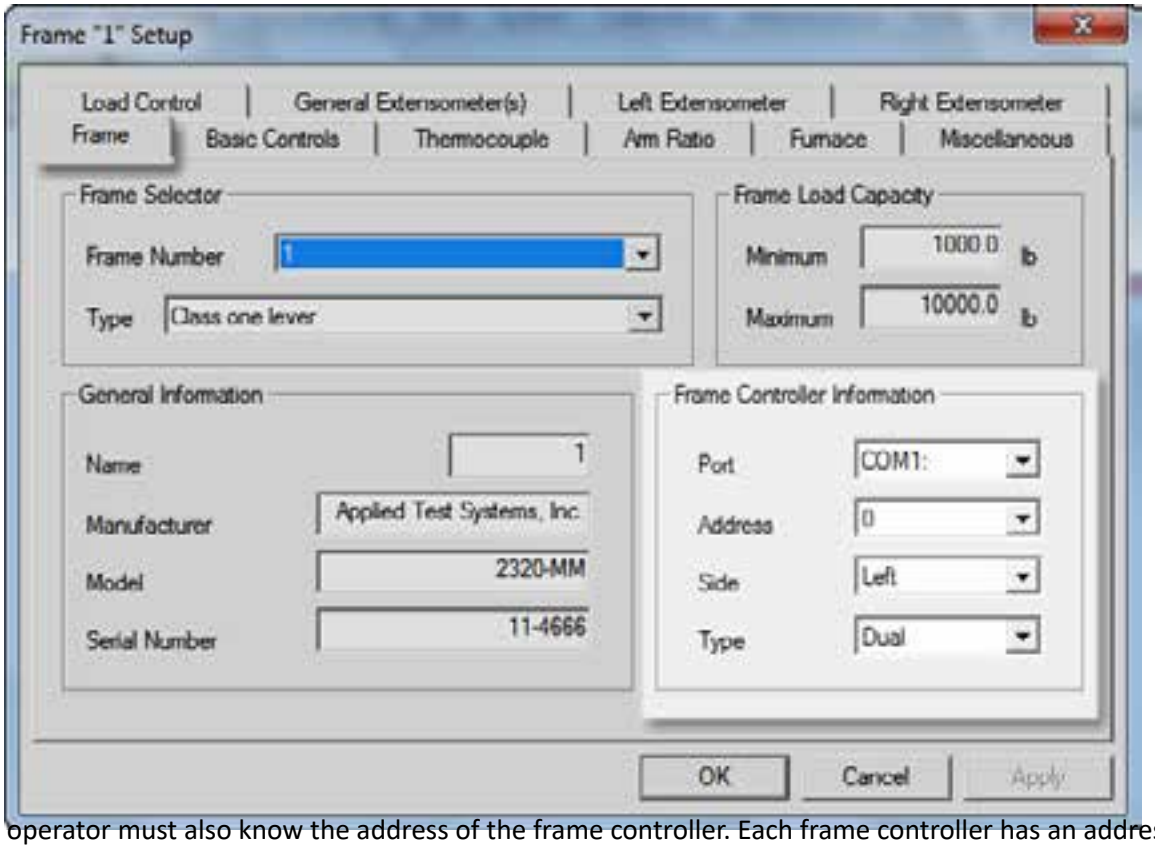
NOTE: Failure to select the proper frame is the single most common reason for setup errors.



2. After selecting the proper frame, select the Type from the pull-down list. Make sure the frame type agrees with the machine's specifications. The most common type is Class One Lever. If there is any doubt about the frame type, contact ATS at +1-724-283-1212.

6.2.2 Frame Controller Information

The operator must know the common RS422 port on which the cable between the computer and CPU Board is installed. Enter that information into the proper space.



The operator must also know the address of the frame controller. Each frame controller has an address from zero to 31, and each controller on a common port must be set to a unique address, which will be set by ATS personnel during setup. ATS personnel will determine which address is used by the controller servicing the frame that is being set up. Enter that address in the Address pull-down list under Frame Controller Information.

To locate a controller's address on WinCCS Classic, use the left side of the Frame Controller Box underneath the left display window and press both outside buttons in the set of three at the same time. The address will be displayed.

The WinCCS Modular requires the address to be set on the CPU Board via dip switches.

Each frame controller services two frames, and they have been designated left (main) and right (secondary). The controller is commonly mounted on the main tester. Enter the proper designation in the Side pull-down list under Frame Controller Information.

Except in the rare case that a frame controller is configured to support only one frame, the proper designation under Type should be listed as Dual.

6.2.3 Frame Load Capacity

The minimum and maximum frame loads are specified by the frame manufacturer, and it is important that the correct information be entered. The frame load specified during any test is checked against this information, and tests which require loads outside the specified limits are not allowed to run. This can protect the frame and load components from damage. To access frame load, click on System—Frame Setup and enter the appropriate information under Frame Load Capacity.

NOTE: Do not change the minimum load capacity, or the test will lose accuracy.

6.2.4 Frame Naming

Each frame must be given a unique name. The default name, which is the frame number, can also be used. To assign a specific name to a frame, go to Frame Setup. Click on the General Information box and enter the frame title in the Name box. The name entered in this space will be viewed on the status display screen and used in all reports and graphs.

At this point, the operator can now set up the various submenus listed under Frame Setup by clicking through the tabs.

6.2.5 Thermocouple Setup

There are spaces to specify four thermocouples (T/C). Typically, a creep furnace will use three control T/Cs on the specimen, and a space is made for a fourth "User" T/C for monitoring purposes. This fourth T/C may be used to monitor room temperature or any other temperature of interest. The temperature of this T/C can be displayed on the temperature graph of any test run on this frame, but it does not appear on the Status Display screen.

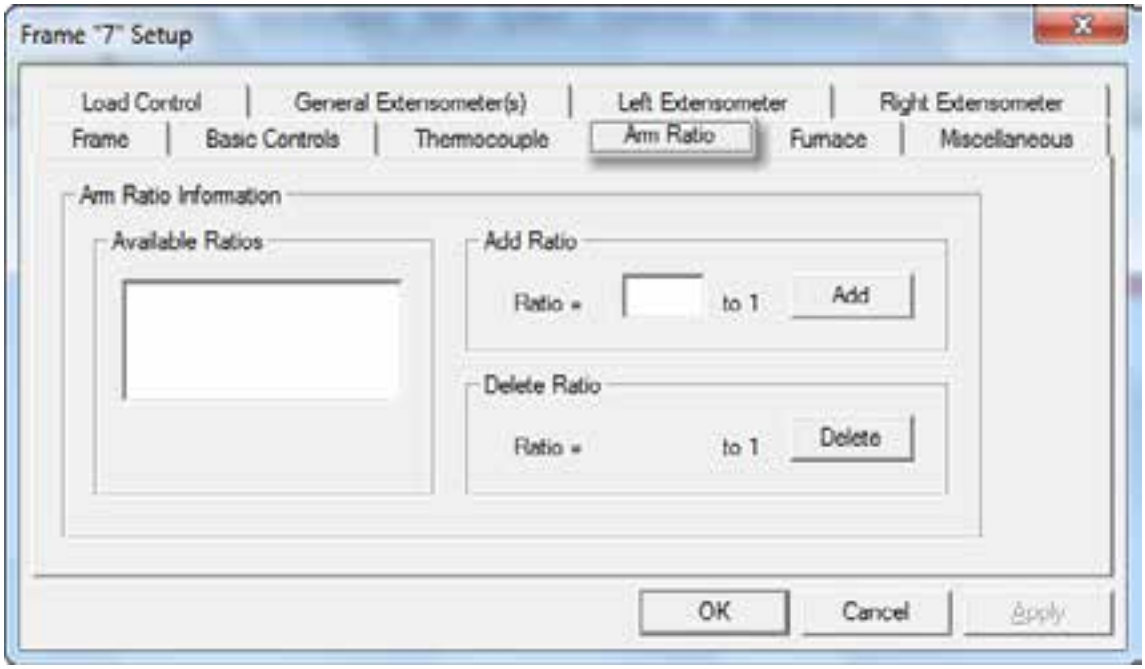
NOTE: Single-zone furnaces will only collect data and control temperature from the top thermocouple.

Enter the appropriate information in the boxes using the pull-down menu.

6.2.6 Arm Ratio Setup

Lever arm testers are available with a wide range of arm ratios, and some have multiple ratios available that are determined by the position of the arm. Therefore, in order for the system to calculate the proper pan load for the stress level specified, in must be told the proper arm ratio. Typical arm ratios are 20:1, 16:1, 10:1, 5:1, and 3:1.

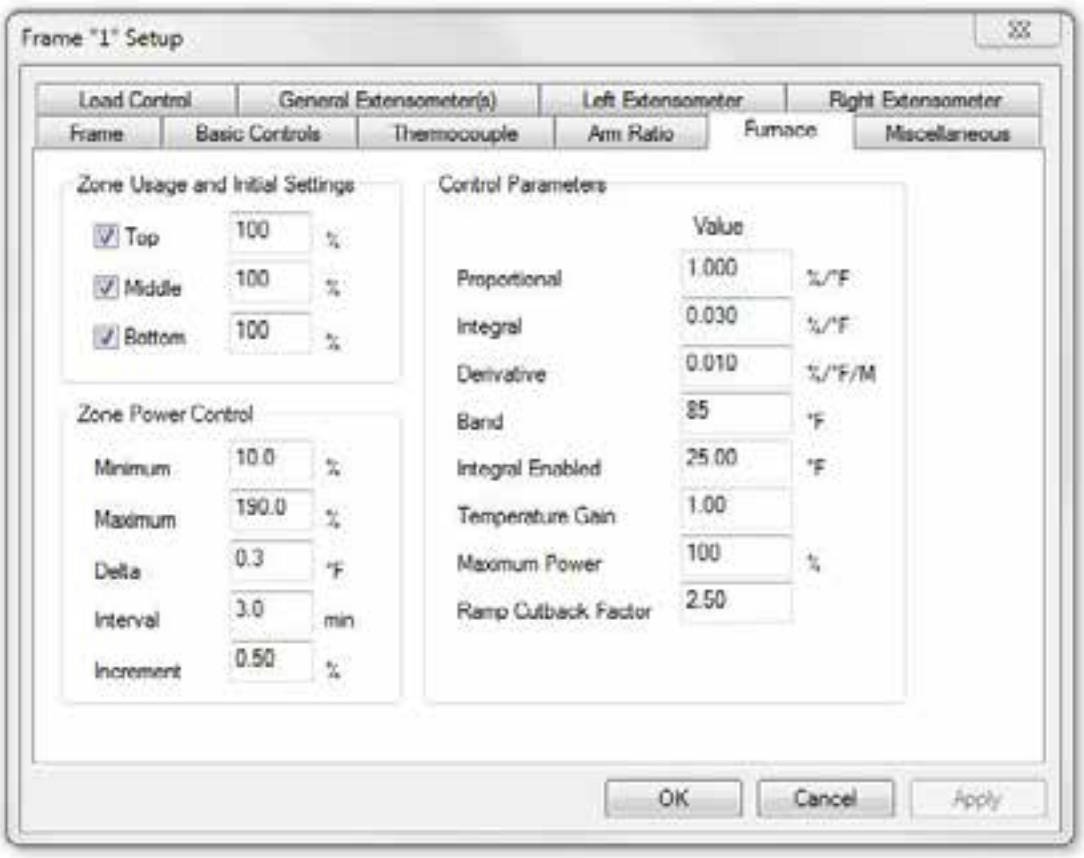
Under the Frame Setup menu, select the Arm Ratio tab.



1. Enter the dividend of the ratio into the Add Ratio box. For example, if the arm ratio is 20:1, enter 20.
2. Click Add and see that the ratio appears in the Available Ratios box.
3. To remove a ratio, highlight the ratio for deletion in the Available Ratios box and click Delete.
4. To edit a ratio, delete the old ratio using Step 4. Then, add the corrected ratio using Steps 1-2.
5. Click OK when finished.

6.2.7 Furnace Setup

Since many different types of furnaces and ovens can be attached to the test frame, it is important to set the proper parameters in the system before testing begins. Select the Furnace tab from the Frame Setup menu.



Zone Usage and Initial Settings: Check the appropriate boxes to indicate the number of independent control zones in the furnace that are attached to the frame. These settings must agree with the wiring configuration. If the correct configuration is unknown, refer to the installation drawings or consult ATS at +1-724-283-1212.

The typical installation will have three furnace zones. Special circumstances, such as the use of either a high temperature furnace or a box oven, may require a single control zone.

NOTE: The number of thermocouples attached to the specimen is not necessarily the same as the furnace zone number.

NOTE: Single-zone furnaces will only collect data and control temperature from the top thermocouple.

Zone Usage and Initial Settings/Initial Power Split: During the ramp of the furnace to the setpoint, no attempt is made to balance the power into zones. Equal power is applied to all zones. Due to the nature of the furnace, and the chimney effect, the bottom zone will normally be colder than the others. Due to the cooling effect of the top pull rod, the top zone may or may not also be colder.

After observing the temperature graphs of several tests, the situation regarding differential temperatures may be apparent. NOTE: The relative temperatures vary as the overall temperature approaches the setpoint. The only relevant data is the information near the setpoint.

If one zone is always significantly colder or hotter (at least 15 degrees) as the setpoint is reached, then the initial power split may be changed to improve the balance of the zones. This will result in less time spent in the presoak state because the computer will have fewer changes to make to get all zones within the minor alarm limit. The test can then proceed to the programmed soak time.

NOTE: When changing this initial power split, it is important to note that if power is added to one zone, it must be taken from another zone. The total of the three zones must still equal 300.

For example, if the bottom zone is 35 degrees low when the top zone reaches the setpoint value, removing some of the power from the top zone and redistributing it to the bottom zone may solve the problem. Setting the values at Top 90, Middle 100, and Bottom 110 can help. Evaluating the changes is the only way to test its effectiveness.

If the zones are within 10-15 degrees, changing the initial split values in this section will not make enough of a different.

Zone Power Control: This section gives the system information about furnace zone control in order to ensure optimum temperature stability and furnace performance. The values given in the original setup will rarely change. If a change seems necessary, contact ATS. Typical values are:

Minimum 10%

Maximum 190%

Delta 0.3°F

Interval 3.0 min

Increment 0.50%

Control Parameters: The system uses a PID algorithm to determine the power needed in each zone to maintain the specimen temperature at a value near the specified setpoint value. Since furnaces vary widely in size and power rating, the PID terms will probably require “tuning” in order to realize optimum operating performance from the furnace.

The following are typical default terms that will serve as a starting point and help achieve optimal settings:

NOTE: Unlike other setup parameters, the PID parameters may be changed while the furnace is operating.

P (Proportional) Default value 1.000%/°F: The Proportional term (P) is in control during ramp to setpoint. The Integral term (I) is enabled when the temperature reaches the difference between the setpoint and Integral Enabled value, which is normally set at 25°F and should not be changed. To experiment with furnace tuning:

1. Set the I term to zero and raise the P term until there is an oscillation of temperature. Reduce the P term until oscillation disappears. This is the optimal value for the P term.

2. Increase the I term until the transition from ramp to steady state setpoint value is a smooth, continuous curve without overshoot. This should occur within a reasonable time. If overshoot exists, reduce the I term. If the transition time is excessive, increase the I term.

NOTE: It should not be necessary to change the remainder of the default values. Consult ATS at +1-724-283-1212 if satisfactory temperature is not achieved.

I (Integral) Default value 0.030%/°F: The I term is enabled during the latter part of the ramp function.

D (Derivative) Default value 0.01%/°F/M: The derivative term will not need to be changed under normal circumstances. Consult ATS at +1-724-283-1212 before changing this term.

Band Default 85°F: This is the amount of "swing" allowed to the control parameters, meaning the WinCCS control box varies the parameters during the control process as necessary. For normal creep furnaces, this value will not need to be changed. Contact ATS for questions.

Integral Enabled Default 25°F: This is the point on the ramp, in degrees, at which the control algorithm enables the I term as the temperature approaches the setpoint value. In the case of the value set at 25°F and the set point at 1000°F the I term will be enabled at 975°F. Enabling the I term prematurely results in a longer time to reach the setpoint. Enabling it later may contribute to overshoot when the setpoint is reached. It is seldom necessary to change this value.

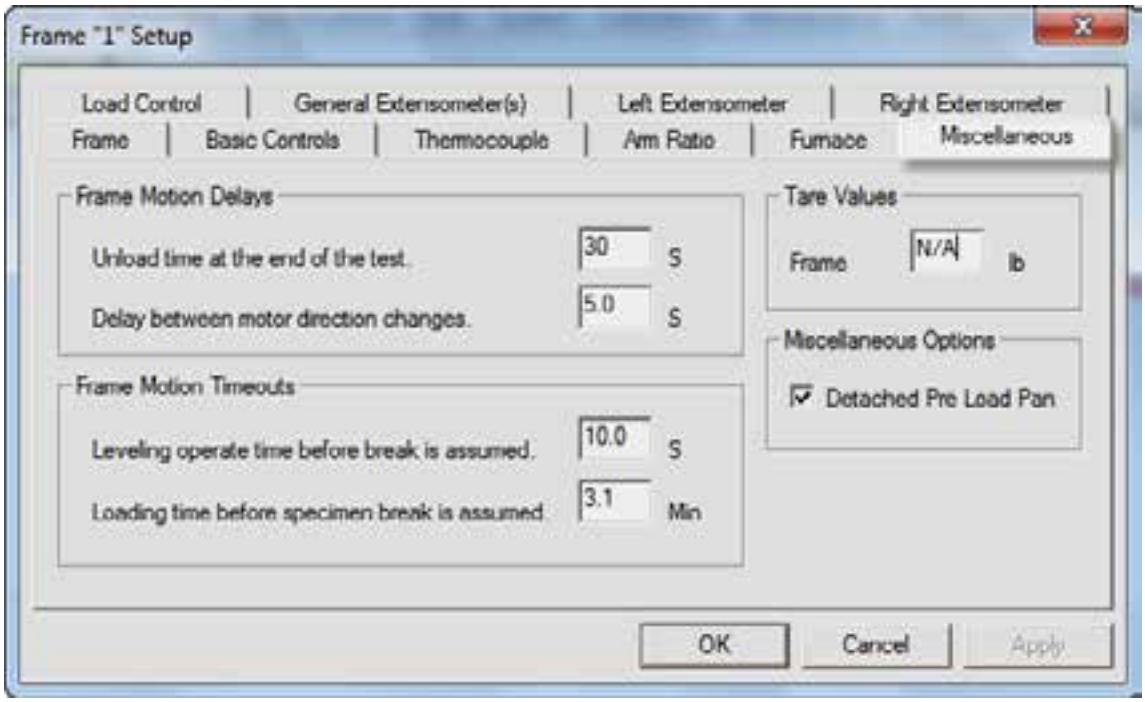
Temperature Gain Default 1.00: This gain term is not normally changed.

Maximum Power: This is normally set at 100%, which allows the control system to make use of the full potential of the furnace. If full power is not needed from the furnace, set this default to a lesser value. The control system will limit the power applied to that value.

Ramp Cutback Factor: As the setpoint approaches, furnace power is automatically cut back from the transition between the ramp and the steady state. This avoids overshooting and creates a steady, continuous curve. The value of this cutback is typically set at 2.50 for a creep furnace.

6.2.8 Miscellaneous Setup

There are miscellaneous items that must be specified. These are established at the time of installation, but may need to be changed for various reasons. Contact ATS at +1-724-283-1212.



Frame Motion Delays: Delays are sometimes needed between the control input and the resulting action in order to protect the hardware. In most cases, the unload value is not used and the box is left clear.

The unload time at the end of the test is the amount of time that the drawhead will run to remove the load at the end of the test. The time must be long enough to fully remove the load; however, the time must not be excessive or damage can result to the tester, load train, extensometer, or furnace.

On frames with motorized drawheads or elevators, a manual control delay is essential. If the motor has not stopped before the reverse motion command is given, the motor may continue to run in the original direction. If both commands are given simultaneously, the motor may be drawing excessive current and will be damaged. This can also cause protective devices to open. To avoid these issues, a three-second delay is normally used. When a reverse direction is specified, the frame motion controls on the system console will be inactive for three seconds, allowing the motor time to stop and reverse safely.

NOTE: A casual operator may be unaware that this delay is a safety measure rather than a sign of equipment malfunction. It is essential for operators to understand this safety feature.

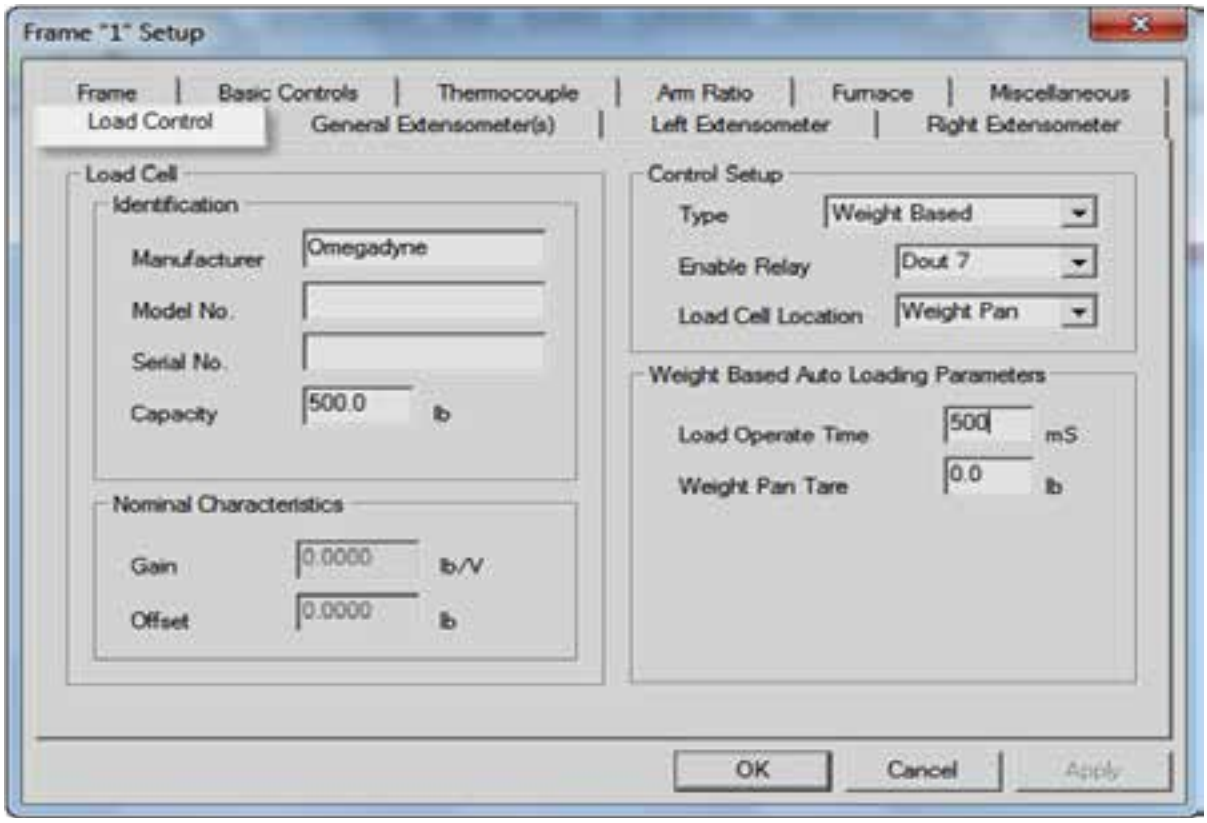
Frame Motion Timeouts: If the computer commands a motion and does not see the result through the switch inputs, it will indicate that something is not right. For example, if the computer commands level, and the drawhead low limit and specimen-loaded switches have not acted, the computer assumes the specimen is not intact and indicates a specimen break. The time between commanding the action and making the resulting decision is specified by the timeout entry under the Miscellaneous tab. While the specimen level value can be left unspecified, the break value is normally set at 30 seconds.

Tare Values: The tare value is the weight of the main load pan and the chain below the preload pan. This value is used during the automatic load cell calibration, which is part of the modulus calculation. It has nothing to do with the calculation of the pan load for stress level.

Miscellaneous Options: This option is selected if the tester includes a preload weight pan. The computer uses this information to instruct the operator on how to load the frame.

6.2.9 Load Control/Automatic Loading Setup

Under Frame Setup, Click on the Load Control tab.



Load Cell Information: Data for this menu is determined by ATS and should not be changed without instructions from the ATS support contact. Some tuning of individual frame types is routinely required, and this will be done at the time of installation. In the event that the load control is not functioning properly, or the configuration of the hardware changes, consult ATS at +1-724-283-1212 for the procedure required to make changes.

Control Setup: There are two types of automatic loading: weight-based and load control. Choose the appropriate load type from the pull-down menu in the Control Setup box. If the tester does not have a load cell, select None. If the tester has a load cell with weights, choose the Weight Based option. If the tester has a load cell with no weights, select Load Control.

Weight Based Auto Loading Parameters: Loading parameters of the load cell are specified by the manufacturer and are indicated on the data sheets supplied with the load cell.

NOTE: In the event of load cell replacement, this data should be updated.

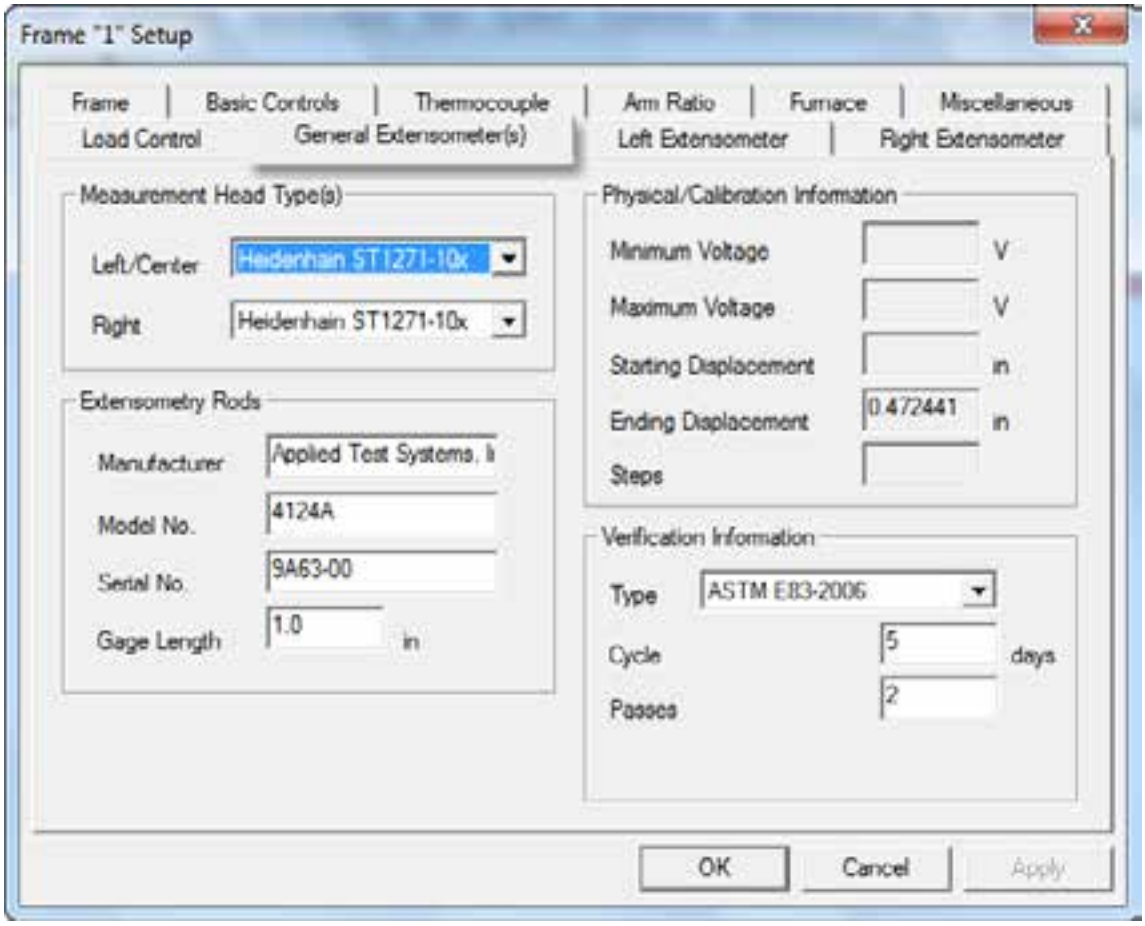
The only other information effecting the operation of the frame is Weight (Load) Pan Tare. This is the weight of the main load pan, not of the preload pan. Since this weight is balanced out during the frame balancing procedure, this tare is not subtracted from pan weight. Instead, it is used during the automatic hot step loading process.

CAUTION: Do not change the Load Operate Time of 500mS without consulting ATS.

6.2.10 Extensometer Setup

NOTE: The term “extensometer” is often used to describe the displacement transducer or encoder mounted on the bottom of the actual extensometer frame. This manual uses this definition for “extensometer” throughout this manual.

To access the General Extensometer submenu, go to Frame Setup and click on the General Extensometer(s) tab.



Measurement Head Type(s): Some extensometer frames provide the use of two extensometers, and the system will average the results for better creep data. If one extensometer is used, enter its description in the Left/Center box. Enter “none” in the Right box. If two are used, enter their descriptions in the appropriate boxes. The Left/Center and Right designations will be used during calibration and verification. The designation of the extensometers is determined by the electrical connections to the signal conditioner board located in the system console.

NOTE: Inadvertently switching extensometers during any phase of operation will result in faulty data.

Extensometry Rods: All information listed under Extensometry Rods, including Gage Length, is for reference only and does not have any effect on the data or calibration process.

Enter the gage length of the extensometer frame. This entry does not influence strain reporting; it is used in extensometer grading only.

Physical/Calibration Information: Enter the appropriate information under Physical/Calibration Information. Consult ATS if the proper voltage or displacement information is unknown. The number of steps tells the calibration and verification program how many data points to take. Ten is the most common value.

Verification Information: There is a choice of a single pass or ASTM-specified multi-pass verification. If ASTM is selected, two is the minimum number of passes. The ASTM procedure will choose the amount of required steps. If single pass is selected, one is the default number of passes. The user selects the number of steps. The default number of steps is ten and will appear in a box under the number of passes.

There is also a choice of assigning a verification cycle. This option enables the user to designate the amount of time needed for re-calibration. For example, if 365 is entered in the cycle box, the equipment will not need to be re-calibrated for 365 days. Click Apply , then OK, if all the information is selected and/or entered.

6.2.11 Left/Right Extensometer Tabs

Under Frame Setup, choose the Left Extensometer tab. If the identification numbers are not entered, then enter them now. Choose the Right Extensometer tab. Again, check the identification numbers. Both sides should be the same except for the serial number. This information will appear in the report.

Click OK when finishing the Left/Right Extensometer tabs.

This completes the frame setup procedure. To view a summary of the frame setup parameters, double-click the status line of a frame while holding down the shift key.

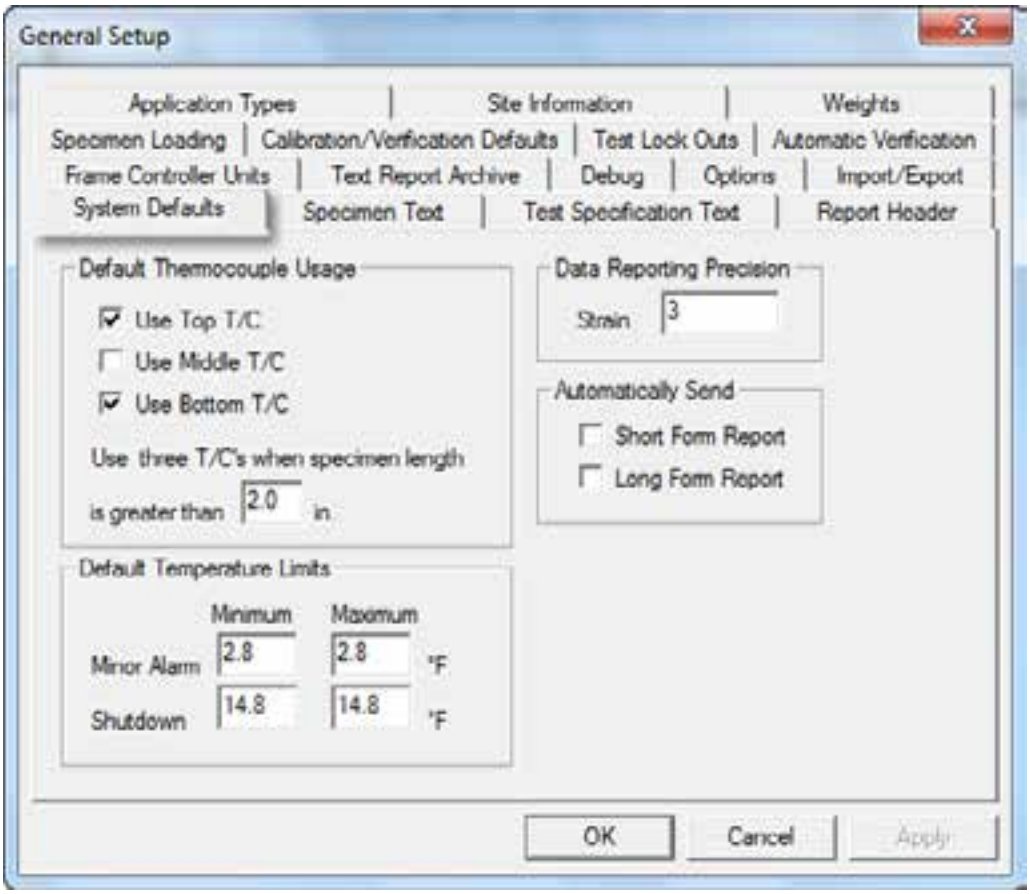
6.3 General Setup

General system setup includes basic settings for the system. To access these settings, select General Setup from the System Menu. The System Defaults tab will appear.

6.3.1 System Defaults

While all the settings under this tab can be entered during the test creation process, entering information that is common across all tests in this default tab can save the operator time when creating a test. Setting these parameters in this tab should only be applied if they are common across all tests.

NOTE: If the setting occurs only some of the time, leave these sections alone and go instead to the test creation process to make individual test decisions.



Default Thermocouple Usage: Tests are typically run with three thermocouples, regardless of the number of control zones in the furnace. All three boxes will be checked here under those circumstances. If specimen testing on this frame will commonly require one or two thermocouples instead, check the appropriate boxes for the number of thermocouples in use.

NOTE: ASTM E139 recommends three thermocouples for a specimen with 50mm or longer reduced sections and two thermocouples for specimens shorter than 50mm.

Default Temperature Limits: Two separate alarm bands are maintained by the temperature control system. The first band is the minor alarm, and it will notify the operator of an unusual condition that is not serious enough to warrant stopping the test. When the minor alarm is triggered, the temperature is logged in the test event log. It is also going to be indicated in red on the system status display and will flash on the frame controller. High and low limits are programmable upon creation of individual test specifications, but common default values can be set on this screen. Typically, the minor alarm is set at ±3°F for temperatures up to 1800°F (1000°C), which adheres to the ASTM suggested excursion limit.

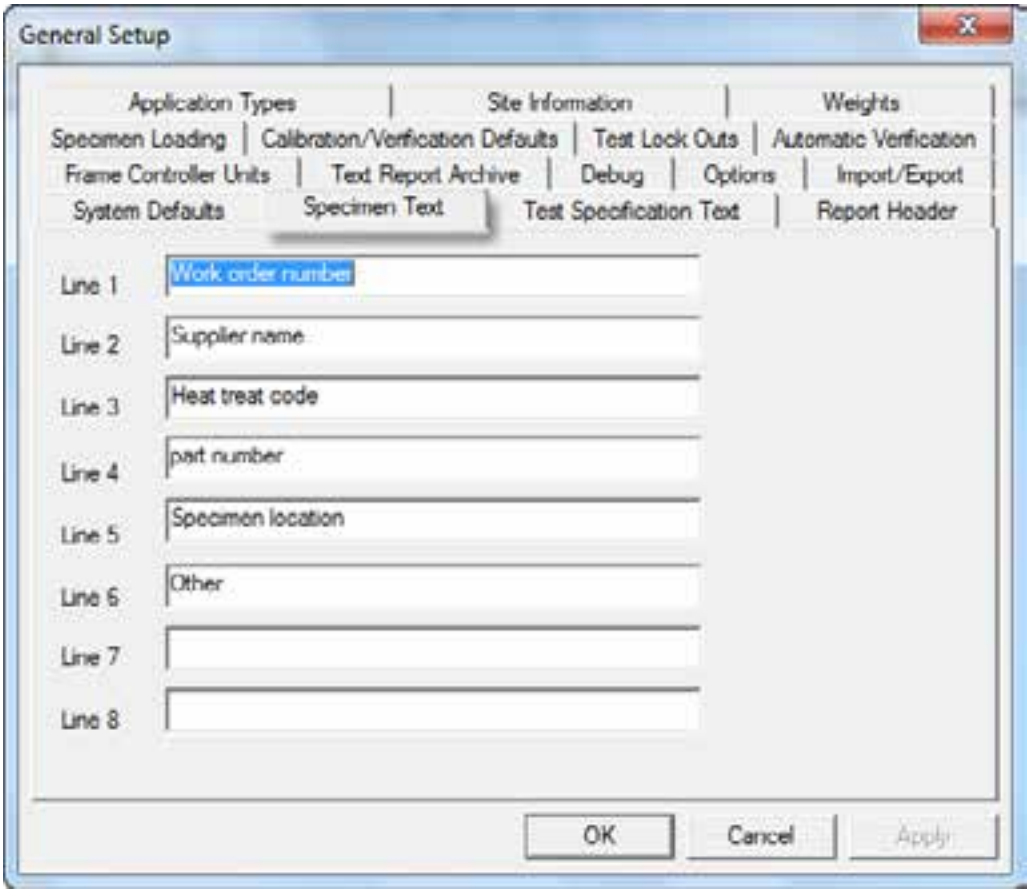
NOTE: The minor alarm value is also the point where the system performs control decisions and state changes during the ramp process.

The second alarm band maintained by the temperature control system is the shutdown alarm. This terminates a test if there is major temperature fluctuation. For example, if the temperature excursion exceeds the set value, the test will automatically shut down, and the event log will record that the shutdown alarm was triggered and the test aborted. Typically, this default value is set at 15°F.

NOTE: Once temperature stability is reached, the temperature will seldom exceed 3 degrees Fahrenheit above or below the setpoint. It should never exceed 15 degrees Fahrenheit above or below unless something has failed.

Automatically Send: It is possible to automatically send either a long form or a short form report to a remote location at the end of each test. This assumes that the computer is equipped with a network card and is configured to be on the network. If this is desired, check the appropriate box, and the report will be sent automatically to the archive files (see section 6.3.10) at the end of the test.

6.3.2 Specimen Text



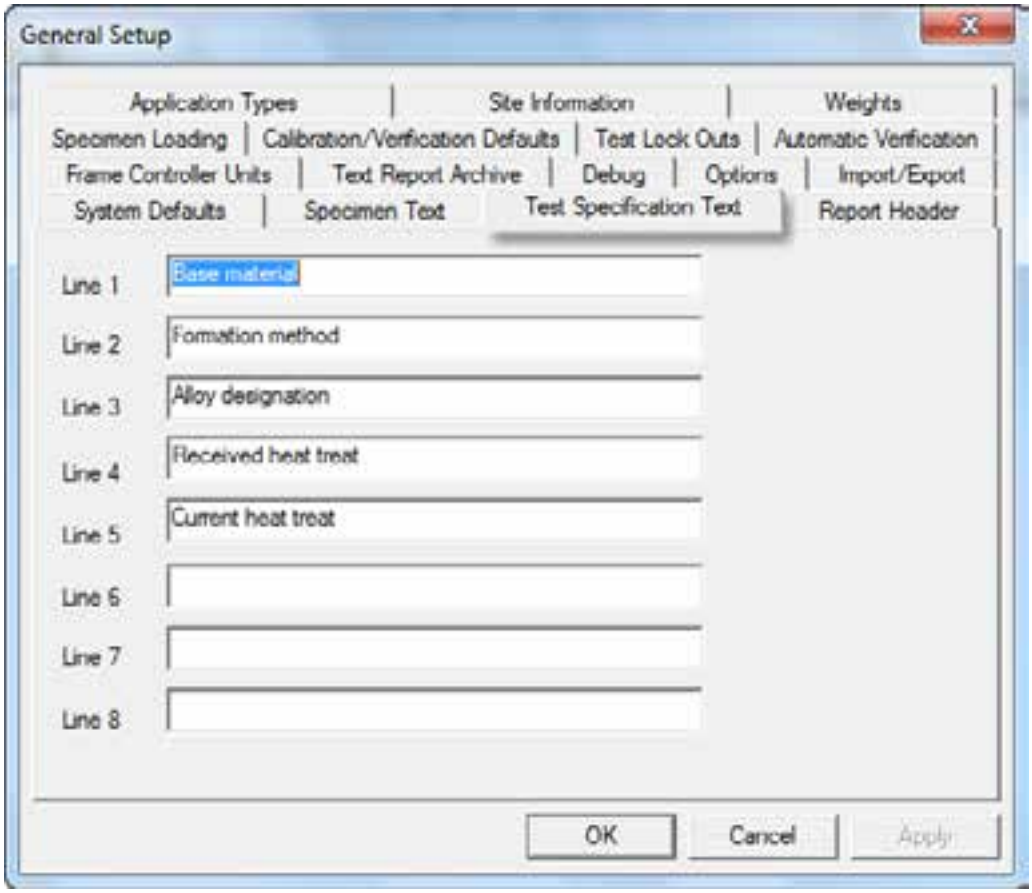
When creating a test, a text field appears that asks the operator to enter specific information about the specimen. Since individual installations may require different information, the titles of these text fields are specified here.

Under the Specimen Text tab, enter the text fields desired. Only the fields containing text will be shown to the operator when creating a test.

To view the application of these text fields, select Create under the Specimens Menu. This information will appear on the Text Information page of the specimen creation process.

NOTE: These text fields are optional. Only essential information, like specimen dimensions, is required by the system before running a test.

6.3.3 Test Specification Text



When creating a test, a text field appears that asks the operator to enter specific information about the test. Since individual installations may require different information, the titles of these text fields are specified here.

Under the Test Specification Text tab, enter the text fields desired. Only the fields containing text will be shown to the operator when creating a test.

To view the application of these text fields, select Create under the Specification Menu. This information will appear on the Specification page of the test creation process.

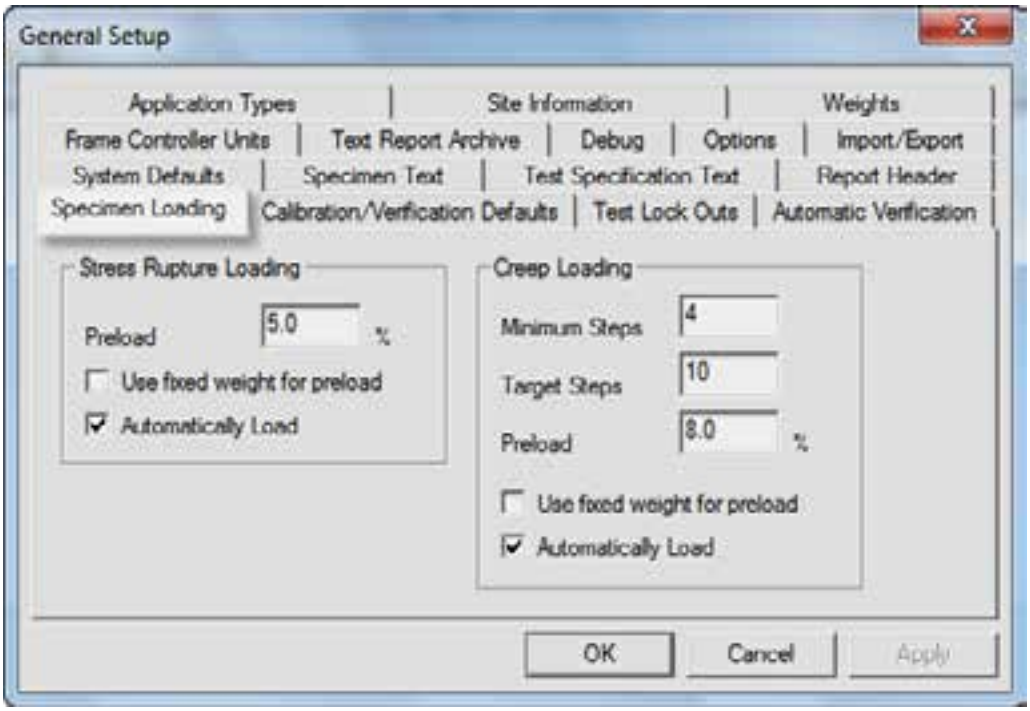
NOTE: These text fields are optional. Only essential information, like specimen dimensions, is required by the system before running a test.

6.3.4 Report Header

Each report and graph contains a header, which is automatically inserted by the system. Under the Report Header tab, insert the desired information into the text fields.

6.3.5 Specimen Loading

This section establishes defaults for the loading of stress rupture and creep specimens. The menu is located under the Specimen Loading tab of the General Setup menu.



Stress Rupture Loading: ASTM suggests that the preload should be no more than 10 percent of the total load. Typically, eight is the default value for this section. If the test requires a fixed preload, check the Use Fixed Preload box and enter the fixed load in pounds into the Preload window. This value may be changed if necessary when a test is started.

If automatic loading of the specimen is desired once the programmed soak period has expired, check the Automatically Load box.

Creep Loading: The Minimum Steps value is the lowest number of loading steps to be calculated for the loading process. This value is typically set at four.

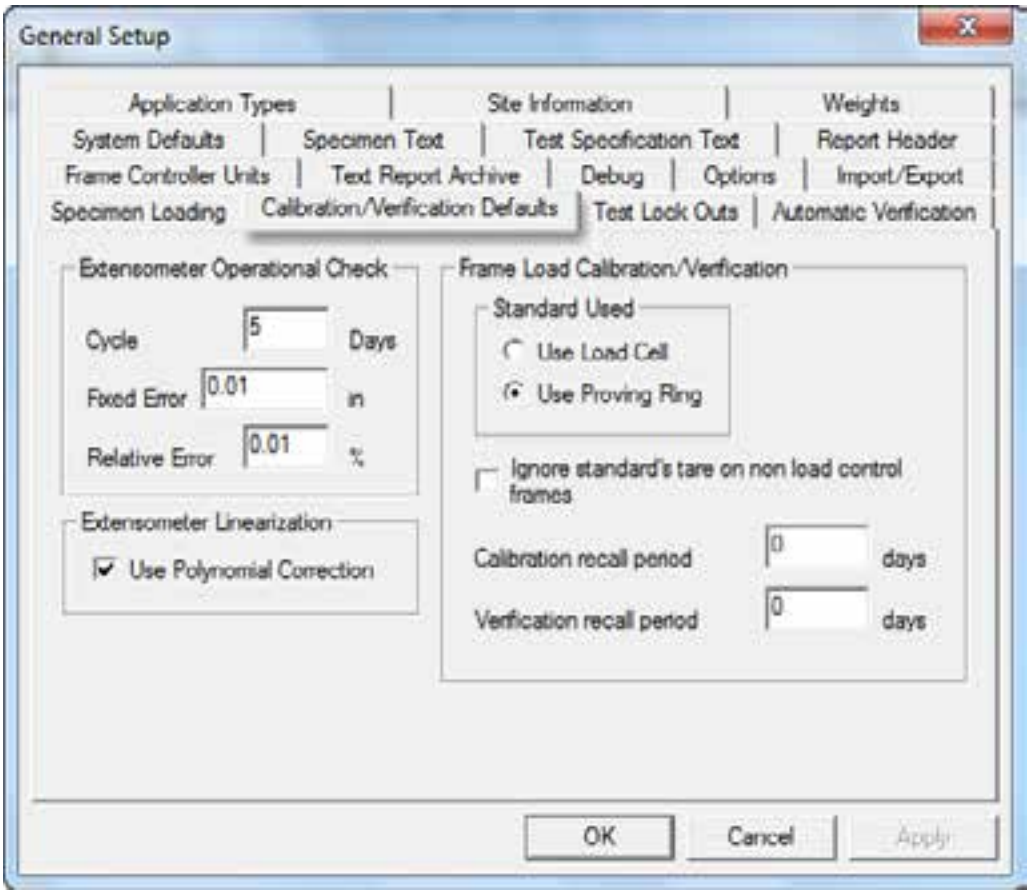
The Target Steps value is the optimum number of steps used to reach the specified stress level. In some cases, the pan load is so low that it is not practical to divide it into the targeted value. The Target Steps value is generally set at ten.

ASTM suggests that the preload should be no more than 10 percent of the total load. Typically, eight is the default value for this section. If the test requires a fixed preload, check the Use Fixed Preload box and enter the fixed load in pounds into the Preload window. This value may be changed if necessary when a test is started.

If automatic loading of the specimen is desired once the programmed soak period has expired, check the Automatically Load box.

6.3.6 General Calibration

The General Calibration menu is found on the Calibration/Verification Defaults tab under the General Setup menu.



Extensometer Operational Check: This area allows details of the extensometer operational check to be specified by the user. It is an abbreviated version of the extensometer calibration setup from the Frame Setup menu.

Extensometer Linearization: Normally, a polynomial curve fit is used to reduce the effect of the non-linear output found in LVDT transducers. This will greatly improve performance of the average LVDT and permit most extensometers to achieve ASTM class A or B1 performance. To use this correction, check the box.

Frame Load Calibration/Verification: This section allows the option of calibrating the frame with a load cell rather than the traditional proving ring.

To ignore the tare measurement listed for the load cell on non-load control frames, check the box. To review load cell information, select Load Cell(s) under the Frame tab on Calibration.

The Calibration and Verification recall periods allow the user to set the amount of time to pass before the next extensometer calibration.

NOTE: Frames must be recalibrated annually. If a frame is not recalibrated, it will finish a currently-running test on the frame, but no new tests can begin. Call ATS at +1-724-283-1212 to schedule recalibration. Be sure to call in advance to ensure the procedure is scheduled in enough time.

6.3.7 Test Lockouts

This section prevents the operator from starting tests when various system components have not been calibrated. All blocks in this section must be checked. Consult ATS at +1-724-283-1212 to schedule recalibration.

6.3.8 Application Types

When creating a test specification, an application type is required. Under the Applications tab, add or subtract specific applications from the list of entries in this field. Once a test is being created, the operator can then pull from this list, ensuring uniformity of data across tests and test frames.

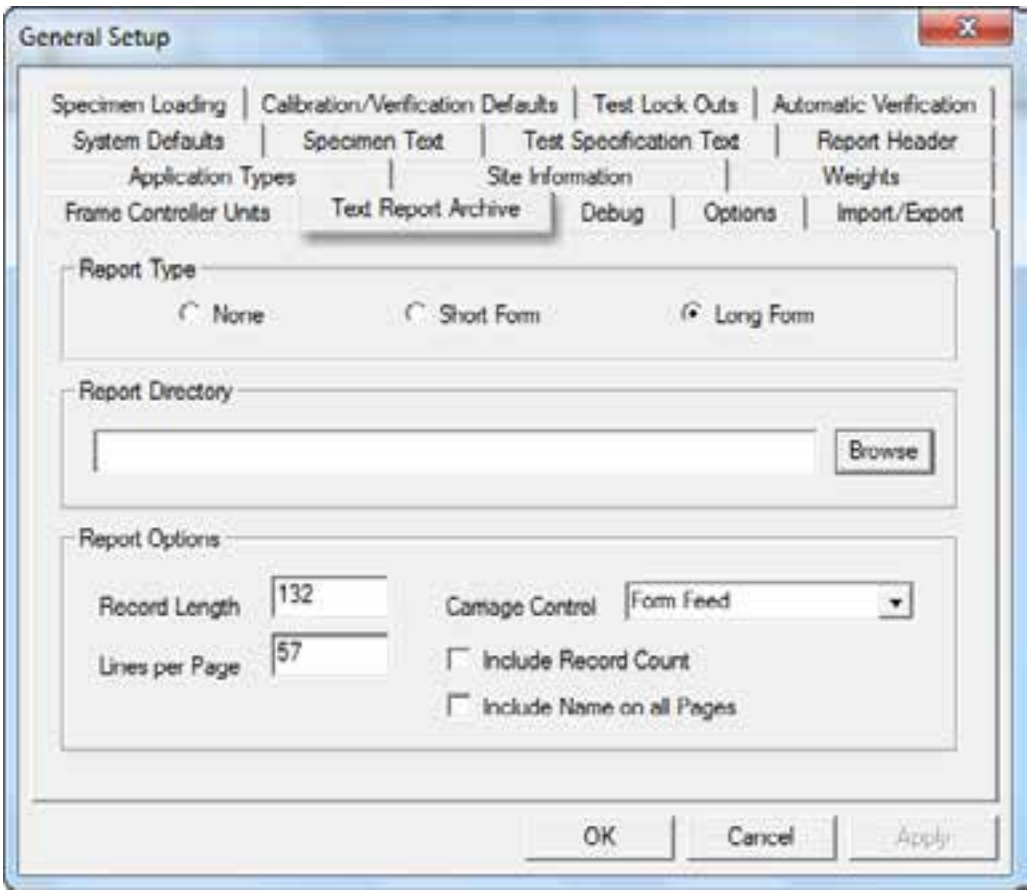
6.3.9 Site Information

The site information refers to the name of the lab that conducts the testing. This will appear on all system reports. Enter the appropriate information under the Site Information tab.

6.3.10 Additional Options

Under the General Setup menu, there are additional tabs that allow the user to set default information for the system.

Text Report Archive: This feature enables the operator to select the directory where the test reports should save each time a test runs. Select the directory using the Browse button.



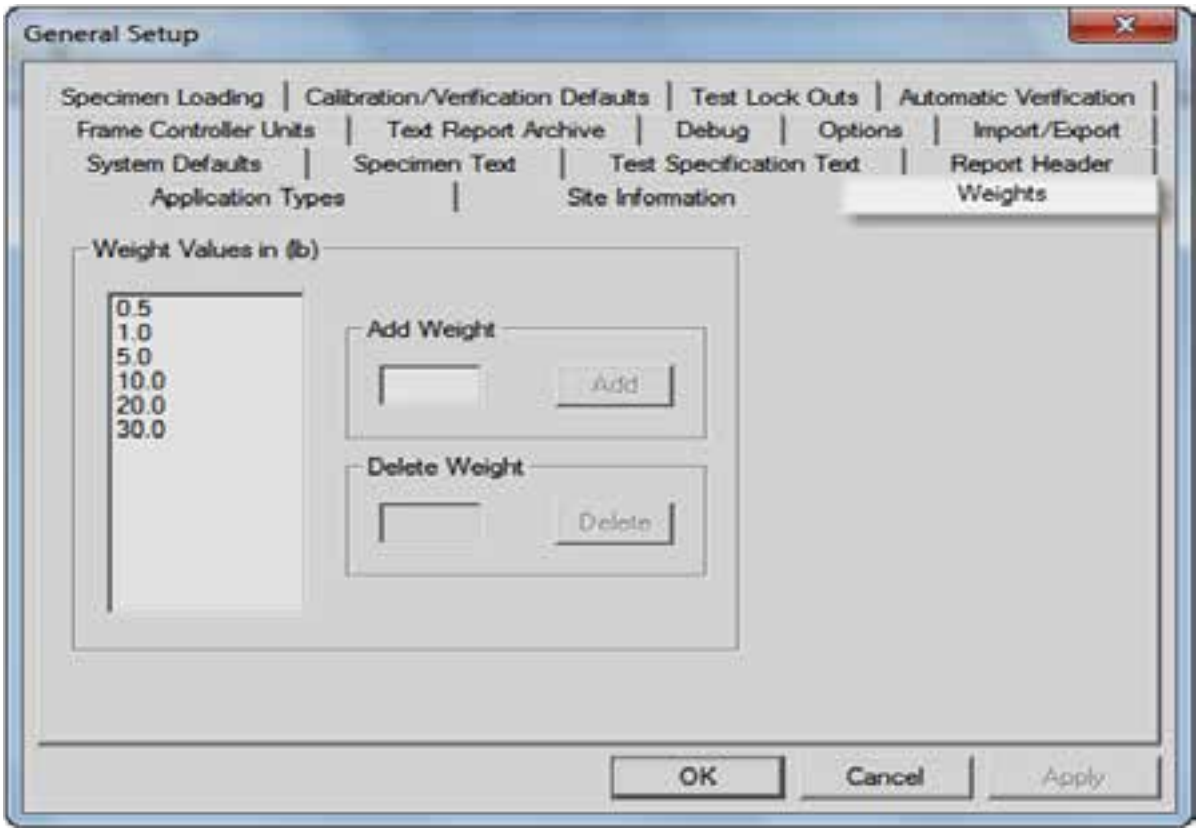
Debug: This tab is used exclusively for troubleshooting purposes by ATS personnel.

Options: This tab is not used on ATS testers at this time.

Import/Export: This tab is not used on ATS testers at this time.

Automatic Verification: This tab is not used on ATS testers at this time.

Weights: In this tab, the user can add weights to match the complement of weights available for use with the tester. Typical systems are supplied with the following weights: 0.5lb, 1.0lb, 5.0lbs, 10.0lbs, 20.0lbs, 30.0lbs. The systems may also be supplied with metric weights 2.5N, 5.0N, 25N, 50N, 100N, 150N. To add weight values, enter the value, in pounds or Newtons, into the Add Weight box and click Add. To Delete, select the weight in the Weight Values box on the left of the screen. Click Delete.



This completes the general setup procedure.

6.4 Thermocouple Circuit Board Calibration

CAUTION: ATS SERVICE PERSONNEL HAVE ALREADY CALIBRATED THE THERMOCOUPLE BOARD BEFORE THE MACHINES AND COMPUTERS ARRIVE AT THE SETUP LOCATION. For questions, contact ATS Service Personnel at 724-282-1212.

See Section 8 for instructions on thermocouple and extensometer calibration.

6.5 Clock Speed

The clock speed on the WinCCS Circuit Board is checked during the manufacturing process. See figures below to locate the clock on the WinCCS Circuit Board for both the Modular and the Classic testers. Using a frequency counter with a 1-second gate time, the cManlock speed must be between the following low and high limits:

Nominal Value: 16.777216 Mhz

Low Limit: 16.760439 Mhz

High Limit: 16.7933993 Mhz

Figure 1 – Clock Location on Modular Testers

Figure 2 – Clock Location on Classic Testers

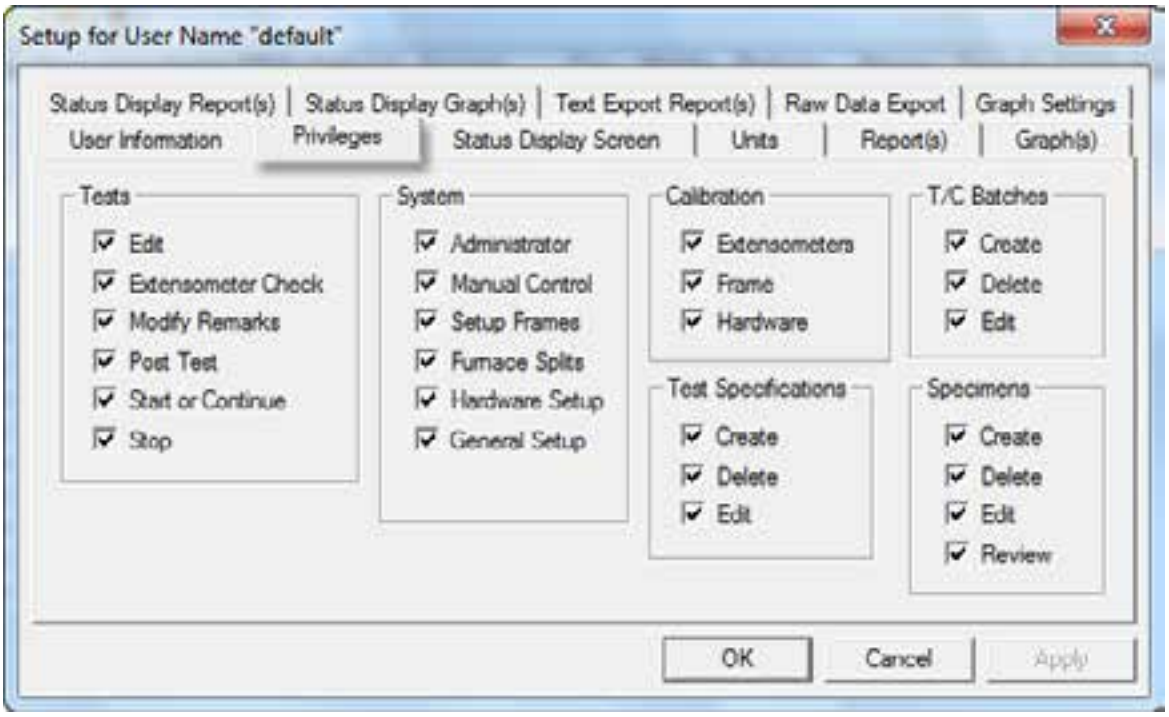
Section 7: Operation

7.1 General Overview

The General overview section describes two important features of WinCCS, User Login and Logout and System Status Screen Information, and gives a general overview of system operation.

7.1.1 User Login and Logout

WinCCS incorporates password protection and individual operator identification. When an operator takes any action, such as calibration, test start-up, specification editing, etc., the identity of the operator is archived with a record of the action. The operator identification is the name assigned to the operator logged in at the time the action is taken. Therefore, it is important that each operator ensure that s/he logs out when not responsible for the system. Before any action can be taken (other than viewing status and test information), an operator possessing the appropriate privileges must be logged in.



These steps eliminate unauthorized and potentially damaging actions from occurring. When no operator is present, no operator should be logged in. When operators change, the new operator should log in.

1. Access the user login screen by clicking on User, then Login.

2. When the login screen appears, type in the name of the user.

3. Enter the password in the Password field.

4. Click OK. The user is now logged in.

NOTE: If an operator is logged in and a second operator logs in, the system recognizes the identity and privileges of the new operator only.

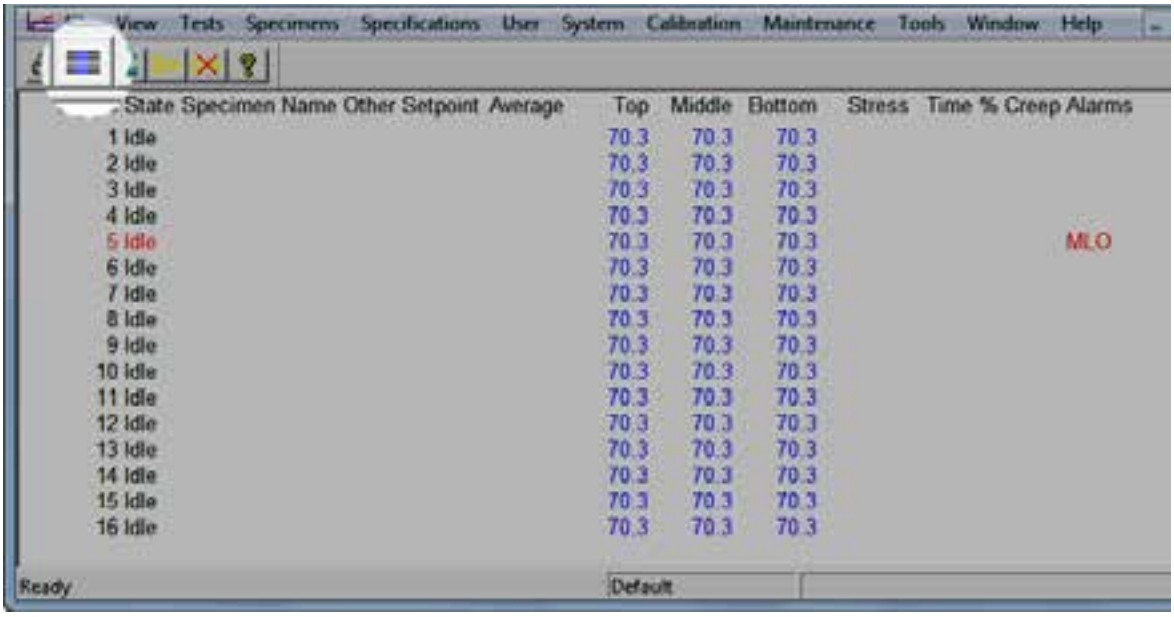
NOTE: System Units and the Status Display Option configuration are unique to the individual operator. For example, if operator A has selected metric units, all aspects of the system will use metric units when operator A is logged in. If operator B as selected English units, the system will automatically revert to English units when this operator logs in. Likewise, the configuration of the Status Display screen will change to the settings chosen by the operator currently logged in.

NOTE: Any function not authorized for an operator will be grayed and inaccessible in the menu.

7.1.2 System Status Display

The System Status Display is the primary screen to which the operator refers during the system operation. The status of the system is displayed here, and it is to this screen that the system reverts when no other operator function is in process.

Click the Status Display icon located underneath the main menu bar in the upper left corner of the screen to access the System Status Display.



When the Status Display screen appears, column headers and frame status conditions are displayed. The purpose of the Status Display is to allow the operator to quickly scan the system status. Too many entries will make this difficult. Perform this procedure every time a new operator logs in, and the System Status Display will be customized for him/her.

7.1.3 Overview of Operation Steps

This section will provide an overview of the steps involved in operating the system and performing a creep or stress rupture test. The following steps assume an authorized operator has already set up the system properly, calibrated and balanced the frames, and calibrated all accessory items, e.g. thermocouples or extensometers.

Test Specifications: In order to perform a test, the operator must first define the test parameters, such as specimen temperature and stress. We refer to this description as the Test Specification. The test specification can be used for more than one test. The specification is automatically retained in the specification subdirectory and is available for use whenever needed. A naming protocol should be developed for the test specification to help the operator select the appropriate specification before starting a test. It is helpful to name specifications in a way that describes test parameters for that particular specification.

Creating a Specimen: The information about the specimen to be tested must be recorded prior to testing as well. This is done by Creating a Specimen, and each specimen is a distinct entity. Since all identification and archival information is based on the specimen name, each must be unique and different. Once a specimen name has been assigned, it cannot be used for another test. Each lab should develop a naming system that will best suit the record-keeping practices in use. Any number of specimens can be created, and they will remain available in the computer until tested.

Test Conditions: Each test specification will include any number of Test Conditions. Information under this section defines test parameters and allows the operator to create a family of test conditions under one specific name. For example, it may be convenient to create a series of conditions that are identical except for temperature or stress level. In this case, a single specification name can be used to define all tests for a particular type of material or common product line. Therefore, a naming protocol for the test condition that describes the test parameters is helpful when the operator needs to select a condition.

To begin, execute, and terminate a test:

1. Test Specifications: Define test specifications before setting up the specimen type. Refer to Section 7.2.

2. Creating a Specimen: Enter the information about the specimen. Refer to Section 7.3.

3. Testing: After the test specifications are entered and the specimen setup is complete, testing may begin. Refer to Section 7.4.

4. Stopping a Test: Tests in progress may be stopped at the user's request. Refer to Section 7.5.

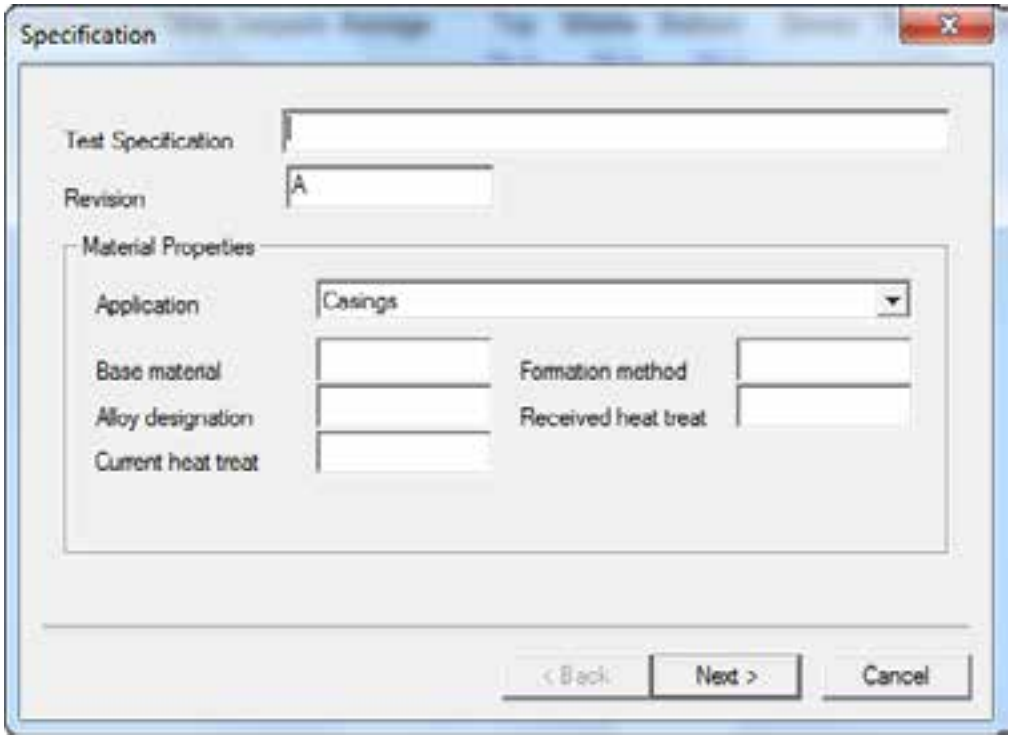
5. Viewing Test Results: The user may view results from current and previous tests. Refer to Section 7.6.

7.2 Test Specifications

This section will describe specification creation, editing, viewing, and deletion.

7.2.1 Creating Test Specifications

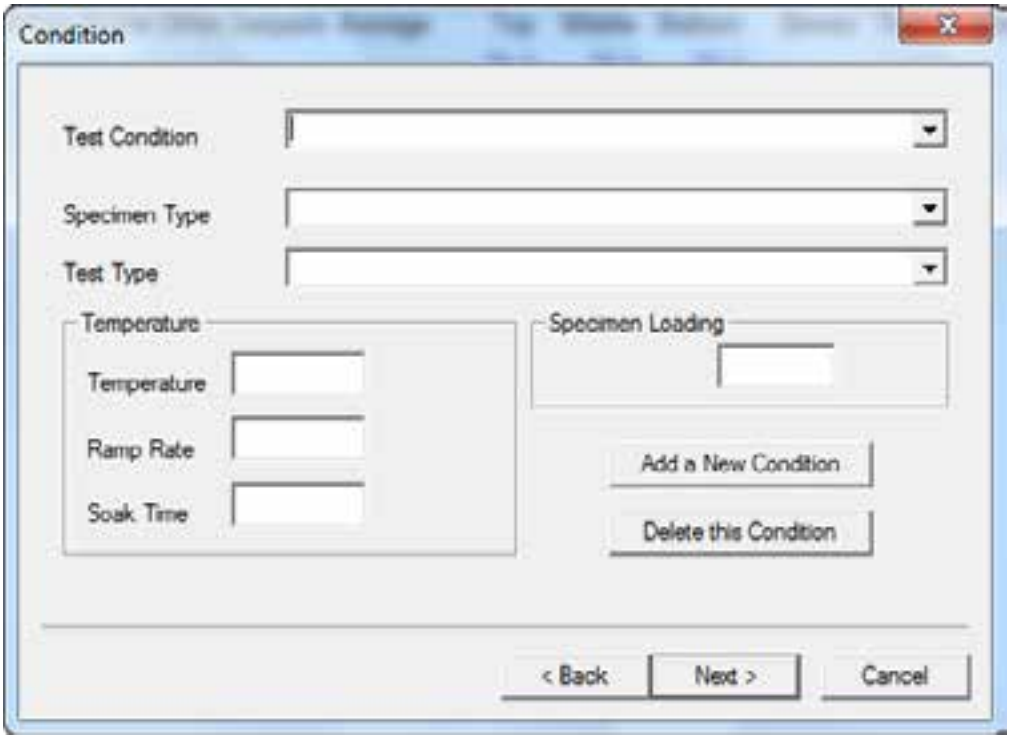
This section enables the user to create new parameters specific to test requirements. The new parameters will automatically be saved and can be used at any time over multiple tests.



1. Select Specifications and Create from the main menu.
2. In the Test Specification field, type the name of the test specification.
3. Use the Tab key to move to the remaining text fields on this screen and enter the appropriate information.

NOTE: These fields are optional and may vary since they can be changed in the Test Specification Text under the General Setup menu (see 6.3.3).

4. Click Next to move to the Test Condition screen.



5. Enter the name of the Test Condition. This field contains the name of the condition and specifications of the test, such as test temperature, stress level, furnace ramp rate and soak time, type of specimen, and type of test.
6. Use the pull-down menus to select the appropriate Specimen Type and Test Type. Review the entire list of options to ensure the correct selection is made.
7. Use the Tab key to move through the remaining fields.
8. Units can be changed using the User Units section (see Section 6.1).
9. Note that Ramp Rate is determined at time of installation and is not normally changed unless testing at an unusually low temperature, when a slower ramp may be necessary to prevent overshoot as temperature reaches setpoint.

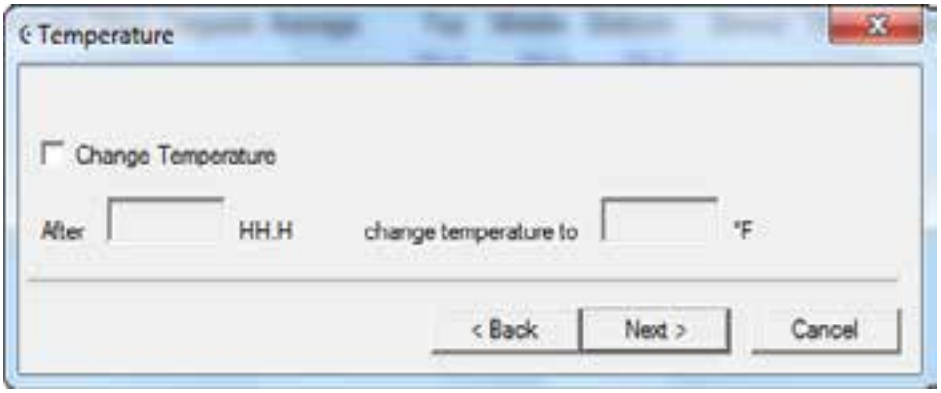
10. Click Next to proceed to the Temperature Limits screen.

11. The Temperature Limits fields allow temperature alarm limits unique to the test to be defined. These values typically are set at 3°F for the minor limit and 15°F for the shutdown limit. If these values are changed, be sure to enter values that will protect the specimen and system hardware in case of control failure.

NOTE: Tests are not interrupted for minor alarms; however, an entry is made in the event log for deviations beyond minor alarms.

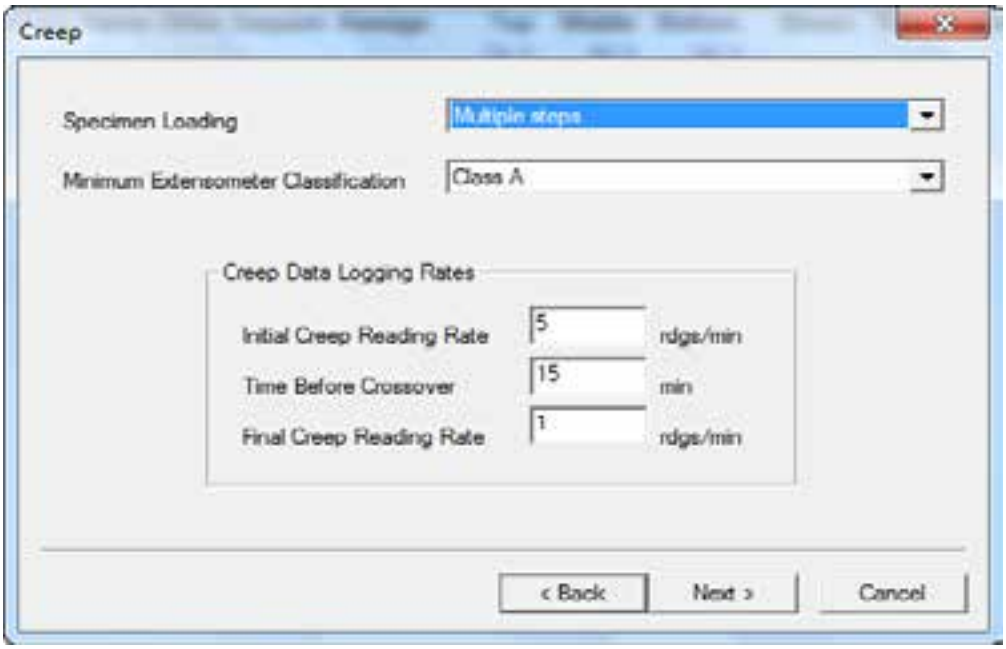
12. The Setpoint Ramping Offset value is used to aid the furnace in reaching the operating temperature more rapidly. This value should remain at 0.0°F. It is not recommended to use any value other than 0.0°F.

13. Click Next and proceed to the Change Temperature screen.



14. This screen is seldom used during testing. If needed, enter the run time and indicate the new setpoint.
15. Click Next to proceed to the Power Failure screen.
16. This screen relates to the load on the frame if a power failure brings the temperature below the major alarm level. If the box is checked, the frame will be unloaded before the specimen is reheated. If the box is unchecked, the frame will remain loaded during the reheat process.

17. Click Next. At this point, a different screen will appear depending on the test. If it a creep test, the Creep screen will appear. If the test is stress rupture, the Creep screen will skip to the Step Loads screen. See step #21 for the Step Loads screen.

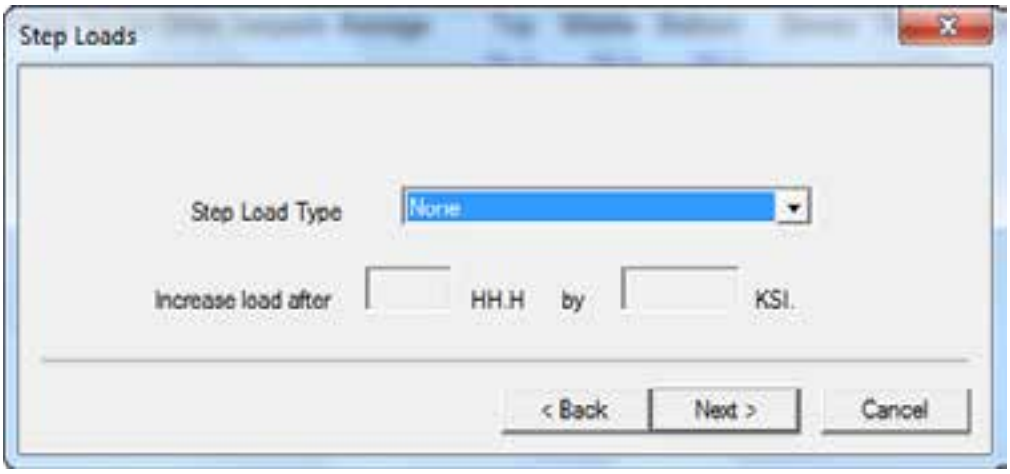


18. The Specimen Loading field specifies how the specimen will be initially loaded once the soak period has been satisfied. Choose either Multiple steps or Single steps from the pull-down menu. Typically, multiple steps will be selected.

NOTE: If Plastic Strain is to be separated from Creep data, then the specimen must be loaded in steps, either manually or via the automatic step load control feature.

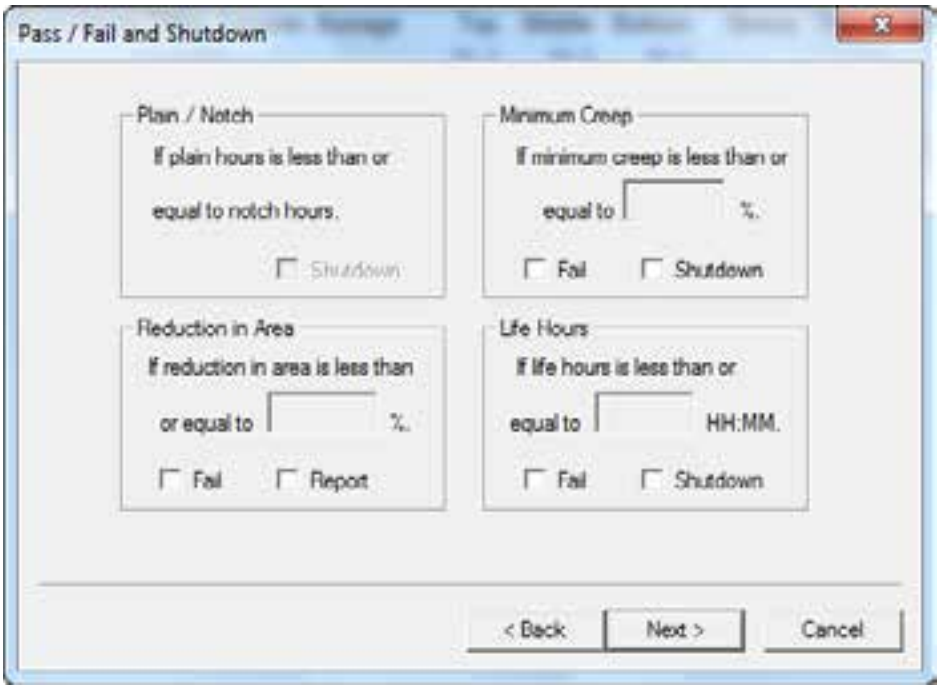
19. Select the Minimum Extensometer Classification from the pull-down menu. The system grades the extensometer to ASTM specifications using a verification process. The system will alert the operator if the extensometer does not meet the minimum requirements. Select Not Classified to turn off this feature.

20. Creep Data Logging Rates allow the system to collect data at a faster rate upon initial loading and then slow down during creep action testing. The default values follow normal ASTM testing and typically are not changed.
21. Click Next to move to the Step Loads screen. This screen is used for stress rupture testing. If performing a creep test, skip this screen by clicking Next. See step 23.



22. If performing a stress rupture test that requires step loading, specify the time for initial step load, step load value, and step load period.
23. Click Next to proceed to the Cyclic screen. This feature is not currently used on most ATS testers. Contact ATS if cyclic loading is desired.

24. Click Next to proceed to the Pass/Fail and Shutdown screen.

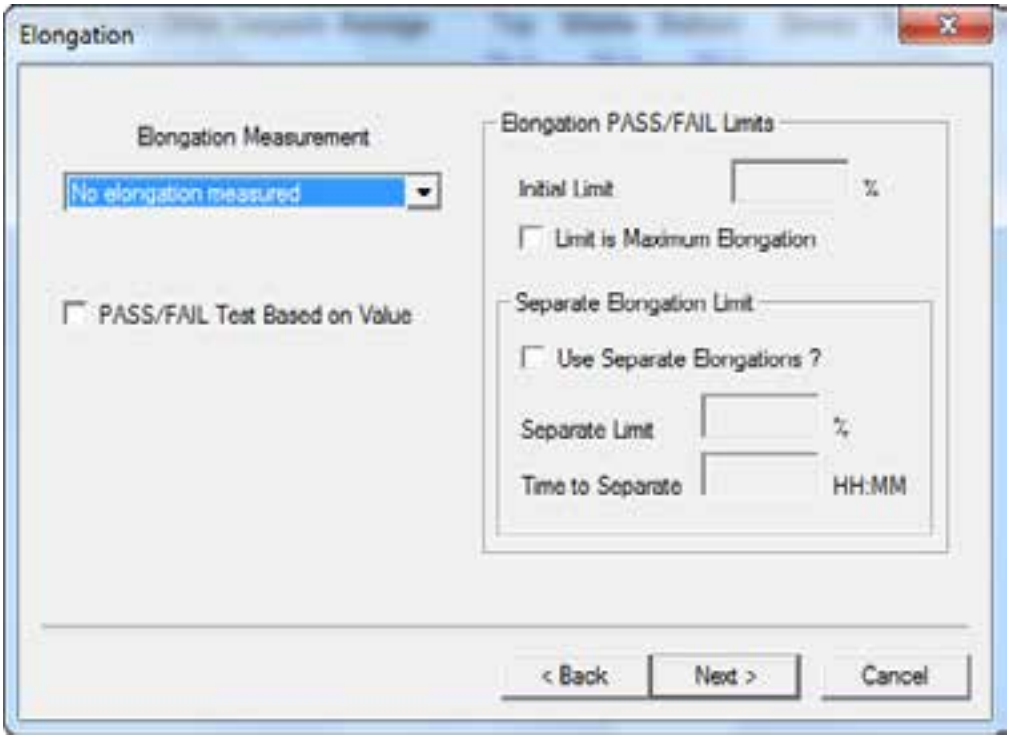


25. If only the Fail box is checked, the test runs to completion, but the report will note that the test failed.

26. Check the Shutdown box to terminate the test.

27. In the Life Hours field, check the box and enter the number of hours desired. Once the specified time has passed, the test will terminate.

28. Click Next and the Elongation screen will appear.



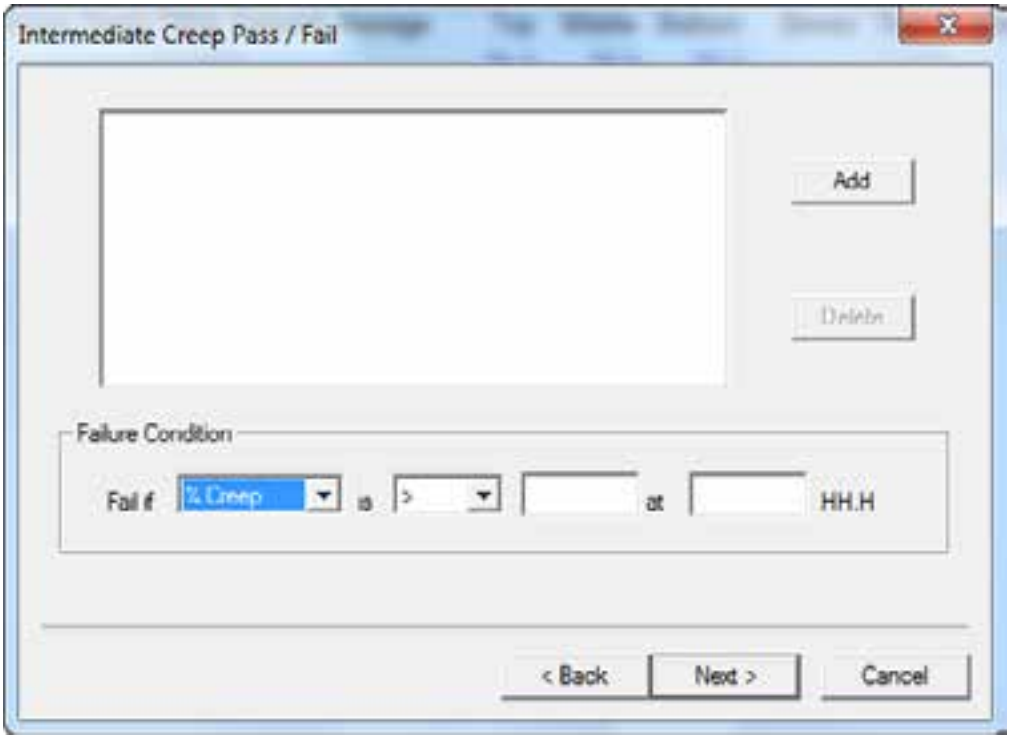
29. Select the method of Elongation Measurement from the pull-down menu.

NOTE: It is possible to defer this decision until after the test is completed.

30. If Pass/Fail or an elongation limit is desired, make the appropriate selections.

31. If necessary, select the Separate Elongation Limit. This limit allows the operator to measure an initial limit and then an additional limit after a specified time. For example, if the operator initially wants to measure 3% elongation and then decides to measure 5% elongation after 48 hours, s/he can select the appropriate information in the window.

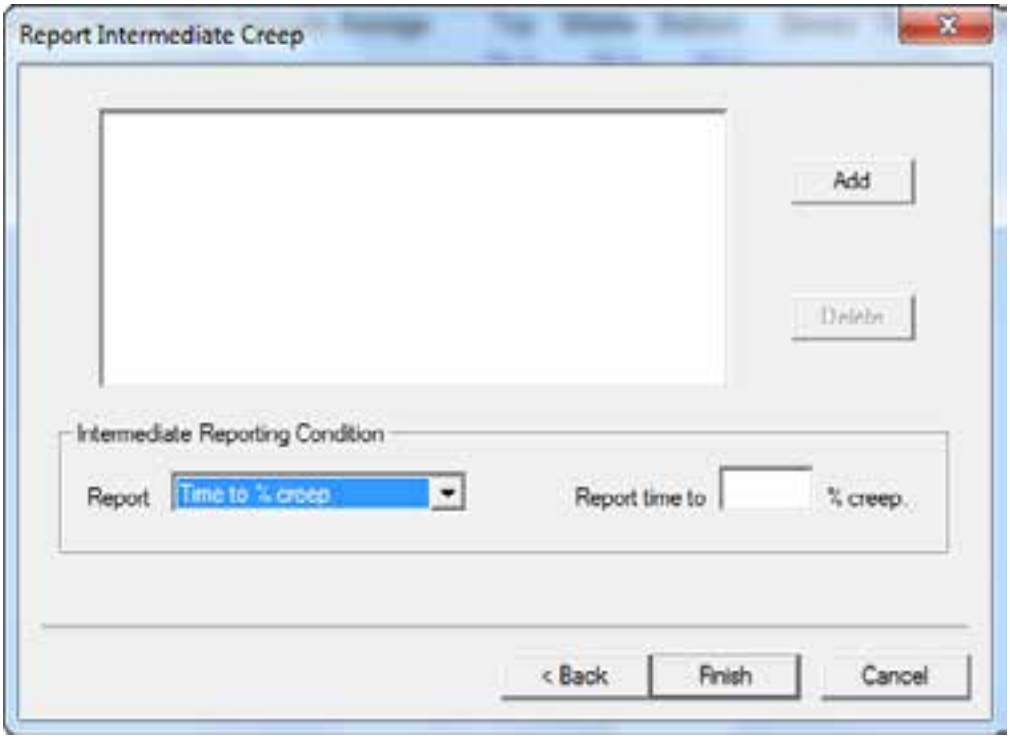
32. Select Next to proceed to the Intermediate Creep Pass/Fail screen.



33. Use the Intermediate Creep Pass/Fail field to establish criteria based on creep performance. Define criteria from the Fail if pull-down menu and click Add.

NOTE: Any number of criteria can be added via this method.

34. Click Next to proceed to the Report Immediate Creep screen.



35. This screen allows operators to receive creep data at several points during the test, either as creep at a specified run time, or as run time to a specific creep value. Use the Report pull-down menu to choose the type, then enter the appropriate time or creep value and click Add.

36. Enter as many reporting points as desired, then select Finish.

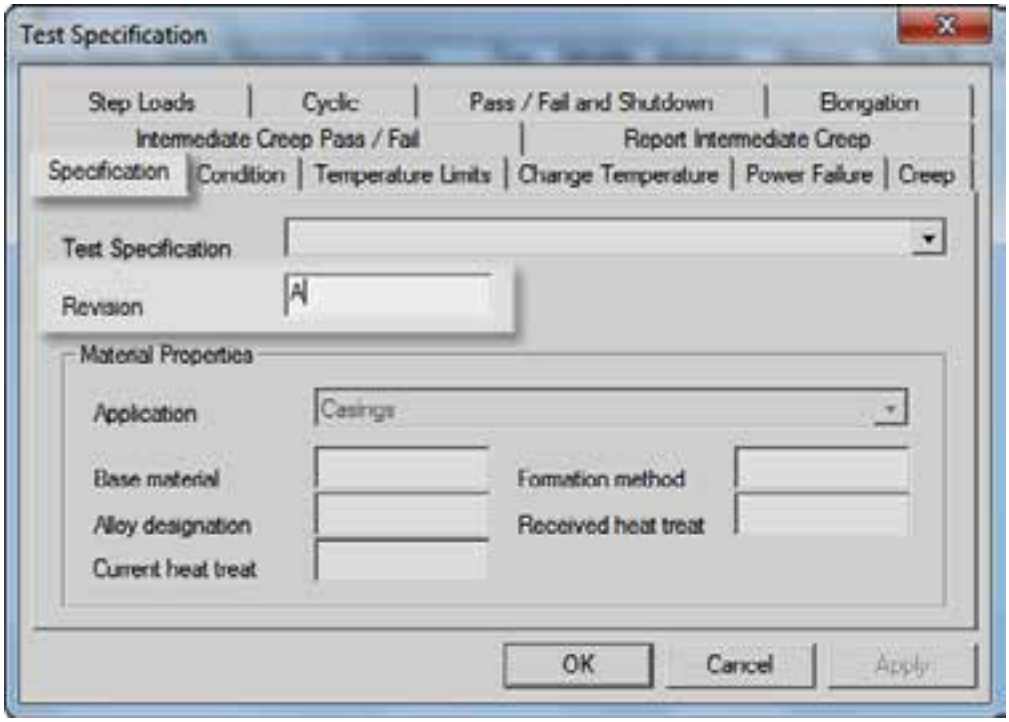
This completes the test specification creation process.

7.2.2 Editing Test Specifications

The Edit Test Specification function allows details of a specification to be changed. A common reason to edit a specification is to add a new condition to a test that has already been created. To edit a specification:

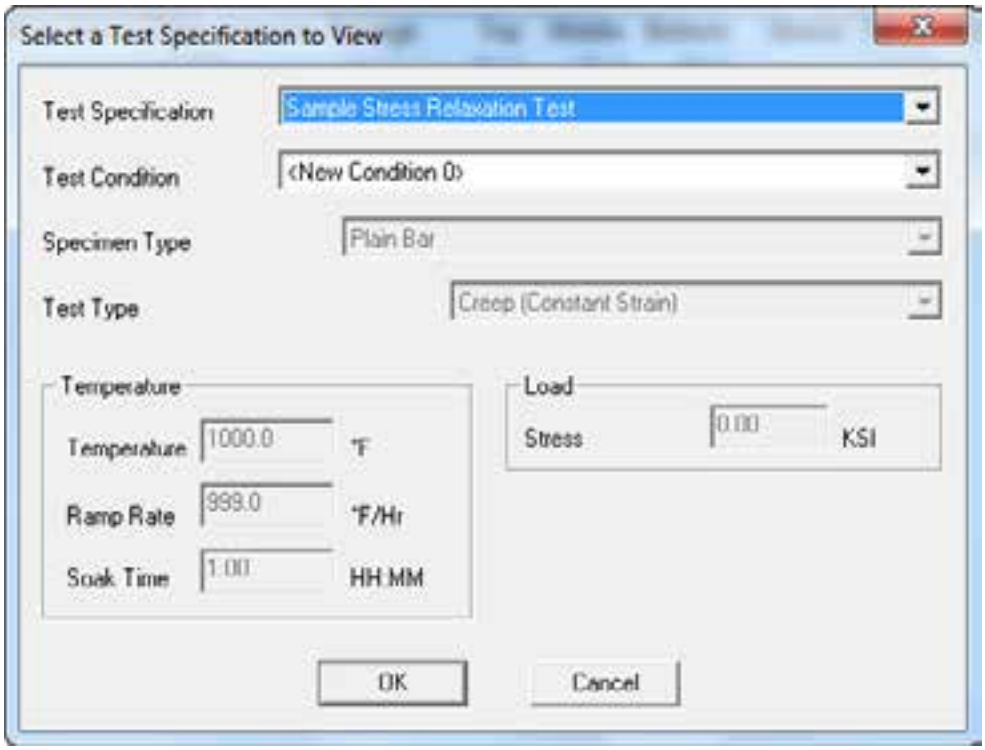
1. Select Specifications and Edit.
2. Use the Test Specification pull-down menu to select the specification requiring editing.
3. Select the field that requires modification. For example, click on Condition to change, add, or delete a test condition. The Condition window will then appear for editing.
4. Click OK when finished.

NOTE: The revision field should be changed in order for the system to keep track of all revisions. Each time the test specification is used, the revision level is noted as part of the test report. If the revision level is not updated, then this information is lost. The test report will append the word “modified” to the specification name, but this loses some information that would be available if the proper procedure is followed.



7.2.3 Viewing Test Specifications

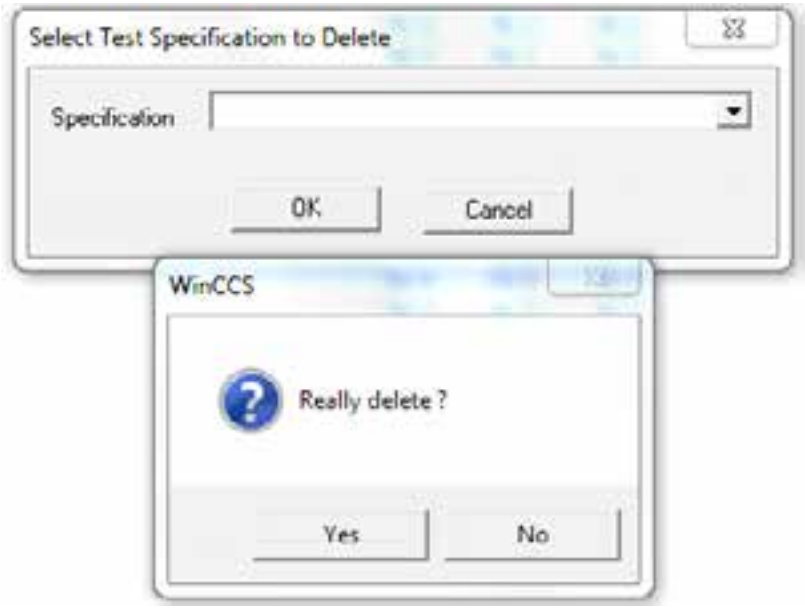
The details of a test specification can be viewed on the screen or printed by selecting Specifications, then View. To see specific specifications or conditions, select the Test Specification or Test Condition from the pull-down menu.



NOTE: Once the specification appears on the screen, all the details can be printed by using normal Windows print functions.

7.2.4 Deleting a Test Specification

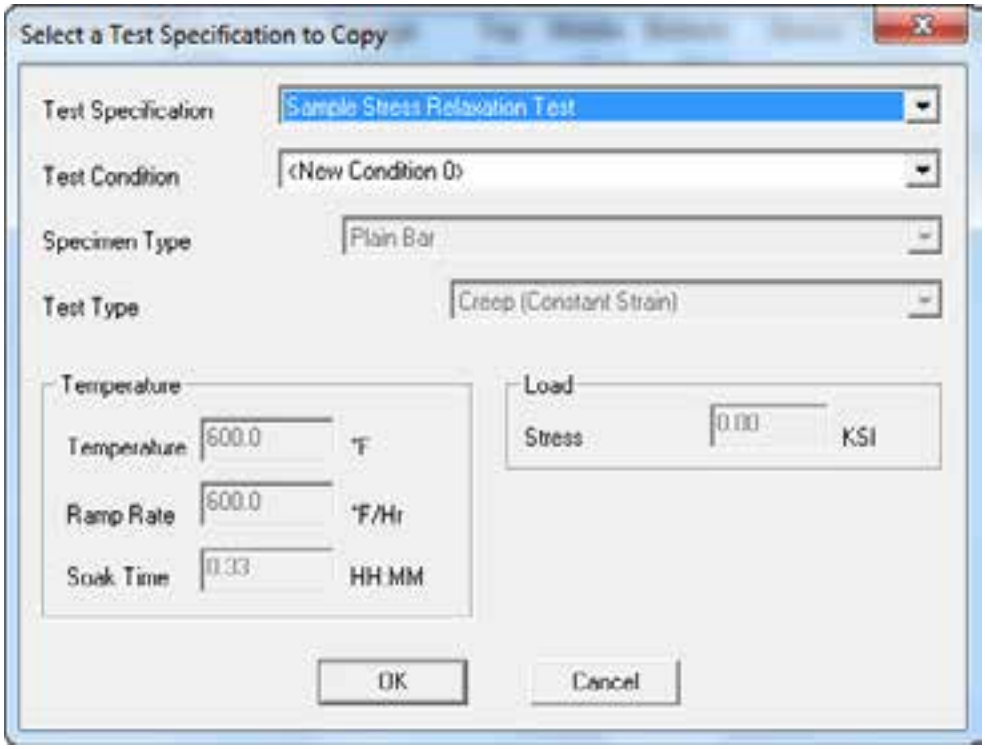
If a Test Specification is no longer needed, it can be deleted from the list, avoiding possible operator confusion.



1. Select Specifications, then Delete.
2. When the Select a Test Specification to Delete screen appears, use the pull-down menu to select the appropriate specification.
3. Click OK.
4. Verify the decision to delete by clicking Yes.
5. The test will be deleted from the list.

7.2.5 Copying Test Specifications

The Specifications Copy feature is convenient if creating specifications that have details in common, or to create a new specification that is very similar to an existing one.



1. Select Specifications, then Copy.
2. Select the existing specification from the pull-down menu.
3. Click OK.
4. Assign the copy a new file name and Click OK.
5. To modify the copied specification, follow the steps in 7.2.2.

NOTE: The original specification will remain unchanged under the original name.

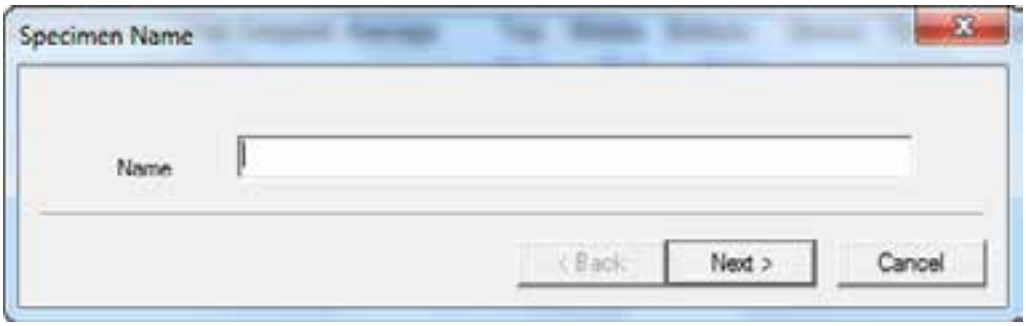
7.3 Specimens

The specimen is the object to be tested. To perform the tests, the system must have a specimen identity to use in testing and data collection.

7.3.1 Specimen Creation

Any number of specimens can be created at one time. It is not necessary to start the test immediately after the creation process. To create a specimen:

1. Select Specimens, then Create. The Specimen Name screen should appear.



2. Enter the name of the specimen and click Next.

NOTE: Each specimen name must be unique and cannot be used for any other test.

3. Use the pull-down menu to select the Test Specification and the Test Condition.

4. The remaining data field will show the details of the test parameters of the test specification chosen. Check that these parameters are correct, and make any changes if necessary. Click Next.

NOTE: The test parameters in the specification can be changed at this time, and this specimen will be tested according to the edited parameters. The test record will show the specification name with the word “Modified” next to it; however, the test specification will not permanently be saved in the system.

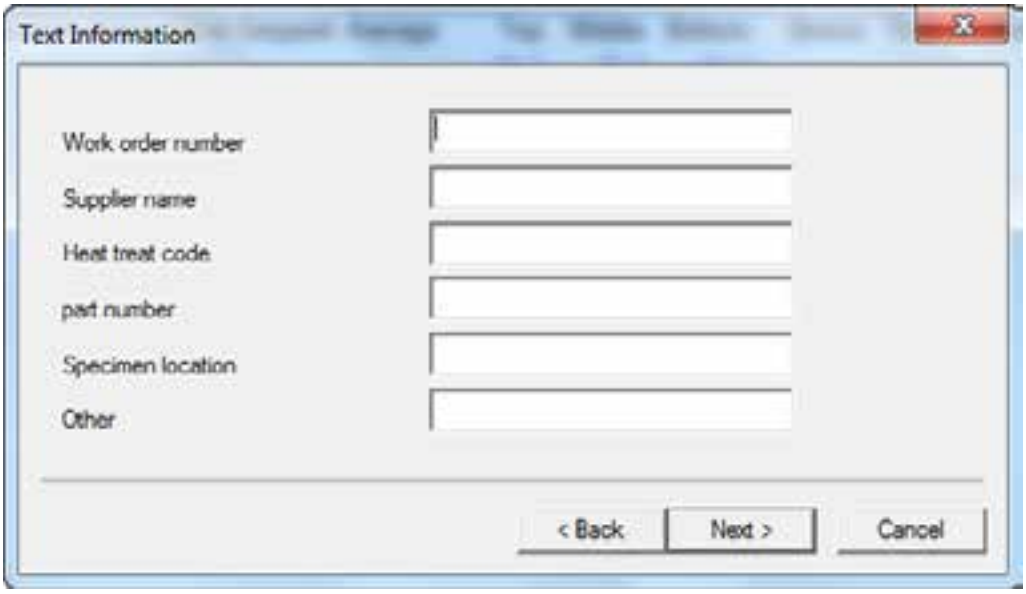
5. Enter the specimen dimensions on the Dimensions screen.

NOTE: The required force and resulting stress information is calculated from the specimen dimensions entered. Make sure they are correct or the results will be in error.

6. Click Next to proceed to the Comments screen.

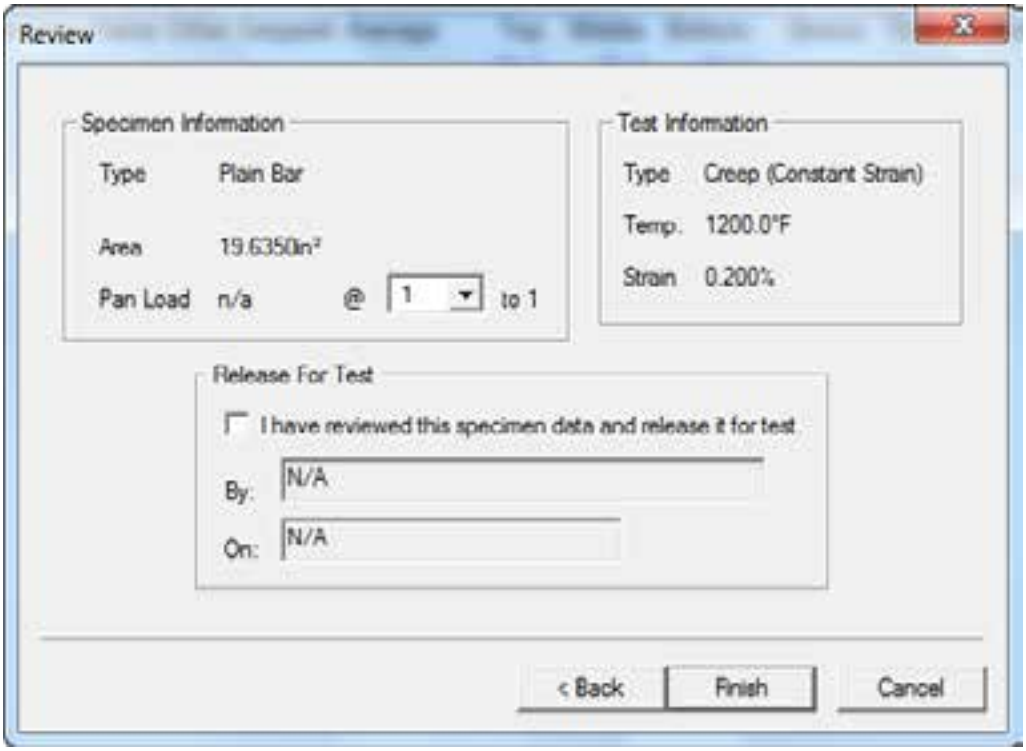
7. Enter any comments about the test or specimen here. If there are no comments, skip this step.

8. Click Next to proceed to the Text Information screen.



9. Enter any text information into the text information fields. Skip this step if there is no text information.

10. Click Next to proceed to the Review screen.



11. Review the Specimen Information and Test Information.
12. The operator must then check the Release for Test box to certify that s/he has reviewed the details of the test and is satisfied that they are correct. The user logged in at that time will be automatically entered in this section. This information will be part of the test record.
13. Select Finish to complete the process and save the specimen for later use.

7.3.2 Editing a Specimen

A test specimen can be edited before the test has been started.

1. Go to Specimens, then Edit.
2. On the Edit Specimen screen, use the pull-down menu in the Name box to select the correct specimen for editing.
3. Select the appropriate tab and make the desired revisions.
4. Click the Review tab to review the details.
5. Select OK when finished.

7.3.3 Reviewing a Specimen

The Specimen Review function allows operators to review the details without making changes. Select Specimens from the main menu and choose Review.

NOTE: This function is especially useful for operators who do not have the privileges necessary for editing specimens.

7.3.4 Viewing a Specimen

The specimen information can be viewed and printed in report form at any time.

1. From the main menu, select Specimens, then View.
2. Use the pull-down menu to select the specimen to view.
3. Print the report by using the normal Windows print functions.

7.3.5 Deleting a Specimen

The test specimen can be deleted after it has been created; however, it cannot be deleted once the test has begun.

1. Select Specimens, then Delete.
2. Choose the specimen from the pull-down menu on the Specimens to Delete screen.
3. Select OK to delete the specimen.

NOTE: Be sure to select the correct specimen for deletion because there is not a verify screen for this process.

NOTE: Once a specimen is deleted, all data regarding that specimen will be lost.

7.4 Testing

Once the test specification and specimen have been created, testing can begin. Before beginning any test, ensure that:

1. All setup procedures outlined in Section 6 have been completed.
2. The frames have been properly balanced.
3. A specimen is installed in the frame with the thermocouples properly attached. Refer to 8.2 for assistance with proper thermocouple attachment.
4. The drawhead and elevator, if equipped, are positioned properly.
5. Observe all safety precautions.

WARNING: TESTING MAY INVOLVE VERY HIGH FURNACE TEMPERATURES. ENSURE THAT THE FURNACE IS CLOSED, MATERIALS ARE IN A POSITION TO AVOID A FIRE HAZARD, AND HIGH TEMPERATURE WARNING NOTICES ARE POSTED TO ALERT PERSONNEL OF POTENTIAL HAZARDS.

7.4.1 System Status Display

The System Status Display is the main display used by the operator during normal operation of the system. Machine states and alarm conditions are displayed on the status display screen.

Refer to Appendix B for a complete list of the display headings, colors, and alarm codes.

7.4.2 Starting a Test

The general procedure to start a test is to select an idle frame, install the specimen in the frame, and tell the system to start testing the specimen. There are four ways to begin this procedure, and the method chosen is based on operator preference.

1. Balance the lever arm with the upper load train installed completely to the specimen.

NOTE: There should be no load weights on the weight pan at this time.

2. Install all upper load train components and specimen per test requirements.

NOTE: The hot coupling, hot stud, alignment coupling, etc. are all part of the upper load train.

3. If an extensometer is used, install the upper crosshead and gauging platform assembly to the specimen.

4. With the lever arm in the level position, check balance and adjust it as necessary.

    a. Loosen screws on each side of the lever arm counterweight.

    b. Adjust the positioning screw on the counterweight for best lever arm balance, making it slightly heavier on the weight pan side.

    c. Tighten position locking screw and check balance.

5. Install lower load train and extensometer (if used).

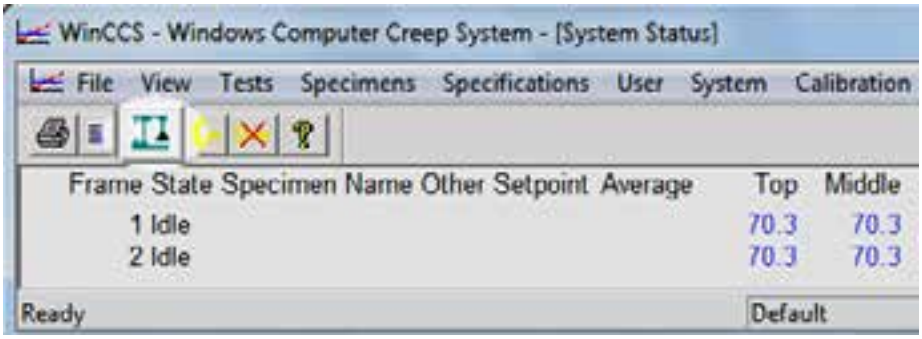
6. Adjust lower take-up stud to ensure the lever arm is level when the load is applied.

7. Access the Start a Test screen:

    a. From the main menu, select Tests, then Start. The Start a Test menu will appear.

    b. From the main menu, select Specimens, then Start. The Start a Test menu will appear.

    c. Click the Frame icon on the main menu.



    d. Double-click on the Status Display line for the frame to be tested.

        i. The Frame Services menu will show.

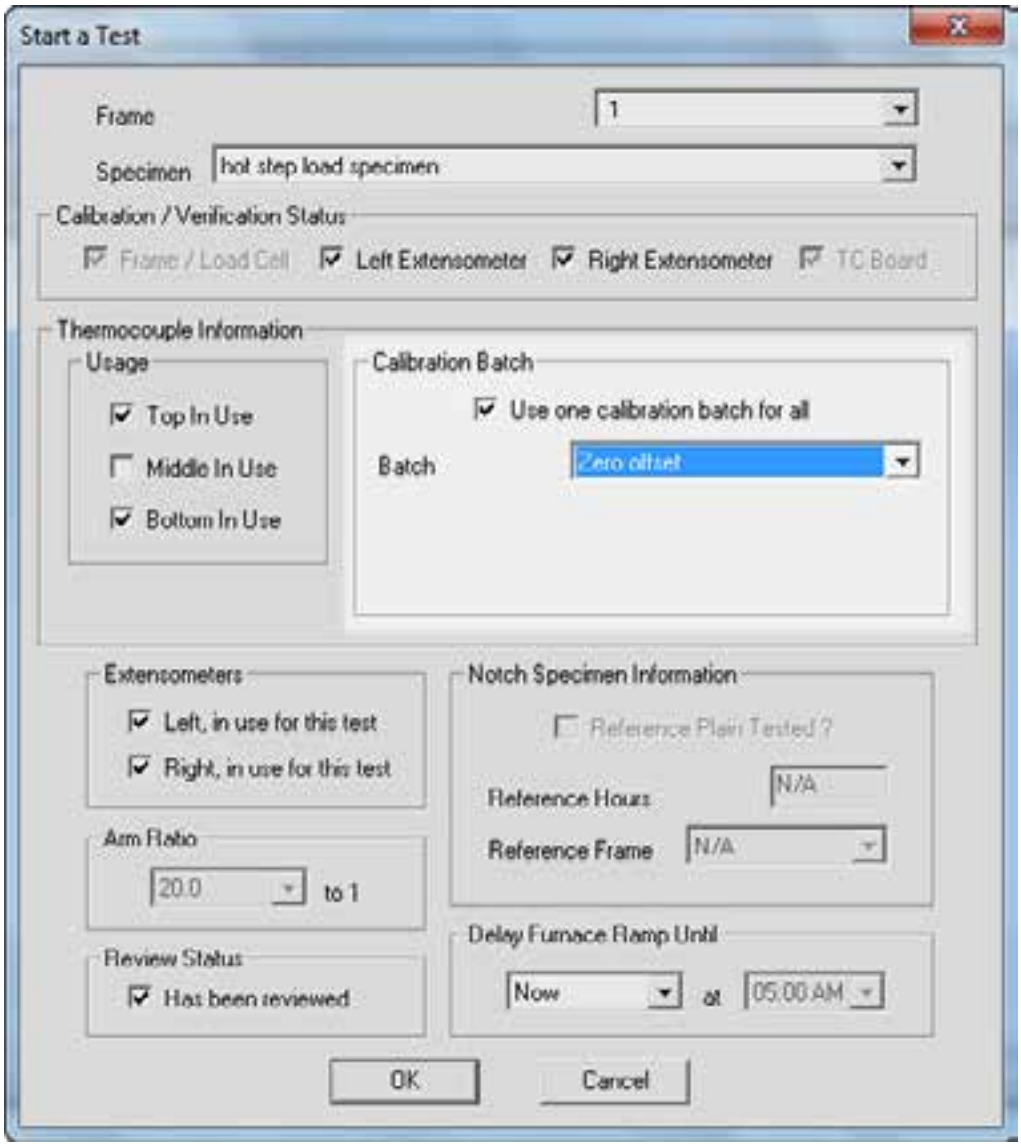
        ii. Click on Start a Test, and the Start a Test menu will appear.

NOTE: In all four options, the correct frame must be selected by either double-clicking on it (Option a) or selecting it from the Frame pull-down menu (Options b-d).

8. Verify that the Calibration/Verification Status section indicates that all required functions are calibrated.

9. Verify that the Usage area of the Thermocouple Information section agrees with the thermocouple installation for this particular test. Make changes if this does not agree.

10. Select the appropriate Thermocouple Batches if using calibrated thermocouples. If not using these, select Zero Offset.



NOTE: Temperature control will be much more accurate if using calibrated thermocouples. Further, using a single batch for all thermocouples will be more convenient and present less chance of an error.

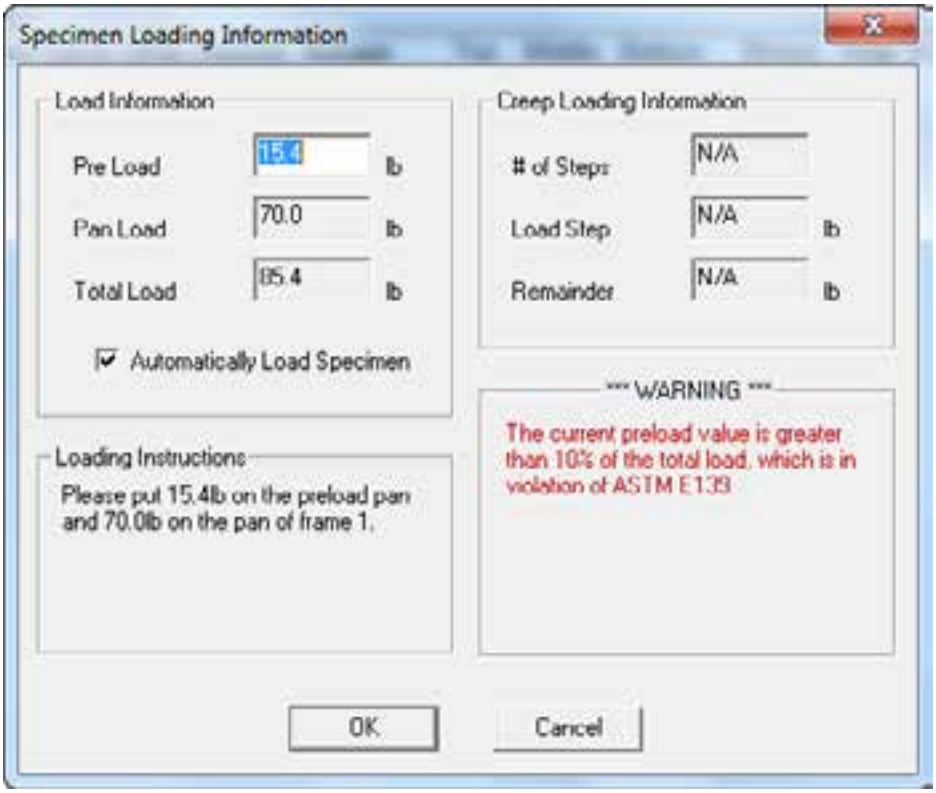
11. Verify that the information in the Extensometers and Arm Ratio areas is correct.

NOTE: By default, both boxes in the Extensometers section are checked and 20:1 is the Arm Ratio.

12. By default, furnace ramping is set to Now, but it is possible to delay ramping until a future time. For example, in a manual loading system, it may be beneficial to have the furnace up to temperature at a specific time to perform the loading. If necessary, make those changes here.

13. Click OK to proceed to the Specimen Loading Information screen.

14. Enter the appropriate preload amount (in pounds), and adjust the value if it does not agree with ASTM or applicable standards.



NOTE: The system will automatically populate the values listed under Creep Loading Information.

15. To use the Automatic Loading option, check the box.

NOTE: If the operator is not going to use automatic loading, then weights will have to be manually loaded on the machine. The administrator can display the amount of weight needed by selecting View, then Required Step Loads from the main menu.

16. Follow the loading instructions.

17. Click OK to begin testing.

7.4.3 Reload a Test

In some instances, it may be necessary to reload a test in order to start it over. Select Tests, then Reload from the main menu.

7.5 Stopping a Test

At any time a test is running, the operator may stop the test manually. There are a variety of reasons why this might be desired. For example, if a problem is detected that would render the test results invalid, or if no further useful data will result, the test can be terminated.

1. From the main menu, select Tests, then Stop.

    a. Select the frame to be stopped from the pull-down menu.

    b. Click OK.

    c. Verify that the system should stop this test and click Yes. The test will be terminated.

2. Click the Frame icon on the main menu.

    a. Select the appropriate frame from the Frame Services menu.

    b. Click Stop the Test from the options.

    c. Verify that the system should stop this test and click Yes. The test will be terminated.

3. Double-click on the appropriate line of the Status Display screen.

    a. Select Stop the Test from the Frame Services menu.

    b. Verify that the system should stop this test and click Yes. The test will be terminated.

Once the operator has terminated the test, the system will proceed through several states, depending on the system configuration. The furnace will shut down, and the load will be removed from the specimen if automatic loading is implemented. The frame will then proceed to the Post Test state, where it will remain until the operator intervenes.

At this point, the operator may choose three options: Post Test, Reset and Clear, or Restart.

1. If Post Test is selected, the frame will be set to an Idle state, and it can be used at any time for another test. All data will be moved to the Previous Test section. See 7.6.2 for details.

2. If Reset and Clear is selected, the frame will be set to an Idle state, and it can be used at any time for another test. All record data of the test will be lost.

NOTE: Do NOT select Reset and Clear in error. Recorded test data will be deleted and cannot be recovered.

3. If Restart is selected, the system will go through the ramp, soak, and load procedures as in the initial start of the test.

7.6 View Test Data

The WinCCS System incorporates provisions to view the results of both currently-running tests and previously-archived tests in both graphic and report form.

7.6.1 View Running Tests

There are three ways to view a test currently running.

1. From the main menu, select View, then Running Test.

    a. When the Select Frame to View screen appears, select the desired frame.

    b. Click OK, and the Report/Graphing Options screen will appear.

2. Click on the Frame icon from the main menu. The Frame Services screen will appear.

    a. Use the frame pull-down menu to select the desired frame.

    b. Select View Data from the pull-down list of options. The Report/Graphing Options screen will appear.

3. Double-click the appropriate line of the Status Display screen. The Frame Services screen will appear.

    a. Select View Data. The Report/Graphing Options screen will appear.

A quick look at data for a running test can be accessed by double-clicking on the status line of the frame on the Status Display screen. For a creep test, a creep graph and an event log will display. For a stress rupture test, a temperature graph and an event log will display.

NOTE: The information displayed in the Status Display Report and graphs will coincide with the default settings chosen by each user. This display can be changed for each test.

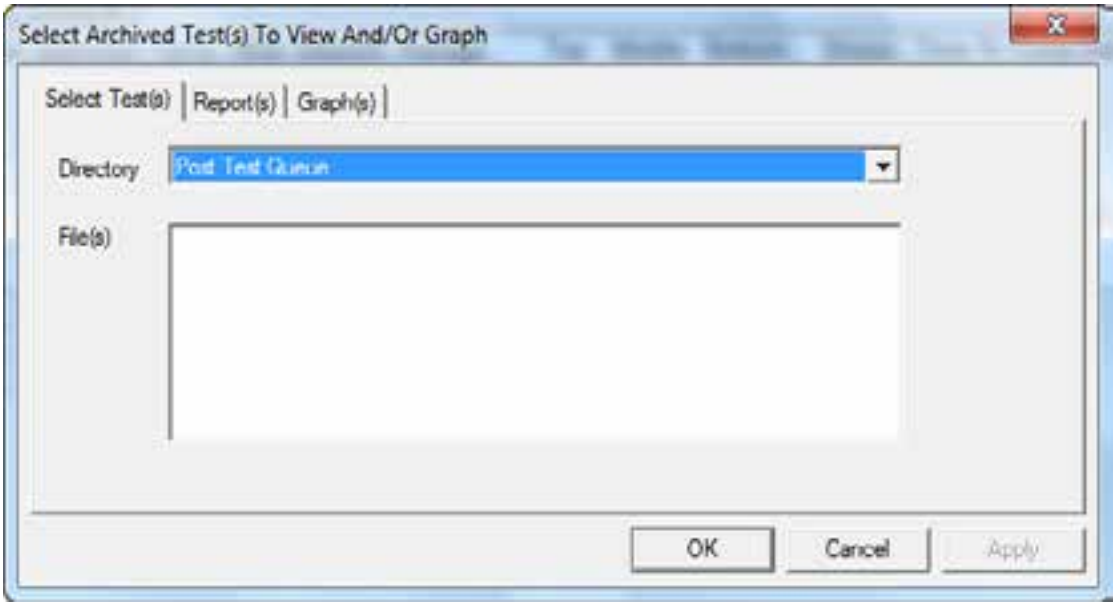
7.6.2 View Previous Tests

Tests that have been completed and automatically archived during the Post Test procedure are known in the system as Previous Tests. The test data, along with the supporting information on test specifications, calibration, etc., are archived on the computer hard drive in a subdirectory reserved for that purpose. The default name for this subdirectory is Tests.

NOTE: There are two different subdirectories that hold test data. One holds data for completed tests, and the other holds data for tests that are currently running. See 7.6.5 for information on how to properly locate data.

To view a completed test:

1. Select View from the main menu, then Previous Tests. The Select Archived Test to View screen will appear.
2. Use the Directory pull-down menu to select Tests.
3. Use the File menu to select the appropriate specimen name from the list of archived tests.

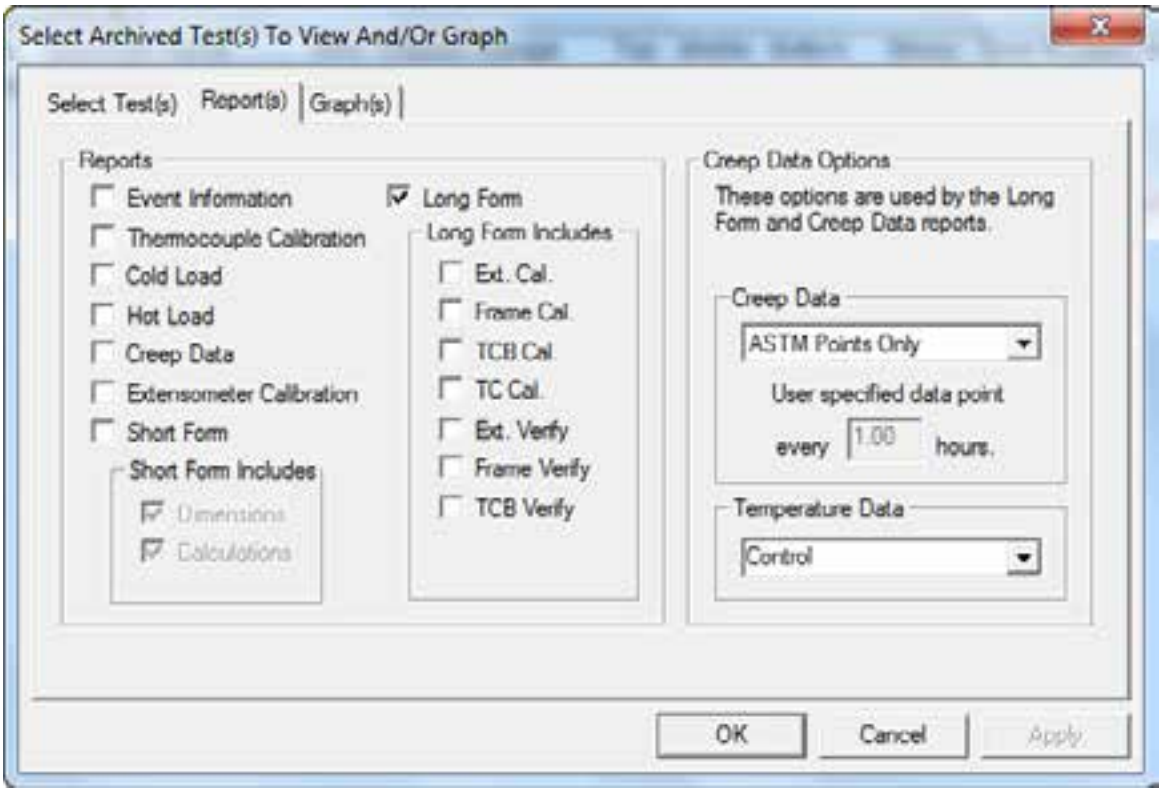


NOTE: There are two special cases where tests are neither complete nor currently running on a frame, yet the test records are stored in the subdirectory. One is a test that has been cleared from a frame before the Post Test process was completed (found in the Post Test Queue). The other case is a test that has stopped but will resume later (found in the Continue Test Queue). To access these records, go to the Post Test Queue or the Continue Test Queue by choosing from the Directory drop-down menu.

7.6.3 Report/Graphing Options

The Report/Graphing Options screen allows the user to select a specific report or graph and configure it to display test data in the most useful form. The screen also allows selected data to be exported into a Common Separated Variable (.csv) format for spreadsheet use.

1. Select View from the main menu, then either Previous Test(s) or Running Test(s) to access the Report/Graphing Options screen.



2. Under the Report(s) tab, check the boxes for the data to be shown in the report.

    a. If the Short Form box is checked, only the following information will be included in the report: Specimen Information, Test Condition, Test Results, Intermediate Creep Values (if appropriate), Post Test Comments, Operator Identification.

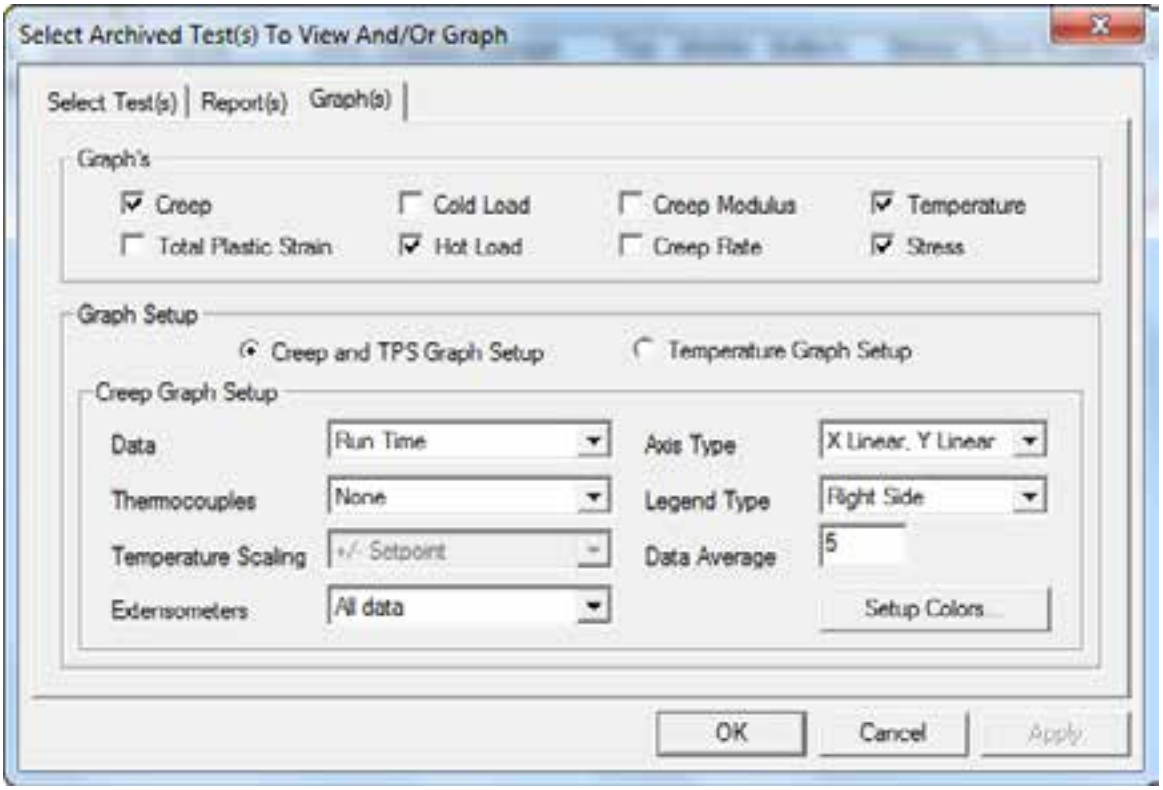
    b. If the Long Form box is selected, all the data listed below the Long Form box will automatically be selected. If not all this information is desired, items can be selected individually.

NOTE: Any of the listed items can be selected, and they will be presented in tiled formatting. The system will make inappropriate selections unavailable, such as a creep graph on a stress rupture test.

3. If creep data is being exported, make the necessary selections in the Creep Data Options area.

    a. Because thousands of data points are collected during a creep test, users can choose which data points are reported. NOTE: This will not change the archived data; the function is used primarily to make reports more concise.

4. Proceed to the Graph(s) tab if graphs are needed on the report. If not, skip to Step 7.



5. Check the appropriate boxes for the desired graphs.

6. Under Graph Setup, choose either Creep and TPS Graph or Temperature Graph to select further options.

    a. For a Creep and TPS Graph, make selections for the following:

        i. Data- Run time data covers the test from the beginning until the test stops. Entire test data covers the test from beginning to end and includes data during initial ramp and soak.

        ii. Thermocouples- This allows the user to select which thermocouple signals to display.

        iii. Thermocouple Scaling- To see the temperature during the test, select + /- Setpoint for maximum resolution. To view temperature during the ramp process, or to see the user thermocouple, select Entire Test Range.

        iv. Extensometers- This will show the average of both extensometers, or will show data from either the left/center extensometer or the right. The processed data is also an option.

        v. Axis and Legend Types- These can be selected based on user preference.

        vi. Data Average- This creates a running average of the points on the graph. The default setting is five, which means that every five data points are averaged and that average is shown on the graph as a data point. This feature is helpful to keep the amount of data from becoming overwhelming.

    b. For a Temperature Graph, make selections for the following:

        i. Data- Run time data covers the test from the beginning until the test stops. Entire test data covers the test from beginning to end and includes data during initial ramp.

        ii. Thermocouples- This allows the user to select which thermocouple signals to display.

        iii. Thermocouple Scaling- To see the temperature during the test, select + /- Setpoint for maximum resolution. To view temperature during the ramp process, or to see the user thermocouple, select Entire Test Range.

        iv. Axis and Legend Types- These can be selected based on user preference.

7. After making all selections, click OK to see the selected reports.

7.6.4 Exporting Data

Data can be exported as an ASCII common separated variable (.csv) format, making it easy to use with Microsoft Excel or other spreadsheet programs. To export data:

1. Select File, then Export from the main menu.
2. Select either Previous Test(s) or Running Test(s).
3. Select Export Data. The Export Data to ASCII File screen will appear.
4. Select the type of data to be exported by making the appropriate choice from the Export Data field.
5. Specify File name and Path by clicking Browse.
6. Modify the file name, if desired, in the Save As text box.
7. Specify the Save In destination for the file by using the Browse button.
8. Select OK to complete the export process.

7.6.5 Exporting Test Data Files

Test data files are complete files containing all aspects of the test. This data is archived automatically once the test proceeds through the Post Test state. Test data files are accessed in the Previous Test(s) section.

Test data files can only be moved or deleted using Windows Explorer.

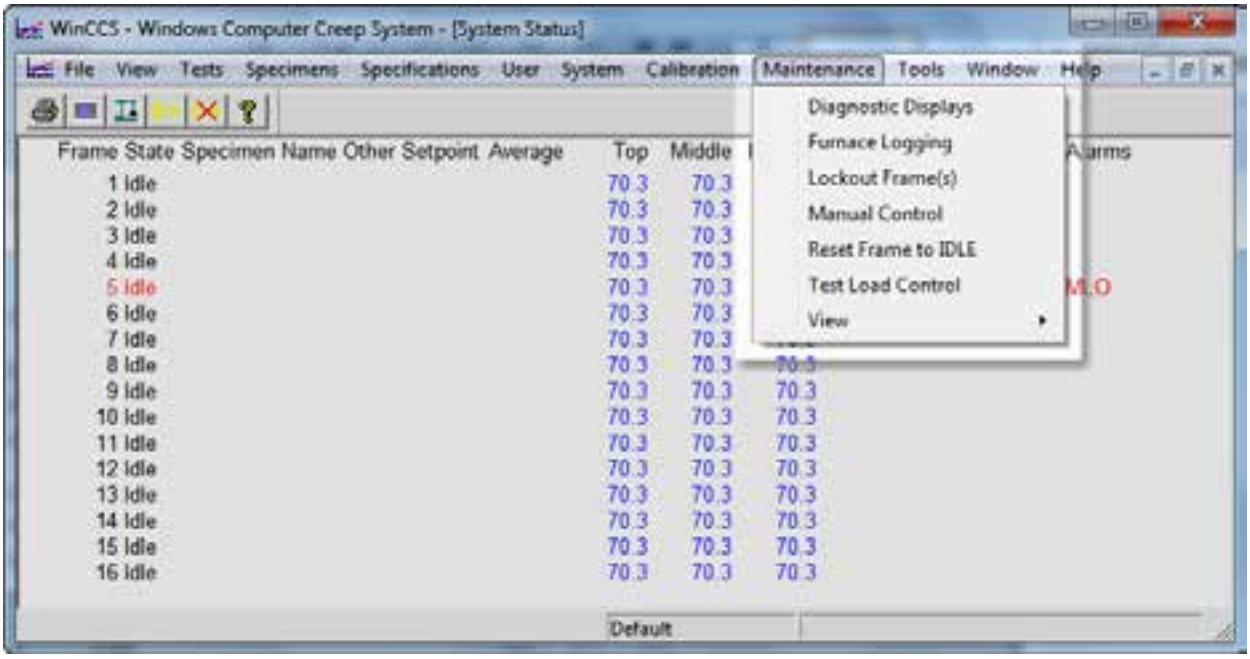
NOTE: There are two directories that hold all test data. If the wrong directory is chosen when exporting test data files, currently-running tests could be disrupted.

7.7 Maintenance

7.7.1 WinCCS Maintenance

The WinCCS software offers a variety of maintenance options that can be accessed easily via the Maintenance menu. The following is a list of features available under the Maintenance toolbar.

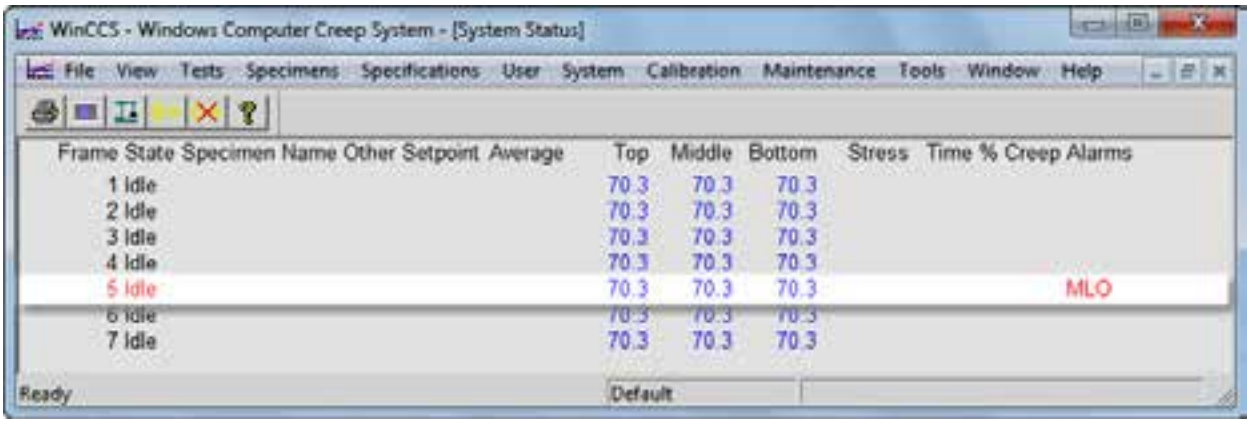
CAUTION: DO NOT PERFORM MAINTENANCE FUNCTIONS WITHOUT ATS SERVICE PERSONNEL.



Diagnostic Displays: This function is reserved for ATS Service Personnel.

Furnace Logging: The furnace logging option allows the operator to log data for a selected frame. This data is sent to the WinCCS Logs directory, where it can be accessed and reviewed at the operator's convenience. The directory is located at C:\ProgramFiles\Virtech,Inc\WinCCS\Logs.

Lockout Frame(s): If an operator wishes to prevent a frame from functioning, he may select to lockout the frame, rendering it inoperative. On the Status Display screen, the alarm code MLO will appear, indicating a Machine Lockout.



Manual Control: This feature should be used ONLY in coordination with ATS Service. This option is typically used for troubleshooting purposes. If used improperly, selecting Manual Control can damage the machine. Upon selecting manual control, the following warning will appear:

Reset Frame to IDLE: This option is another troubleshooting feature that may be used in the event of a computer lock-up.

NOTE: If the frame is reset to Idle, all test data for that particular frame will be lost.

Test Load Control : This allows the user to input a setup parameter and then test it in real-time without going to the test function.

CAUTION: THE MACHINE MUST BE SET UP PROPERLY WITH AN ADEQUATE LOAD TRAIN INSTALLED BEFORE ATTEMPTING THIS. DO NOT ENTER A LOAD GREATER THAN THE CAPACITY OF THE TESTER OR LOAD TRAIN.

Viewing: The three options listed allows the user to view various parameters.

a. Frame Controller Status: This relates information pertaining to the frame: temperature, inputs, outputs, furnace power, etc. Some information can be viewed in volts by clicking the appropriate box on the bottom of the screen.

b. Frame Status: This relates other information pertaining to the frame: flags, alarms, etc.

c. Furnace Data: This relates information pertaining to the furnace: setpoint, target temperature, ramp rate, etc.

Additional Maintenance Options: There are two additional options, Write Communication Statistics and Write System Info, found under the File menu. These options are reserved for ATS Service Personnel only.

7.7.2 Lever Arm Tester Maintenance

Knife Edges: Check quarterly or after heavy loading. If they are damaged, rotate to a new edge. Replace when all four edges have been used.

V-Blocks: Regrind or replace if damaged. The lever arm must be recalibrated once the V-blocks have been removed, replaced, or reworked.

Leveling: Check the machine annually using a level on the upper crossbeam.

Lubrication: A high temperature lubricant can be used if high temperature seizing is experienced.

NOTE: Avoid excessive lubrication.

Storage: Coat the knife-edges and V-blocks on tester arms and couplings with a thin coat of oil to prevent corrosion.

NOTE: Avoid excessive lubrication because lubricants attract dust to the equipment.


CAUTION: Do not overload the machine. Observe rated capacity on data tag.


CAUTION: Do not overload load train components. Elevated temperatures lower their capabilities. A load train is no stronger than its weakest element.


CAUTION: Provide snubbers and/or stop nuts on the elements of the load train, where necessary, to prevent damage to accessory equipment in the event of a specimen failure.


CAUTION: Stack weights on weight pan with the slots alternating to prevent tipping.

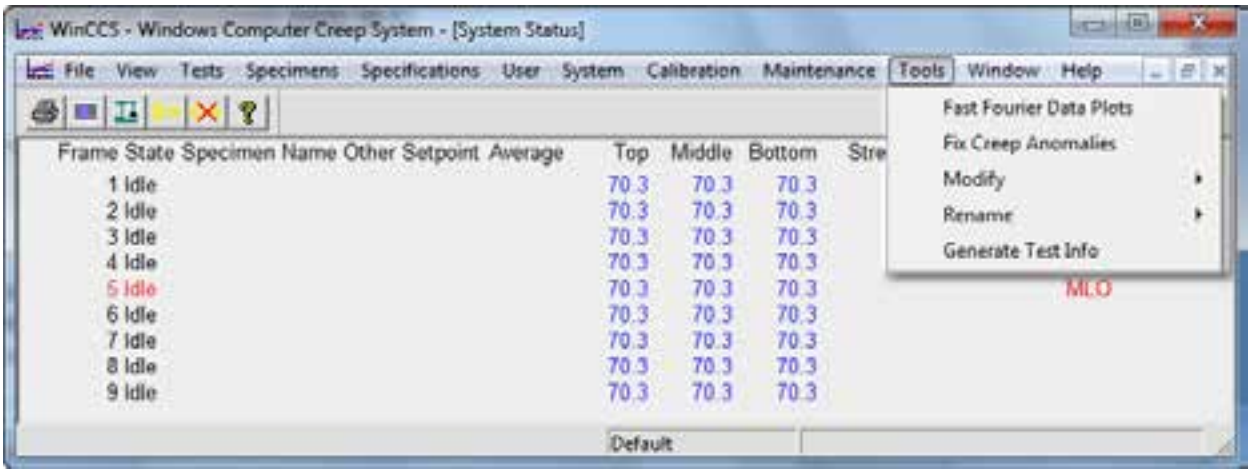

CAUTION: Do not jam threads to the bottom on load train components. Back off one half-turn to prevent misalignment. Thread engagement should be 1 ¼ times the diameter of the thread.


CAUTION: Check the tester daily for any signs of problems with either the currently running tests or test equipment.


CAUTION: Match the serial numbers on test frames, support blocks, and lever arms when assembling multiple testers.

7.8 Tools

Various tools are available to modify, reclassify, and refine tests. These tools are listed under the Tools menu.



Fast Fourier Data Plots: This is a way to search a temperature graph or a creep graph for something that is periodic, making it an ideal option for finding sources of extraneous data. For example, this tool will make a spectrum analyzer plot out of the temperature graph.

Fix Creep Data Anomalies: This function allows the system to recognize an anomaly in the creep graph and delete it. The creep graph will then more accurately portray creep without discontinuous data.

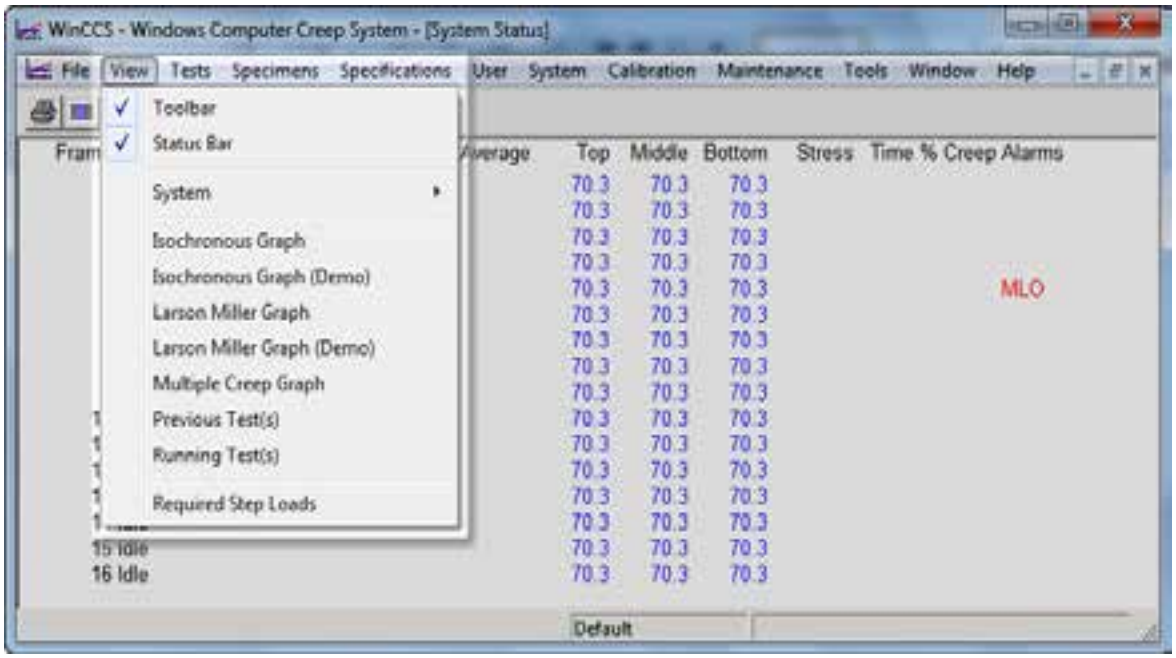
Modify: This feature enables the operator to modify certain test details after the test is completed. For example, an operator may add Remarks to a certain test, redefine the Specimen Measurements, or add Post Test Information.

Rename: The operator can assign an alternative name to a Previous Test, Running Test, or a Specimen.

Generate Test Info: This section is not currently used on ATS testers.

7.9 Graphing Options

There are a variety of graphing options available to the user, so that s/he may display data in a preferred style/format. Select View from the main menu to access these options.



The Multiple Creep Graph option allows users to select multiple creep tests. It then superimposes the creep data, allowing users to view multiple graphs simultaneously. This graph is useful when comparing creep curves for more than one test.

7.10 Help

For additional questions and information on using the WinCCS software, consult the individual sections of this manual or ATS Service at +1-724-283-1212.

Section 8: Accessories

8.1 Thermocouples

8.1.1 Thermocouple Batch Calibration

The system is set up to use any standard NIST-specified thermocouple type. Simply by selecting, during the setup procedure, the type of thermocouple wire used, the temperature readout will be correct for an ideal perfect thermocouple. Because no thermocouple ideal exists, it is common practice to calibrate the actual thermocouple and provide a chart of actual temperature, indicated temperature, and offset.

The calibration information can be entered with an identifying Batch name. Every time a thermocouple is made from this particular batch of wire used, the system will correct temperatures using this calibration information. Completing this calibration process will ensure that temperatures are corrected across different batches of wire. See the instructions below on how to create a batch.

If uncalibrated thermocouples are used, select the Zero Offset Batch Name, and the system will assume a perfect NIST Thermocouple.

Typically, the thermocouple is tested at several temperatures over the useful range of the thermocouple wire type and a chart is provided as a calibration record (see below). Sometimes an error is reported, as in the following example. At other times, the program will present the error as a correction factor, which will return the temperature to the NIST profile.

True Temperature (°Celsius)	Measured Temperature	Offset/Deviation
200	199.40	+0.60
400	399.50	+0.50
600	599.60	+0.40
800	800.10	-0.10
1000	1000.00	0.00
1200	1200.20	-0.02

NOTE: The Actual Temperature is the sum of the Measured Temperature and the Offset.

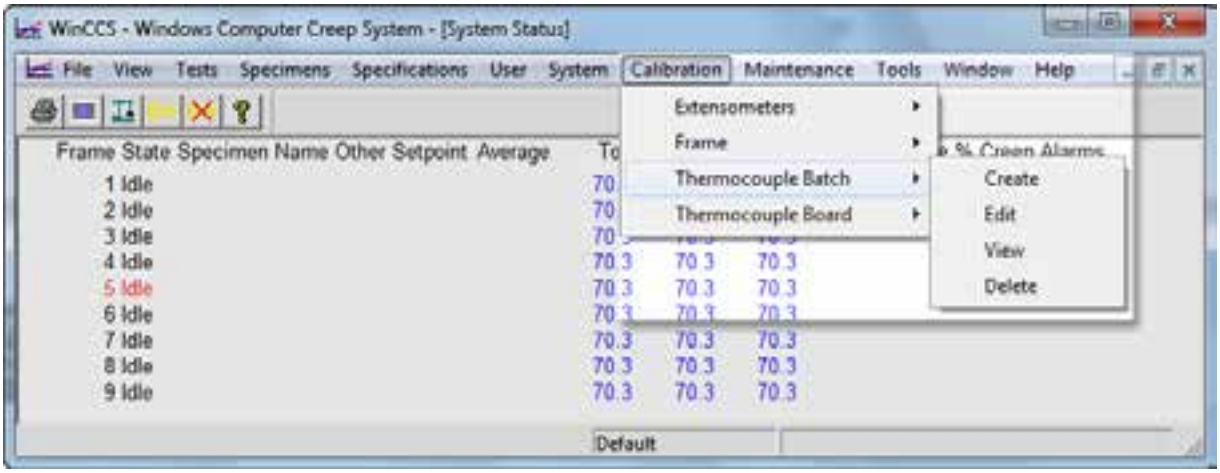
The system will simply add the measured temperature and the offset. If the previous offsets were entered into the batch file, the correction would be opposite of the desired effect.

The operator must, therefore, examine the calibration report carefully and make sure the sign of the correction factor is entered properly.

NOTE: Care must be taken to ensure the test temperature is within the calibrated range. If the measured temperature drops below the minimum or rises above the maximum, a correction factor will not be applied.

In order to create a batch name and enter calibration information, perform the following steps:

a. Select Create from the Thermocouple Batch pull-down under the Calibration menu.



b. Click on New or Add and enter the Batch name. Be sure to use a unique name for each batch.

c. Enter the appropriate information.

d. Enter the Temperature and Offset Correction in the appropriate window.

e. Click Add.

f. Repeat these steps for each temperature point in the Correction Data window.

g. Click OK to complete the batch creation process.

Previously created batches can be edited, viewed, or deleted by choosing the appropriate option from the Thermocouple Batch pull-down from the Calibrate menu.

8.1.2 Proper Thermocouple Attachment

Good contact between the specimen thermocouples and the specimen must be maintained to provide the best temperature measurement and control.

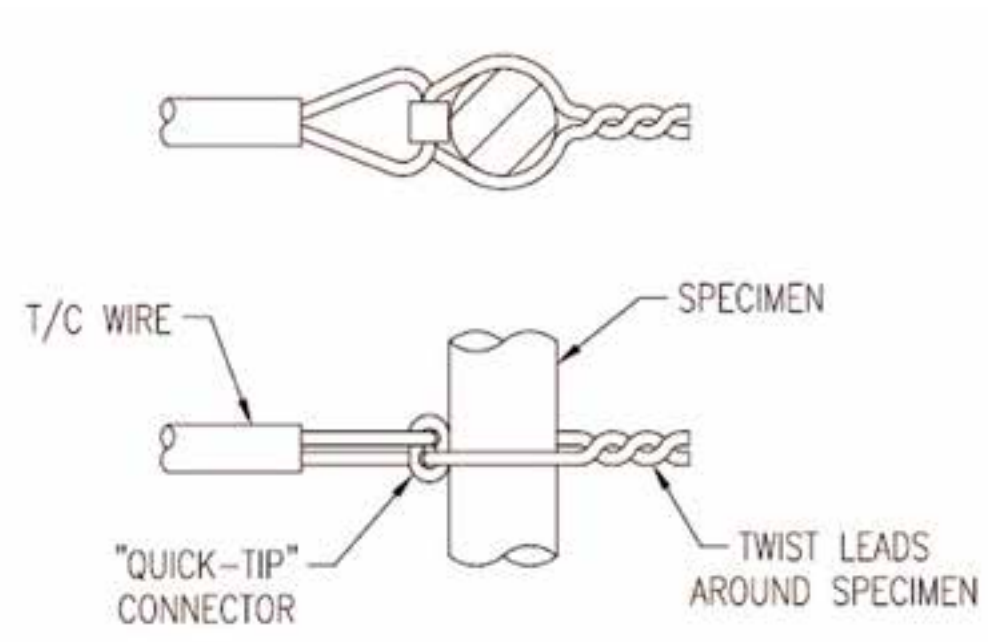
The use of Quik-Tips is one of the most effective ways to provide this contact.

1. Start with a length of insulated thermocouple wire with sufficient length to extend from the gauge section of the furnace to the thermocouple junction box. It is typical to route the thermocouple out of the bottom of the furnace adjacent to the pull rod. Allow an extra 2 in. (50 mm) of wire on the specimen end.

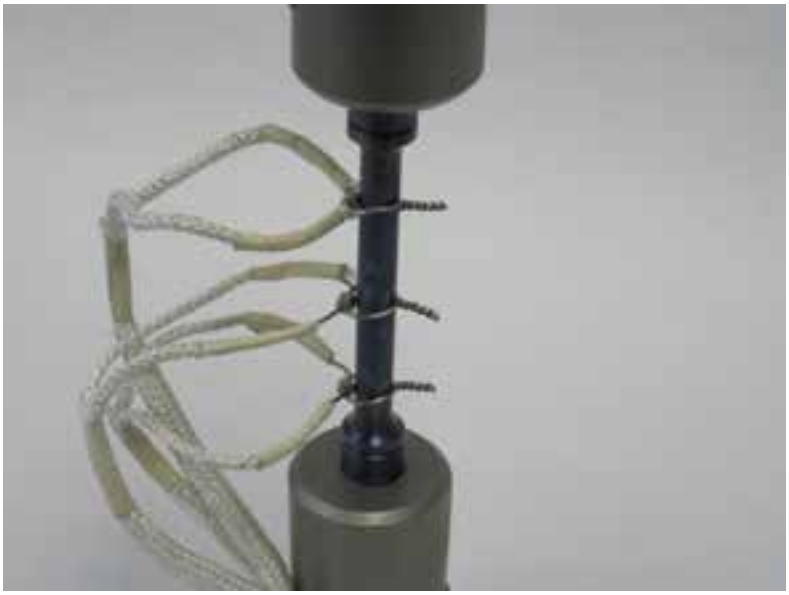
2. Attach a Male Thermocouple Connector to the Junction Box end of thermocouple wire.

3. Slide a Quik-Tip onto the specimen end of the wire about 2 in. (50 mm) per the illustration and crimp using the Quik-Tip Tool.

4. Attach the thermocouple to the specimen by wrapping the 2 in. (50 mm) extension around the specimen and twisting the ends to tighten the thermocouple to ensure the Quik-Tip is making good contact with the specimen. Make sure the thermocouple wires are not touching each other prior to the junction with the Quik-Tip.



Once these steps are completed, the thermocouples will be properly attached to the specimen.



8.2 Extensometers

8.2.1 Series 4112 Creep Extensometer Frame Assembly

1. Lay extensometer flat on a workbench with Crosshead Halves facing upward.
2. Remove Crosshead Clamping Nuts and Crosshead Halves. Leave Clamping Bolts in place.
3. Verify that extensometer is equipped with the proper size extensometer inserts to fit specimen shoulder groove, v-ridge or gage diameter.
4. Set the specimen onto the back half of the extensometer inserts taking care to properly engage the specimen groove or v-ridge. If attaching directly to the specimen gage diameter, verify proper gage length between extensometer inserts.
5. Install Crosshead Halves, taking care to properly engage the specimen groove or v-ridge.
6. Reinstall Crosshead Clamping Nuts and lightly tighten.
7. Adjust location of Extensometer Rod Guide if needed. The Extensometer Rod Guide must be located far enough below the furnace to prevent heat damage.
8. Adjust location of gauging platforms if needed.
9. Attach Series 4031A Threaded Couplings and Series 4043 Pull Rods onto specimen.
10. Install Series 4021 Knife Edge Coupling Quick Change Nuts to the outer end of each Pull Rod.
11. Install assembled load train/extensometer into test machine.
12. Apply a slight preload to the load train assembly.
13. Verify the specimen is properly attached to the Extensometer. Tighten the Crosshead Clamping Nuts.
14. Attach displacement-measuring device to Lower Gauging Platform.

8.2.2 Series 4124 Creep Extensometer Frame Assembly

1. Lay extensometer flat on a work bench with Crosshead Halves facing upward.
2. Remove Crosshead Clamping Nuts and Crosshead Halves. Leave Clamping Bolts in place.
3. Verify that extensometer is equipped with proper size extensometer inserts to fit specimen shoulder groove, v-ridge or gage diameter.
4. Attach proper length Extension Rods.
5. Set the specimen onto the back half of the extensometer inserts taking care to properly engage the specimen groove or v-ridge. If attaching directly to the specimen gage diameter, verify proper gage length between extensometer inserts.
6. Install Crosshead Halves, taking care to properly engage the specimen groove or v-ridge.
7. Reinstall Crosshead Clamping Nuts and lightly tighten.
8. Adjust location of Extensometer Rod Guide if needed. The Extensometer Rod Guide must be located far enough below the furnace to prevent heat damage.
9. Attach Series 4031A Threaded Couplings and Series 4043 Pull Rods onto specimen.
10. Install Series 4021 Knife Edge Coupling Quick Change Nuts to the outer end of each Pull Rod.
11. Install assembled load train/extensometer into test machine.
12. Apply a slight preload to the load train assembly.
13. Verify the specimen is properly attached to the Extensometer. Tighten the Crosshead Clamping Nuts.
14. Attach displacement-measuring devices to Adapters.

8.2.3 Series 4124A Creep Extensometer Frame Assembly

1. Lay extensometer flat on a work bench with Crosshead Halves facing upward.
2. Remove Crosshead Clamping Nuts and Crosshead Halves. Leave Clamping Bolts in place.
3. Verify that extensometer is equipped with proper size extensometer inserts to fit specimen shoulder groove, v-ridge or gage diameter.
4. Set the specimen onto the back half of the extensometer inserts taking care to properly engage the specimen groove or v-ridge. If attaching directly to the specimen gage diameter, verify proper gage length between extensometer inserts.
5. Install Crosshead Halves, taking care to properly engage the specimen groove or v-ridge.
6. Reinstall Crosshead Clamping Nuts and lightly tighten.
7. Adjust location of Extensometer Rod Guide if needed. The Extensometer Rod Guide must be located far enough below the furnace to prevent heat damage.
8. Adjust location of gauging platforms if needed.
9. Attach Series 4031A Threaded Couplings and Series 4043 Pull Rods onto specimen.
10. Install Series 4021 Knife Edge Coupling Quick Change Nuts to the outer end of each Pull Rod.
11. Install assembled load train/extensometer into test machine.
12. Apply a slight preload to the load train assembly.
13. Verify the specimen is properly attached to the Extensometer. Tighten the Crosshead Clamping Nuts.
14. Attach displacement-measuring devices to Lower Gauging Platforms.

8.2.4 Extensometer Cautions

CAUTION: Do not use extensometer at a temperature above the rating of the extensometer. There is a standard temperature rating of 1100 degrees Celsius for most extensometers manufactured from Inconel 600/601 materials.

CAUTION: Do not install extensometer in any manner that could damage the extensometer if specimen failure occurs. For example, avoid limited clearance and restrictive movement.

CAUTION: The displacement transducers should extend far enough below the oven or furnace so as not to be damaged by heat.

8.2.5 Extensometer Calibration

Each extensometer must be calibrated in the channel in which it is to be used. In practice, the LVDT or other transducer remains attached to the signal conditioner board in the system console. In this manner, the inadvertent switching of transducers is avoided.

There are two distinct, but similar functions available to the operator to ensure proper operation and accuracy of the extensometer: Calibration and Verification. Both involve using a micrometer to increment the LVDT in precise amounts through its range of operation, but they differ in the way the signal is handled by the system.

8.2.5.1 Calibration

In the Calibration function, a polynomial curve fit is used to effectively ensure that the device is linear, allowing much greater accuracy of operation. In this process, the calibration device is assumed to be perfect and the output signal is corrected to a straight line, against which the data will be compared to produce strain information. In the verification process, the LVDT is again incremented through its range using a precise micrometer and the resulting output is compared to the original. After correcting for non-linearity, any difference is presumed to be error and the extensometer is graded based on the result. It is important, therefore, to run the verification process frequently, since this is the true check of extensometer performance.

A System Calibration Report can be found by choosing Calibration from the System pull-down under the View menu. Other calibration reports can be found under the Calibration menu.

Details of both calibration and verification are defined during the Frame Setup Process (see Section 6.2.10). To initiate extensometer calibration:

a. Select Calibrate from the Extensometer pull-down under the Calibration menu.

b. Select the appropriate frame from the pull-down menu and click OK.

NOTE: At this point, the main menu and status display screen will be displayed, and the status display line corresponding to the selected frame will turn red. “Cal/Ver” will be displayed in the alarm column.

c. For the Classic tester, use the buttons located below the LCD display on the Control console to proceed, as directed by the instructions on the LCD display. For Modular testers, use the LCD display on the Portable Display Module.

d. The LCD display will move through a series of steps requiring moving of the LVDT in precise increments given by a micrometer calibration device.

e. When the process is completed, the status display screen will return to normal.

f. To review the calibration report and graph, select View Calibration Report from the Extensometers pull-down on the Calibration menu.

g. Choose the appropriate extensometer and click OK. The selected report will appear.

NOTE: This report will provide all pertinent data on the calibration, including a grading (gradation comparison) against ASTM standards. In almost all cases, the data will indicate a class A extensometer, though this does NOT guarantee that the extensometer will perform as a class A.

8.2.5.2 Verification

In order to know how the extensometer will perform in actual operation, repeat the above process, selecting Verify from the Extensometer pull-down on the Calibration menu instead of Calibrate. After completing the verification process, the resulting verification report will show the true capability of the extensometer.

In practice, it is normal to perform the calibration process at the interval specified in the setup field, and to perform verification much more frequently.

8.2.5.3 Reports

Both calibration and verification reports are archived with the data for all completed tests.

Both Calibration and Verification report windows are a list of information on a plain screen.

It is possible to view these reports for frames on which tests are currently running by selecting Running Test from the View menu. When the screen appears, select the desired frame.

Another method for viewing the calibration reports is by accessing the Frame Services menu. Double-click on the status display line of the appropriate frame. Select View Data from the Frame Services menu, select the Extensometer Calibration from the Report/Graph menu that appears and click OK.

8.2.5.4 Viewing Calibration Summary

A review of the calibration status of a frame can be acquired by double-clicking with the left mouse on the status line of the frame while holding down the Control (Ctrl) key. This can be done regardless of the state of the frame.

A report screen is generated after the frame calibration. This type of calibration is normally done once a year with the proper equipment. For more information on how to calibrate a frame, please contact the ATS Service Department at +1-724-283-1212.

Please note that for the initial test, the frame is pre-calibrated at the ATS factory. To keep it current, the frame should be recalibrated one year later.

Appendix A: System Status Display

A.1 Status Display Headings

Frame: Each frame has an identifier, either a name assigned during the setup process, or a number from one to the total system complement. The default lists frames in numerical order.

State: The frame state allows the operator to monitor the process of the test.

Specimen Name: The specimen name is the unique identifier assigned to the particular test subject installed in the frame. This identifier will be used for all archival purposes for subsequent test data.

Setpoint: The setpoint is the temperature specified in the test specification to which the specimen will be tested. In case of room temperature tests and idle frames, N/A is displayed to indicate the furnace is not in use.

Average: This column displays the average of the temperatures of all the thermocouples in use on this frame. The user thermocouple is not included in this average.

Top (Middle, Bottom): The display here assumes that three thermocouples are in use, and the temperature of the uppermost thermocouples is displayed here. The middle and lower thermocouples are likewise shown in the adjacent columns.

Power: At any time during the test, the furnace control algorithm will be varying the power into the furnace in order to keep the temperature at the specified value. This display, which is a % of the total power available, provides an indication to the operator of the power level being delivered to the furnace.

Time: Depending on the frame state, time may have a different meaning. For example, if a test is running normally, time will be the total run time of the test, starting from initial specimen loading. A frame in soak state will show the time remaining until specimen loading.

% Creep: When a creep test is in process, this display will show the amount of creep of the specimen in real time.

Alarms: This display shows an abbreviation name for the alarm state of the frame. In addition, this column indicates to the operator that some action at the individual frame is required. For example, load weights, zero extensometer, etc. may appear in this column.

A.2 Status Display Colors

Individual frame lines will change color frequently as the frame state and alarm conditions change.

Red: Major alarm or action required, alarm condition will be displayed.

Green: Normal run state, test in progress.

Blue: Indicates normal activity under Temperature Columns and signals a Minor alarm state, alarm condition will be displayed.

Black: Column header, idle frame state.

Orange: Time only, normally indicates time remaining until change of frame state.

A.3 System Status Error Codes

Error codes explain issues with the system. Some of the errors are fatal and will stop the test, while others supply information and indicate a potential problem but do not indicate that the test is faulty.

ACLow: The frame controller's AC power line has dropped below 95VAC, indicating a severe brownout condition.

ACV: The frame has no AC power to the frame and/or furnace.

BAT: The frame controller's battery for the NVRAM needs replacing.

Break: The frame's break detect switch is active.

Cal/Ver: The frame is currently having the extensometer calibrated or verified.

Com: The host PC is unable to communicate with the frame controller.

ECnt: The number of events in the event log is greater than fifty.

FZone: The furnace zone control algorithm has reached its limits and is unable to control the differential temperature between zones. This is usually caused by one or all of the following: open furnace zone, thermocouples in wrong position on the specimen, open zone control relay, or specimen too high or low in the furnace. See A.3.1 for an extended explanation of the FZone alarm.

LCtrl: The automatic load control system has faulted. This is usually due to elevator-style machines running out of travel, and the lever arm must be re-zeroed.

Load: The test is ready to load weights.

MLO: Machine Lockout

Open: A control thermocouple is open.

SErr: A startup error has occurred. This is caused by a reversed thermocouple or an open thermocouple specified as active in a test. Once the problem is corrected the test will start automatically.

SLoad: The test is ready for a load increase.

TCBCal: There is no thermocouple measurement unit calibration found on the system.

THigh: A control thermocouple is above the minor temperature alarm limit.

TLow: A control thermocouple is below the minor temperature alarm limit. See A.3.2 for more information about this alarm.

ZExt: The extensometer has traveled beyond its specified re-zero range and must be re-zeroed.

A.3.1 FZONE alarm:

Refer to the Furnace Setup menu, under "Zone Power Control," to find a set of parameters which define the zone power control limits.

Min and Max usually 10 and 90 percent, mean that of the available power to the furnace, any one zone should be receiving a minimum of 10%, and no zone should be receiving more than 90%. If the control algorithm cannot achieve the required control within these limits, the FZONE alarm will be activated, which indicates a problem with the furnace or specimen arrangement. It does not mean that the test should be stopped or is invalid. It means that attention is required.

The following problems are associated with the FZone alarm:

1. The problem can be with the hardware; for example, one half of the furnace elements in a zone may be open.

2. In unusual circumstances, a wiring error in the thermocouple connections or the furnace zone control relays could result in the thermocouple or zone relay being associated with the wrong zone. This produces a very distinctive temperature pattern, and a review of a test file will easily identify this problem. To receive advice through a review of archived test files, call the ATS Service Department.

3. It may be that one or more of the thermocouples are not properly attached or are not in the proper location.

4. It may mean that the furnace is not properly closed or that the end caps are not in place.

5. The most common problem is that the specimen is not in the center of the furnace, requiring the furnace to be adjusted vertically. If the specimen is below the center of the furnace, then the bottom end of the specimen will not be inside the furnace. This will result in the bottom of the specimen being even cooler than normal. This makes it much more difficult for the differential algorithm to function, resulting in the FZone alarm.

NOTE: With a specimen installed and the lever arm positioned correctly, the furnace should be positioned so that the specimen is vertically centered in the middle zone. This is part of the installation procedure and should be checked any time a change is made to either specimen or pull rod length.

A.3.2 TLow alarm:

TLow simply means that the temperature of one or more of the thermocouples is more than the minor alarm value below the setpoint of the test specification.

Specimen size is not a factor. The system is designed to operate in a typical creep furnace, which is usually a three-zone arrangement with each zone typically 3-4 inches long and a specimen of about three inches. A shorter specimen is easier to control than a longer one.

In rare cases, widening the alarm band may help avoid these alarms, though relaxing these limits may exacerbate the problem. Frequently, the same problems that cause an FZone alarm lead to persistent TLow or THigh alarms.

If TLow occurs frequently during the soak cycle, it may be that the Integral Algorithm is not active enough. Increasing the “I” term of the furnace setup may help. For example, if the setting is 0.03, it may be beneficial to increase the value to 0.04 or 0.05. Contact ATS for help with this.

NOTE: These parameters may be reset during operation of the furnace, so if a test has persistent TLow alarms, change the “I” term value and observe what happens.

During operation, furnace power will not be equal among the zones because the bottom zone will typically receive more power to keep it to temperature. If everything is set up satisfactorily, one TLow alarm may appear at the beginning of the test. It is uncommon if the alarm continues to repeat and typically indicates an issue.

Appendix B: Glossary

B.1 Prompts that may appear during Setup and Running a Test

Apply Load: The load is applied to the specimen.

Cal/Ver: The frame is having the extensometer calibrated, verified, or checked.

Disable: This state makes sure that if the termination was due to a temperature alarm that the specimen did not actually break.

Fault: A hardware fault has occurred on the frame.

Idle: The frame status is idle.

Initial Load: Sets the initial drawhead or elevator position before ramping the furnace.

Loading 2: No action, except to take the frame offline. Used by the test load control.

Load Invalid: The load control has been unable to maintain the load within the 1% limit for over five minutes.

Manual: The frame is in manual control.

Pre Start up: The frame is requested to start; all parameters are downloaded to the frame controller.

Post Test: The test is complete and ready to be removed.

Ramp: The furnace is ramped from the current temperature up to the setpoint. When at least one of the thermocouples is within the minor limit, the soak state is entered.

Remove: The frame controller is waiting for the host to upload the final test data before the specimen is removed.

Restart: The system is restarting the test after a power failure.

Run: Normal running state of the test.

Shutdown: Entered at the termination of a test. Stops all frame motion and stops the furnace.

Soak: Furnace soak state.

Start-up: Refers to frame status.

Start-up Delay: Test start-up was delayed.

Terminate: This state is entered when a test is terminated by the operator.

Unload: The load on the specimen is removed.

WF Power: A power failure has just occurred and the system is waiting for the hardware to reinitialize.

B2: States that occur while Running a Test

All Specimen Thermocouples are Open: All control thermocouples are open and the test will be shut down.

Automatic Loading Failed: The automatic creep loading system failed; this statement is usually accompanied with a reason for load failure.

Automatic Loading Timed Out: The automatic creep step loading routine failed due to insufficient load change during the loading procedure.

Cannot Start, Open TCs: One or more thermocouples are open during the initial start-up or ramp of the specimen.

Check Furnace Alarm, Shutdown: A fatal temperature event precedes this message. This indicates the actual shutdown of the furnace control due to that event.

Control T/C Switched to Highest T/C: Informational alarm which indicates that the temperature control is completely stable and the control is now on the highest physical thermocouple in the furnace.

Furnace Split Exceeded: Indicates the system has adjusted the power split between the zones as much as possible and was not able to control temperature uniformity.

ISO Thermal Temperature Range Error, Shutdown: The temperature measurement subsystem ambient temperature sensor is outside the range of normal operation, which is less than 32 degrees Fahrenheit or greater than 120 degrees Fahrenheit.

Rezero of Extensometer Requested: The system has detected that the specimen has creeped close to the range of the displacement transducer. The system is requesting a mechanical rezero of the extensometer.

Shutdown Due to Furnace Out of Band Time Exceeded: The furnace has been out of band limits for more than fifteen minutes and the ramp up will be terminated. Check for the following conditions:

1. Open furnace element or solid state relay
2. Specified ramp rate is too fast
3. Shorted thermocouple
4. Low AC line voltage

Specimen Broke During Loading: The system was loading the specimen and after five minutes the break switch never went to a not broken state. The system assumes that the specimen broke.

Specimen is Ready to Load Weights: The specimen is ready to be loaded on manual frames.

Specimen Loaded: The specimen was loaded by the system.

Specimen Reached Creep Limit: The test is being shut down because the creep limit specified in the test specification has been reached.

Specimen Reached Life Hours: The test is being shut down because the run time limit specified in the test specification has been reached.

Specimen Reached Reference Plain or Life Hours: The notch specimen has reached the reference plain's hours and the test will be shut down.

Specimen Ruptured: The system has detected a specimen rupture.

Step Load Completed by User Name: Indicates the user that completed the manual step load.

Temperature Measurement Error, Shutdown: A fatal hardware error has occurred in the temperature measurement subsystem of the frame controller.

Test Reloaded or Restarted: Indicates that a test which had been previously removed and post tested has been restarted.

Test Restarted Automatically by System: The test has been automatically restarted after a controller power failure.

Test Restarted Manually: The test was restarted by a user after it had shut down.

Test Terminated by User Name: Indicates which user terminated the test.

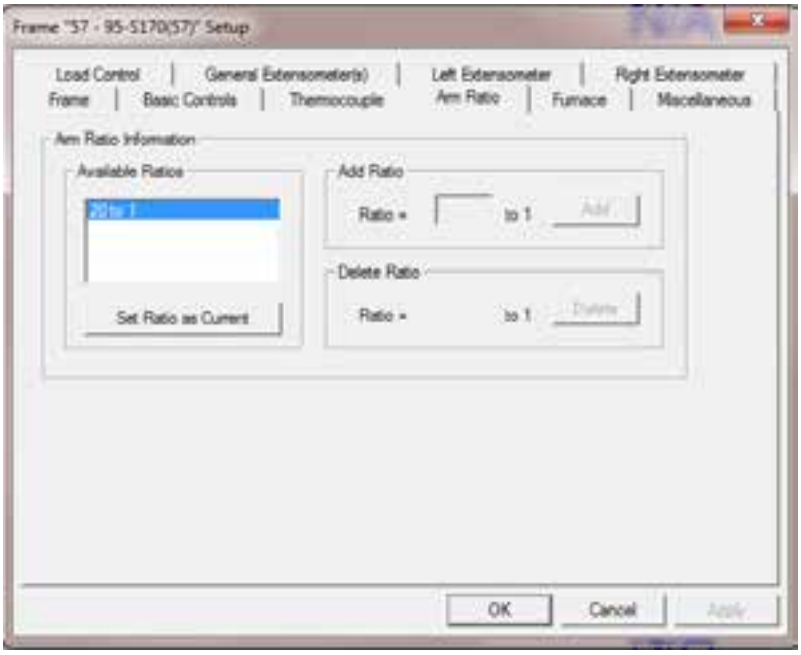
(Top, Middle, or Bottom) T/C at x.x °F has returned below limit, dev x.x °F from setpoint: Indicates that specimen thermocouple has returned from below temperature limit.

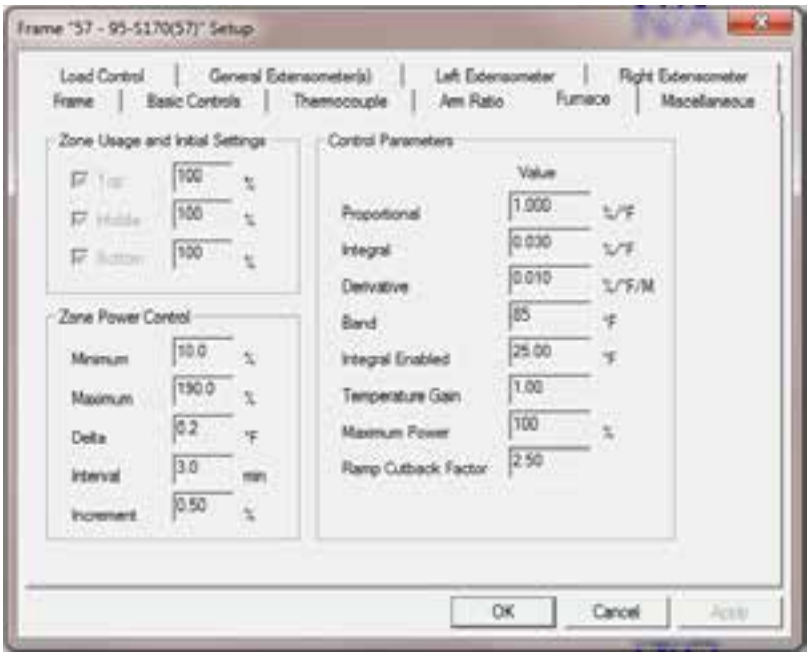
(Top, Middle, or Bottom) Thermocouple is Open: The thermocouple is open.

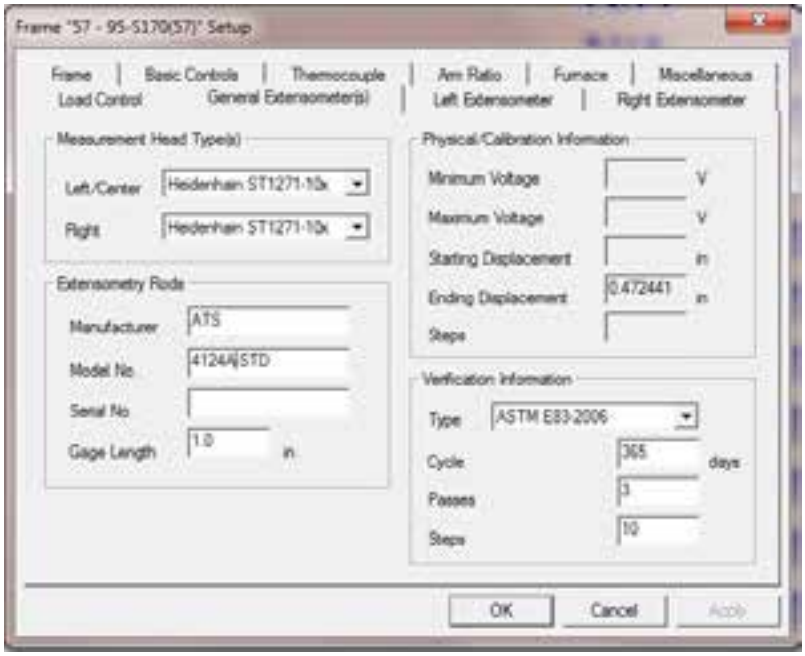
(Top, Middle, or Bottom) Thermocouple Repaired: The thermocouple that was previously open has been repaired.

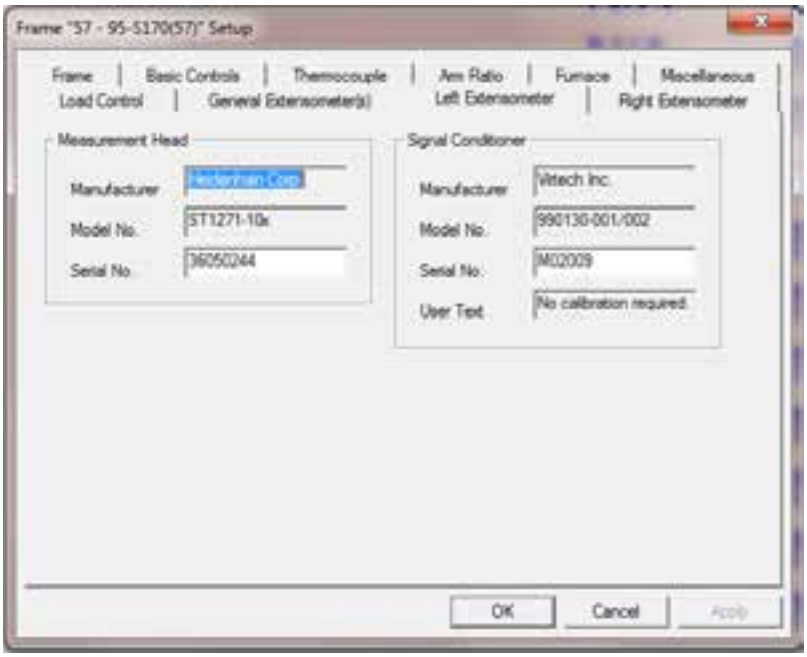
Appendix C: Default Values

This appendix includes all the default values typically seen on a WinCCS tester.

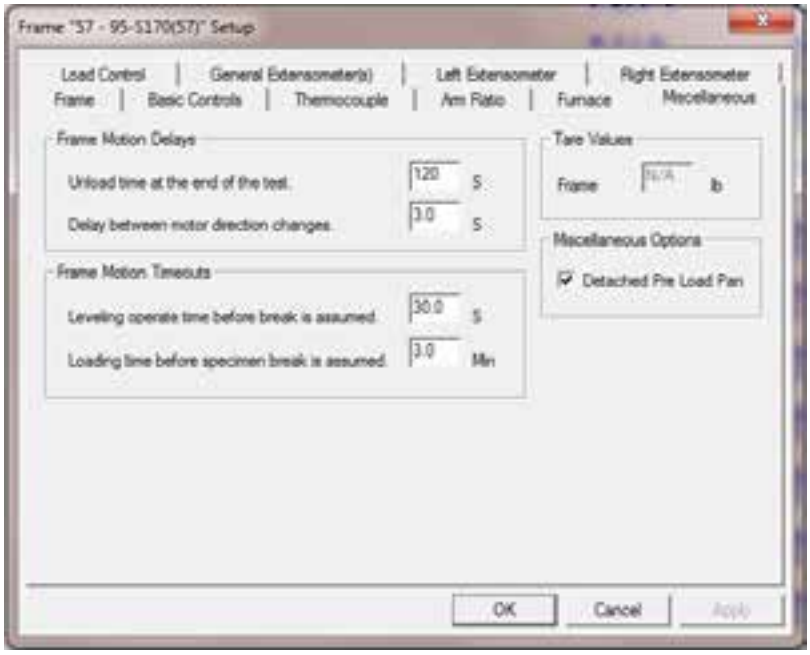


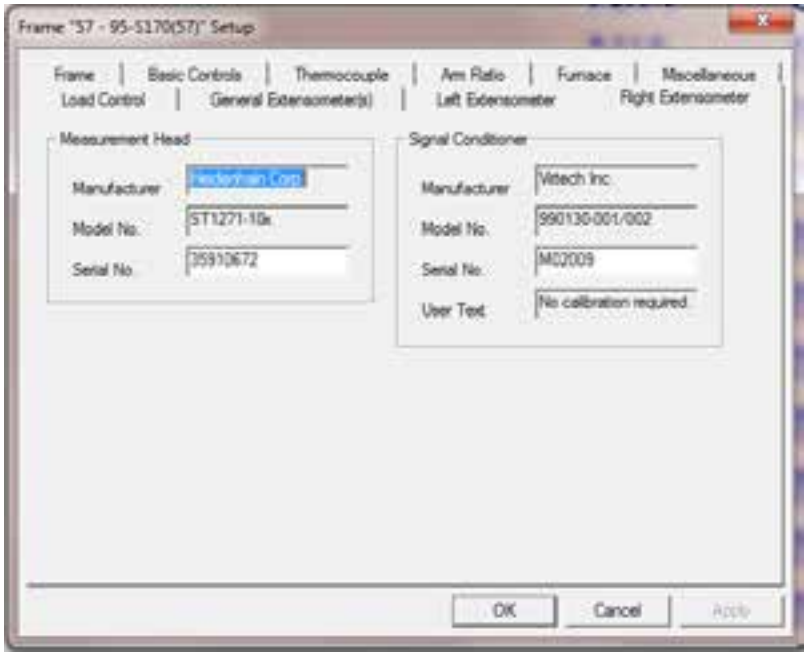

Frame "57 - 95-S170(57)" Setup
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Zone Usage and Initial Settings
Top
100
%
Middle
100
%
Bottom
100
%
Zone Power Control
Minimum
10.0
%
Maximum
100.0
%
Delta
0.2
°F
Interval
3.0
min
Increment
0.50
%
Control Parameters
Value
Proportional
1.000
%/°F
Integral
0.030
%/°F
Derivative
0.010
%/°F/M
Band
85
°F
Integral Enabled
25.00
°F
Temperature Gain
1.00
Maximum Power
100
%
Ramp Cutback Factor
2.50
OK
Cancel
Apply


Frame "57 - 95-S170(57)" Setup
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Measurement Head Type(s)
Left/Center
Heidenhain ST1271-10x
Right
Heidenhain ST1271-10x
Extensometry Rods
Manufacturer
ATS
Model No
4124A/STD
Serial No
Gage Length
1.0
in
Physical/Calibration Information
Minimum Voltage
V
Maximum Voltage
V
Starting Displacement
in
Ending Displacement
0.472441
in
Steps
Verification Information
Type
ASTM E83-2006
Cycle
365
days
Passes
3
Steps
10
OK
Cancel
Apply

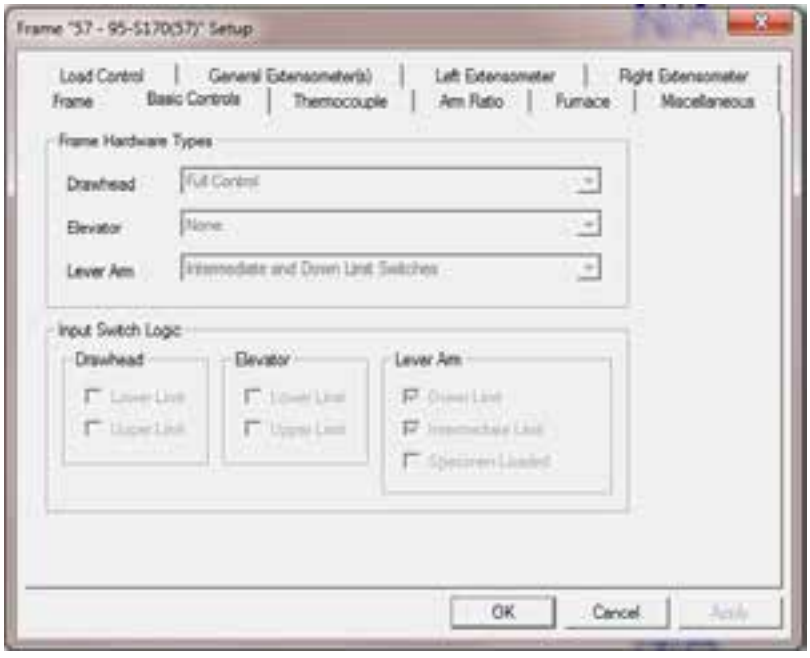

Frame "57 - 95-5170(57)" Setup
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Measurement Head
Manufacturer
Hedenhain Corp
Model No.
ST1271-10x
Serial No.
36050244
Signal Conditioner
Manufacturer
Vitech Inc.
Model No.
990130-001/002
Serial No.
M02009
User Text
No calibration required.
OK
Cancel
Apply


Frame "57 - 95-5170(57)" Setup
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Load Cell
Identification
Manufacturer
Omegadyne
Model No.
LC101-500
Serial No.
273037
Capacity
500.0
lb
Nominal Characteristics
Gain
66.6454
lb/V
Offset
12.1357
lb
Control Setup
Type
Load Control
Enable Relay
Dout 7
Load Cell Location
Weight Pan
Load Control Parameters
Control Limit
0.30
lb
Small Step Limit
200.0
lb
Small Step Gain
50.00
mS/lb
Small Step Offset
200
mS
Reverse Gain
1.00
OK
Cancel
Apply


Frame "57 - 95-S170(57)" Setup
Load Control | General Extensometer(s) | Left Extensometer | Right Extensometer
Frame | Basic Controls | Thermocouple | Arm Ratio | Furnace | Miscellaneous
Frame Motion Delays
Unload time at the end of the test.
120
S
Delay between motor direction changes.
3.0
S
Frame Motion Timeouts
Leveling operate time before break is assumed.
30.0
S
Loading time before specimen break is assumed.
3.0
Mn
Tare Values
Frame
N/A
lb
Miscellaneous Options
Detached Pre Load Pan
OK
Cancel
Apply


Frame "57 - 95-S170(57)" Setup
Frame | Basic Controls | Thermocouple | Arm Ratio | Furnace | Miscellaneous
Load Control | General Extensometer(s) | Left Extensometer | Right Extensometer
Measurement Head
Manufacturer
Heidenhain Corp
Model No.
ST1271-10x
Serial No.
35910672
Signal Conditioner
Manufacturer
Vitech Inc
Model No.
990130-001/002
Serial No.
M02009
User Text
No calibration required
OK
Cancel
Apply


Frame "57 - 99-S170(57)" Setup
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Thermocouple Setup
Channel
Type
Top
K NIST
Middle
K NIST
Bottom
K NIST
User
K NIST
OK
Cancel
Apply


Frame "57 - 99-S170(57)" Setup
Load Control
General Extensometer(s)
Left Extensometer
Right Extensometer
Frame
Basic Controls
Thermocouple
Arm Ratio
Furnace
Miscellaneous
Frame Hardware Types
Drawhead
Full Control
Elevator
None
Lever Arm
Intermediate and Down Limit Switches
Input Switch Logic
Drawhead
Lower Limit
Upper Limit
Elevator
Lower Limit
Upper Limit
Lever Arm
Down Limit
Intermediate Limit
Specimen Loaded
OK
Cancel
Apply

Appendix D: Warranty

This appendix includes all required information for the WinCCS tester.

Warranty Statement

Your Applied Test Systems product has been manufactured and inspected by experienced craftsmen. Applied Test Systems warrants, for the original purchaser, each product to be free from defects in material and workmanship for a period of thirteen (13) months from date of shipment or twelve (12) months from date of installation whichever comes first. This warranty does not apply to failures caused by normal usage, misuse, or repair or service by unauthorized personnel, nor does it cover limited life electrical components which deteriorate with age such as tubes, lamps, fuses, and heaters. The warranty does not extend to products not manufactured or assembled by Applied Test Systems.

This warranty is expressly limited to the repair, replacement, or adjustment of the product at Applied Test Systems' option. The product must be returned to the Applied Test Systems factory or an authorized repair center. Applied Test Systems shall not be liable for any labor, transportation, or installation costs that may arise in connection with the product or return.

To obtain warranty service:

1. Applied Test Systems must be promptly notified in writing of the defect.

2. Upon receipt of written authorization, said defective equipment is returned as directed, with transportation charges prepaid by the buyer and –

3. Applied Test Systems examination of such equipment discloses to its satisfaction that the defect exists and was not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranty of merchantability or fitness for particular purpose. In no event shall Applied Test Systems be liable for direct, indirect, special, incidental, collateral or consequential damages.

The aforementioned provisions do not extend the original warranty period of any article that has been either repaired or replaced by Applied Test Systems.

Applied Test Systems reserves the right to change published specifications.

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