

L2 Series Software for Force Measurement

Advanced Test Builder



Starrett®

The Better Solution



Starrett®
FMS5000



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General Safety Precautions

Force measurement systems are potentially hazardous. Prior to operating your testing system, Starrett recommends that you read and understand the instruction manuals for your system and components and that you receive training on the proper use of this equipment from your authorized Starrett representative.

Observe all warnings and cautions identified in this manual for your equipment. A warning identifies a function that may lead to injury or death. A caution identifies a hazard that may lead to damage to equipment or loss of data.

Starrett products, to the best of our knowledge, comply with various national and international safety standards as they apply to material and force measurement testing. This Starrett product has been tested and found to comply with the following recognized standards:

- EN61010-1 Safety Requirements for Electrical Equipment
- EN61000-6-3 EMC Generic Emissions Standard
- EN61000-6-1 EMC Generic Immunity Standard

Starrett also certifies that this product complies with all relevant EU directives and carries the CE mark.

Warnings

Emergency Stop

Press the emergency stop button whenever you feel there is an unsafe condition during a test. The emergency stop button removes power to the motor drive system causing the crosshead to stop.

Flying Debris

Eye protection, protective clothing and splinter/safety shields should be used whenever any possibility exists of a hazard from the failure of a sample, assembly or structure under test. Due to the wide range of materials that may be tested and that may result in a failure which may cause bodily injury, the precautions and preventative methods taken prior to testing is entirely the responsibility of the owner and the user of the equipment.

Crush Hazard

Always use caution when installing or removing apparatus and your sample material between the frame's crosshead and the base. A potential pinch/crush hazard exists. Keep clear of the testing fixture, and particularly the jaw faces at all times. Keep clear of the crosshead during movement. Always make sure the Pinch Load feature is enabled. This will stop inadvertent crosshead operation if in manual mode. Always ensure that other personnel cannot operate the system while you are working within the test fixture area.

Electrical Hazard

Disconnect equipment from the electrical power supply before removing any electrical safety covers. Disconnect power when replacing fuses. Never reconnect power while the covers are removed. Never operate the system with protective covers removed.

Rotating Machinery Hazard

Always disconnect power before removing covers that protect the user from the internal rotating mechanisms. If maintenance to the drive mechanism is required, and power is needed to perform maintenance to the drive system, maintenance should be performed by an authorized Starrett representative who has received factory training on performing such procedures.

1.0 Introduction

Thank you and congratulations for selecting the Starrett FMS Series for your force measurement testing.

Your FMS testing system may be used for tension and compression testing including specific test methods such as peak, break, constant hold, flexural, shear, peel, coefficient of friction and more. Your FMS testing system should be used with Starrett equipment and accessories only. And for optimum performance, your FMS testing system should be maintained and serviced annually by an authorized Starrett representative.

1.1 System Description

Your Starrett FMS Series system consists of the testing frame, L2 digital controller, load cell sensors and test fixtures. Together, these components provide you with a full-featured testing system for most force measurement testing applications.

1.2 Product Support

If you require product support for your Starrett system, contact your authorized Starrett representative. Authorized Starrett representatives are listed on our website at www.starrett.com. In the event that your Starrett representative may not be able to assist you, contact Starrett at one of our many international sales offices. Our sales offices are listed on our website at www.starrett.com.



FMS500

FMS1000

FMS2500

FMS5000

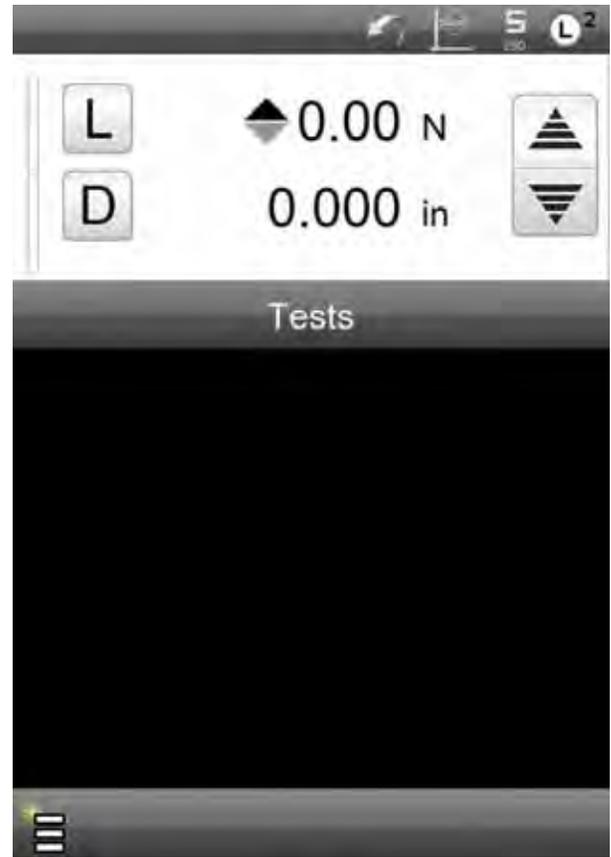
The Starrett FMS Series - Single-column Force Measurement Systems

2.0 Using the Test Builder

The Test Builder application let's you create any type of test for your FMS Series systems. You also have the option to use pre-configured test setups using the Test Templates supplied with your L2 controller.

The Test Builder lets you setup Pre Test and Post Test operations for your tester. Additionally, you select the results, called coefficients, that you want reported based on the completion of your test. All tests created using the Test Builder use steps, that control the operation of your tester and more specifically control the direction and velocity for your crosshead movement.

The Test Builder is especially useful for complex and multi-step test methods. It can also be used to create test procedures that follow international testing standard procedures from ASTM, DIN, ISO and others.



New Test Symbol

3.0 Creating a New Test

You create a new test by selecting the New Test symbol. The New Test symbol is always located at the Home view.

Select the New Test Symbol.

The Home view displays the Menu for New Tests. You have four New Test options:

- Load Test
- Distance Test
- Break Test
- Test Builder

The Load Test template lets you create a quick load limit test. Your test is complete when your system meets the load setpoint that you specified.

The Distance Test template lets you create a quick distance limit test. Your test is complete when your system meets the distance setpoint that you specified.

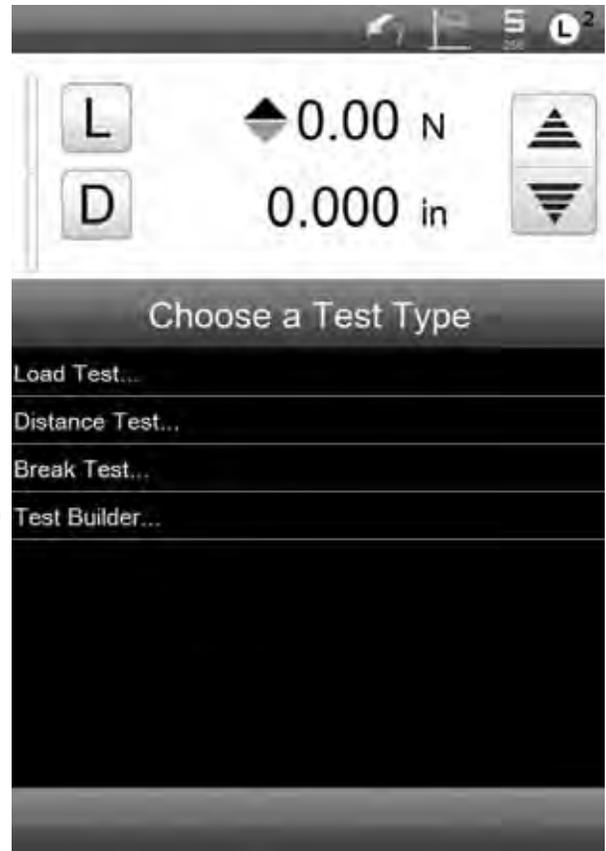
The Break Test template lets you create a quick break limit test. Your test is complete when a sample break occurs based on your specified break criterion.

The Test Builder is an advanced application where you have total freedom to create the test method you desire.

3.1 Selecting the Test Builder

The Test Builder is used when you want to create your test from scratch without using the pre-configured Load Test, Distance Test or Break Test templates.

Select the Test Builder... menu option.



Home View

When you select the New Test symbol, you have four methods for creating a new test setup:

Load Quick Test

Distance Quick Test

Break Quick Test

Test Builder Application

4.0 Test Steps

All test setups have four fundamental steps:

- Pre Test
- Step Moves
- Data (Coefficients)
- Post Test

The Pre Test step lets you define activities and functions that occur prior to the actual testing, hence the term, Pre Test. Pre Test options include:

- Lock Test
- Load Units
- Distance Units
- Set Home
- Sampling (Hz)
- Last Batch Step
- Load Cell
- Height Mode

Lock Test may be either NO (disabled) or YES (enabled). If enabled, the test setup cannot be revised, edited, or deleted unless performed by an authorized user.

The Load Units may be either N (newtons), LBF (pound-force), KGF (kilogram-force), GF (gram-force) and OZF (ounce-force). Some higher capacity load cell sensors will not allow GF or OZF units to be selected due to the available display resolutions.

The Distance Units may be either in (inches) or mm (millimeters).

If Set Home = YES, the location where the crosshead is positioned when your test is started is automatically assigned as the Home position.

The factory setting for Sampling (Hz) is 100 or 100 samples per second. During a test, data is sampled and collected 100 times per second. You have the option to increase or decrease the sampling rate from 5 to 1,000.

The Last Batch Step option is useful when you are performing the same test setup on multiple samples or parts (a “batch” of parts). The ASK step may be used (at the beginning of the test setup) to ask questions that only need to be answered once, such as “Operator Name” or “Batch ID”. These ASK steps will be skipped on the second and subsequent runs of the test if the Last Batch Step is set to the first step after them.



The Load Cell option allows you to select which load cell sensor model and capacity is to be used for your test setup. All load cell sensors are TEDs compatible. This means that they comply with IEEE 1451 and that the sensor self-identify their model number, capacity and other key characteristics when they are connected to your Starrett testing frame. By specifying the load cell model, you can ensure that your test is always performed using the same sensor model and capacity.

When Height Mode is YES, the tester uses the height of the sample on which to base distances. Height mode is normally used in compression tests like for a spring compression test. Using height mode, you must first establish the datum position on which the height result is based upon.

When you create a test setup using the Test Builder application, you select steps that represent steps or individual movements of the crosshead in a direction you desire. Steps are also referred to as steps because a series of steps are generally necessary to create a test setup.

In an L2 test setup using the Test Builder, the Pre Test function is always Step 1 whether or not you use any of the Pre Test options. The Step number is displayed in the setup menu view.

4.1 Step Reference

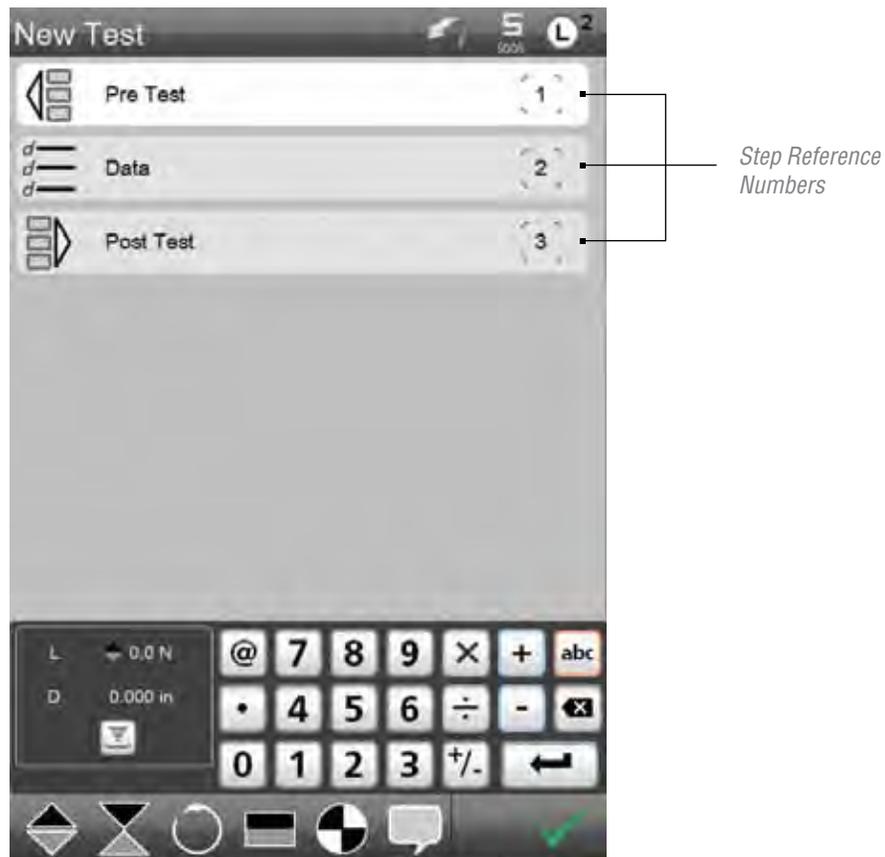
All steps within your test setup have a reference number. The reference number is the sequence in which the step takes place. The step reference is also used with scoping and helps identify how functions or formulas are to be performed within a test and between identified steps.

4.2 Step Sequence

All test setups are a combination of steps. Steps are performed in sequential order. The Pre Test step is always step 1 whether or not any Pre Test options are used.

When you create a new test setup, the Pre Test is always step 1. The Data step is step 2 and the Post Test is step 3. However, a test cannot be performed until you add a movement step, therefore, a move step is inserted based on the type of test you want to perform. The move step is always added after step 1 (Pre Test). Once a step is added, in this case a move step, the subsequent steps are incremented, e.g. step 2 (Data) becomes step 3. Steps continue to be incremented downward as more steps are added to your setup.

Step references are also displayed during the test in the status message. During your test, the status message will display the test step being performed. Once your test is completed, the message will read "Test is complete."



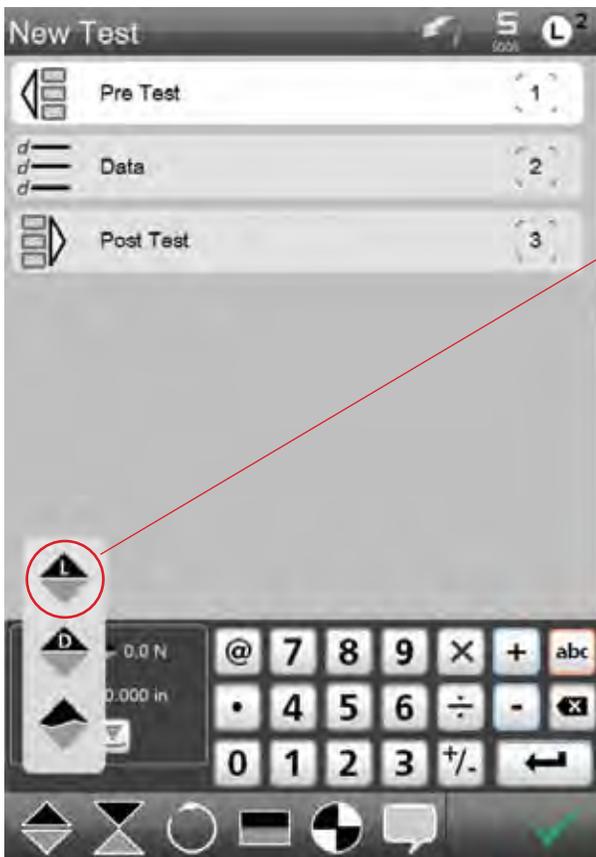
4.3 Adding a Step

Crosshead move steps are listed at the bottom of the test setup menu. Six types of steps are listed and available for your to add: Tension, Compression, Cycle, Hold, Datum and Ask. The individual step types will be described later in this section.

To add a step, select the crosshead step type. The step will automatically be added above the Data step (except Loop steps which are inserted after the Data step). Adding another move step will add that step sequentially to your test setup list. If multiple move steps are used, the steps are listed in the order you added them to your test setup, but always above the Data step.

4.4 Deleting a Step

Steps may be selected by touching the step reference number. Touching the step on the left will expand the step for editing and step definition. Select the step reference number to delete a step, then select the delete symbol (X). This will permanently delete the step.



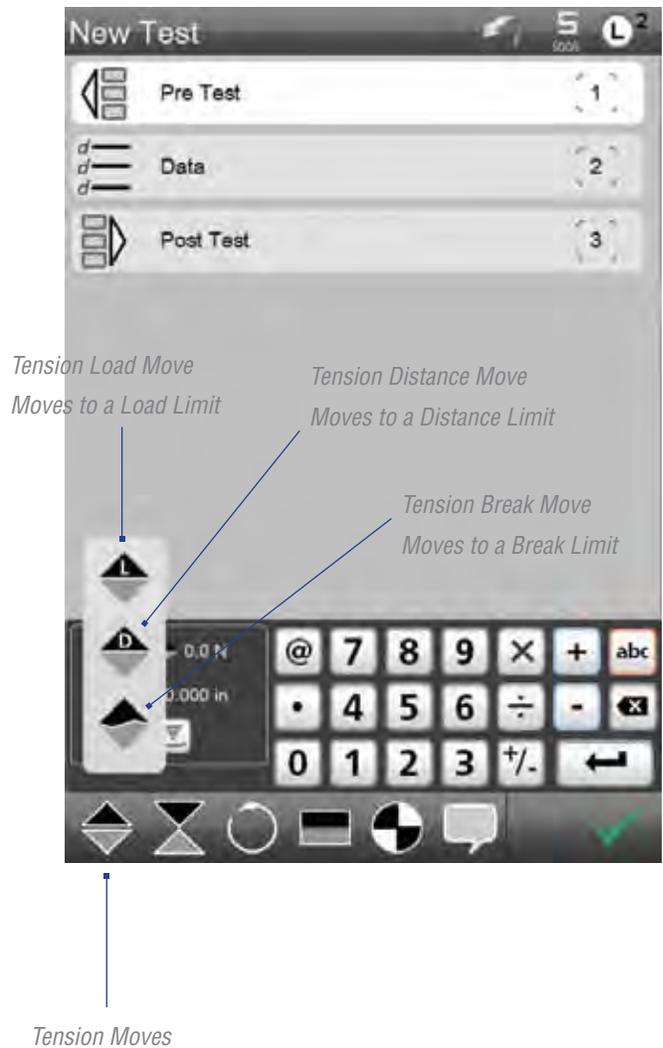
Select a Stage Move type.
Our example Adds a Tension Load Move.



Select the Stage Move to Delete.
Select the "X" to delete the step.

5.0 Tension Steps

Break and input tension steps always move the crosshead upwards. Tension movements are “pull” movements. Your L2 controller supports three types of tension steps: Load, Distance and Break. You may have multiple tension steps within a test setup.



5.1 Tension Load Limit

The Tension Load Limit move causes the crosshead to move upward until it meets a load setpoint. You define the load target (setpoint), which is measured by the load cell sensor during your test. Once this load is achieved, the test or the step is completed.

- FSelect the Tension symbol.
- FSelect the Tension Load symbol.
- FEnter your Load Target and Test Speed.

*Tension Load Move.
Enter the Load Limit setpoint.*



Enter the Test Speed.

5.2 Tension Distance Limit

The Tension Distance Limit move causes the crosshead to move upward until it meets a distance setpoint. You define the distance target (setpoint), which is measured by the encoder during your test. Once this distance is achieved, the test or the step is completed.

- FSelect the Tension symbol.
- FSelect the Tension Distance symbol.
- FEnter your Distance Target and Test Speed.

*Tension Distance Move.
Enter the Distance Limit setpoint.*



Enter the Test Speed.

5.3 Tension Break Limit

The L2 controller can be used to perform a break test.

During a break test, the sample is pulled until the measured load drops (either by a % from peak or by a specific load value), which indicates a break event.

When you configure a break test, you specify the Break %. This is the percentage drop in load from a measured peak load. For example, if the measured peak load is 100 lbf, and the Break % = 20%, the break load = 80 lbf.

The Minimum Break is the measured load that must first be achieved before the system starts looking for the break event. The minimum break protects against false break events in samples that exhibit significant load changes when under stress, e.g. peel tests.

- Select the Tension symbol.
- Select the Tension Break symbol.
- Enter your Break % (percentage drop from the peak load)
- Enter the Minimum Break value.
- Enter the Test Speed.

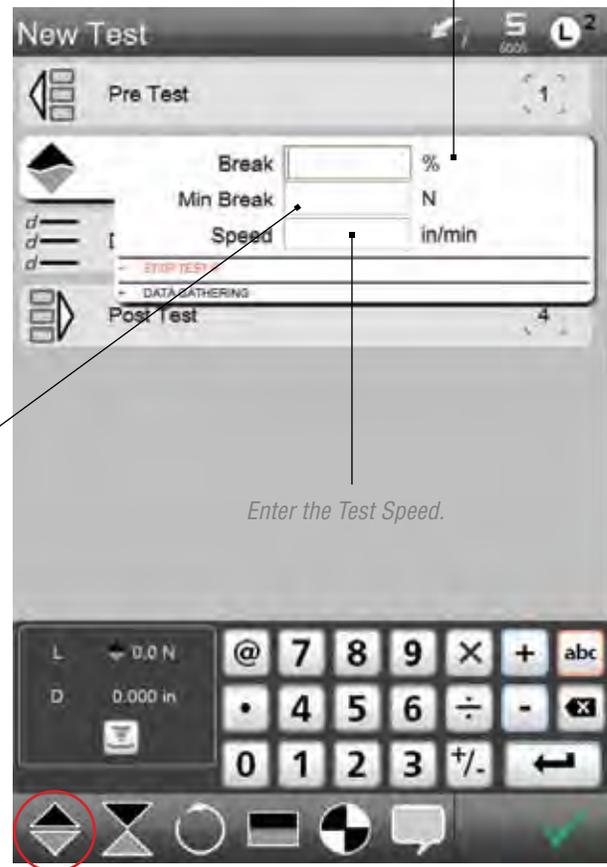
Enter the Minimum Load for the Break
This is the load value that must FIRST be met before your L2 software begins to look for your Break % Drop.
Min Break is a "precondition" that must happen FIRST before the load detection begins.

Enter the Break %.

The Break % is the percentage drop in the measured load from a previously measured Peak Load.

When the load drops by this percentage, the L2 software determines the Break Load.

Before a Peak Load or Break Load can be determined, the sample must FIRST exceed the Minimum Break Load you establish. You are required to enter the Min Break to counter samples that may exhibit significant load changes during their initial tension.



Enter the Test Speed.

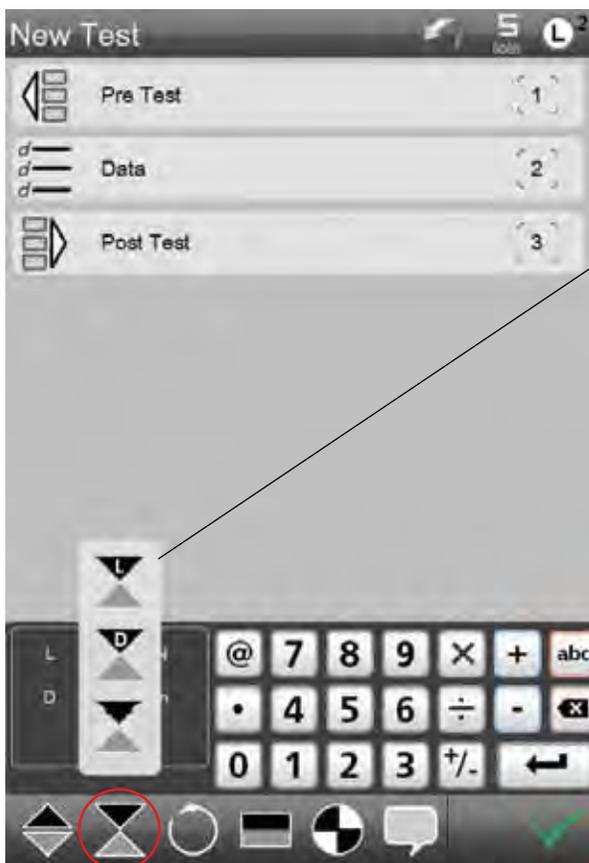
6.0 Compression Steps

Compression steps move the crosshead in an downward direction. Compression movements are “push” movements. Your L2 controller supports three types of compression steps: Load, Distance and Break/Rupture. You may have multiple compression steps within a test setup.

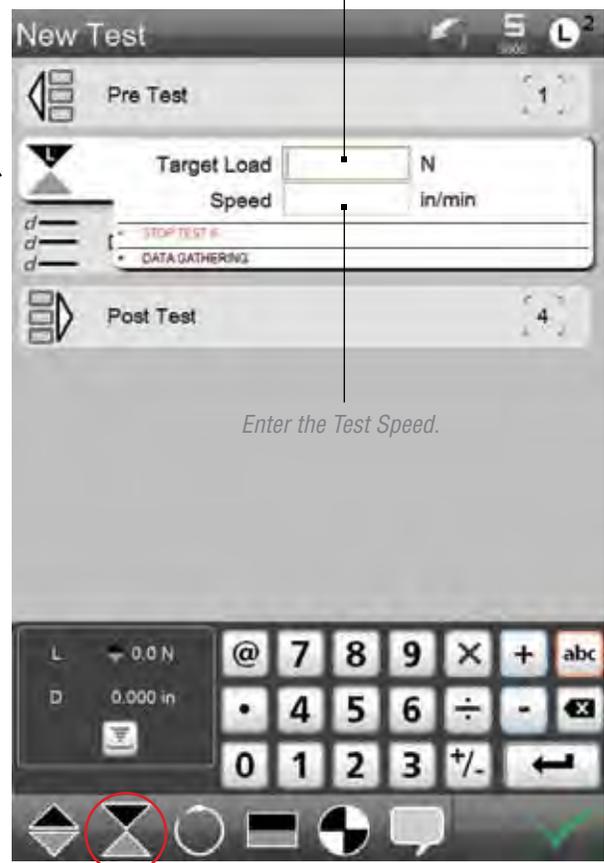
6.1 Compression Load Limit

The Compression Load Limit move causes the crosshead to move downward until it meets a load setpoint. You define the load target (setpoint), which is measured by the load cell sensor during your test. Once this load is achieved, the test or the step is completed.

- Select the Compression symbol.
- Select the Compression Load symbol.
- Enter your Load Target and Test Speed.



Compression Moves



Compression Load Move.

Enter the Compression Limit setpoint.

Enter the Test Speed.

6.2 Compression Distance Limit

The Compression Distance Limit move causes the crosshead to move downward until it meets a distance setpoint. You define the distance target (setpoint), which is measured by the encoder during your test. Once this distance is achieved, the test or the step is completed.

- Select the Compression symbol.
- Select the Compression Distance symbol.
- Enter your Distance Target and Test Speed.

*Compression Distance Move.
Enter the Compression Limit setpoint.*



Enter the Test Speed.

6.3 Compression Break Limit

The L2 controller can be used to perform a break test.

During a break test, the sample is pulled until the measured load drops (either by a % from peak or by a specific load value), which indicates a break event.

When you configure a break test, you specify the Break %. This is the percentage drop in load from a measured peak load. For example, if the measured peak load is 100 lbf, and the Break % = 20%, the break load = 80 lbf.

Another method for defining the break is to specify a Break Drop. Using the same 100 lbf peak, if my Break Drop = 20 lbf, the Break Load = 80 lbf.

The Minimum Break is the measured load that must first be achieved before the system starts looking for the break event. The minimum break protects against false break events in samples that exhibit significant load changes when under stress, e.g. peel tests.

- Select the Compression symbol.
- Select the Compression Break symbol.
- Enter your Break % (percentage drop from the peak load)
- Enter the Minimum Break value.
- Enter the Test Speed.

Enter the Break %.

The Break % is the percentage drop in the measured load from a previously measured Peak Load.

When the load drops by this percentage, the L2 software determines the Break Load.

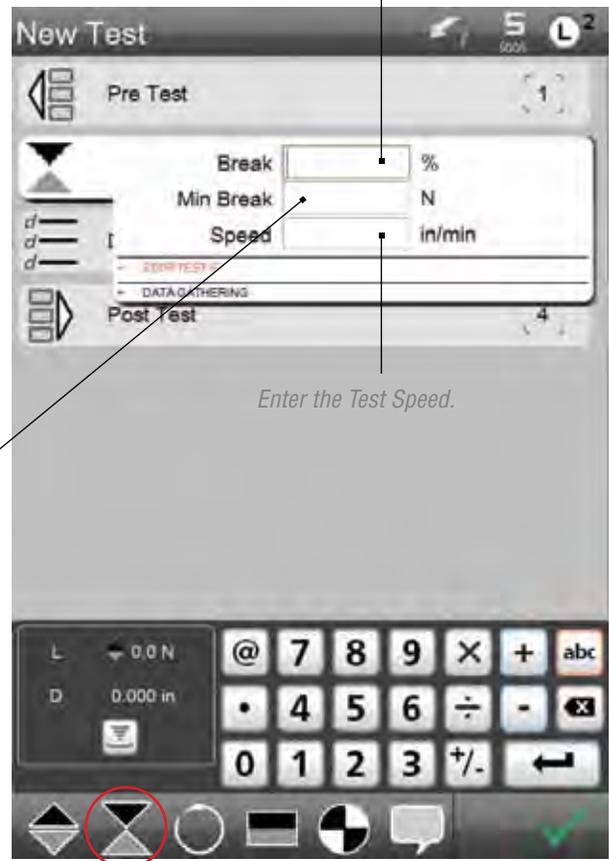
Before a Peak Load or Break Load can be determined, the sample must FIRST exceed the Minimum Break Load you establish. You are required to enter the Min Break to counter samples that may exhibit significant load changes during their initial tension.

Enter the Test Speed.

Enter the Minimum Load for the Break.

This is the load value that must FIRST be met before your L2 software begins to look for your Break % Drop

Min Break is a "precondition" that must happen FIRST before the load detection begins.

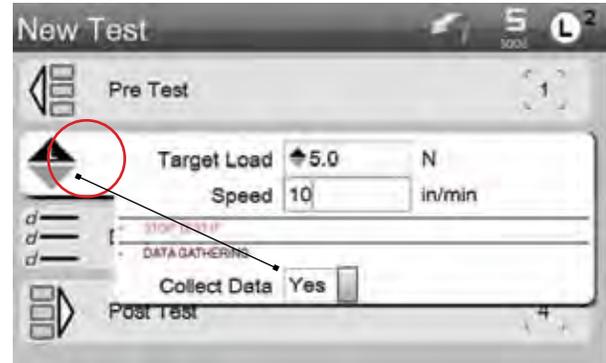


7.0 Steps and Data Gathering

Steps have an option called Data Gathering. When Data Gathering = YES, data is collected by the system for the move. This data is used for graphing and available for export as raw data.

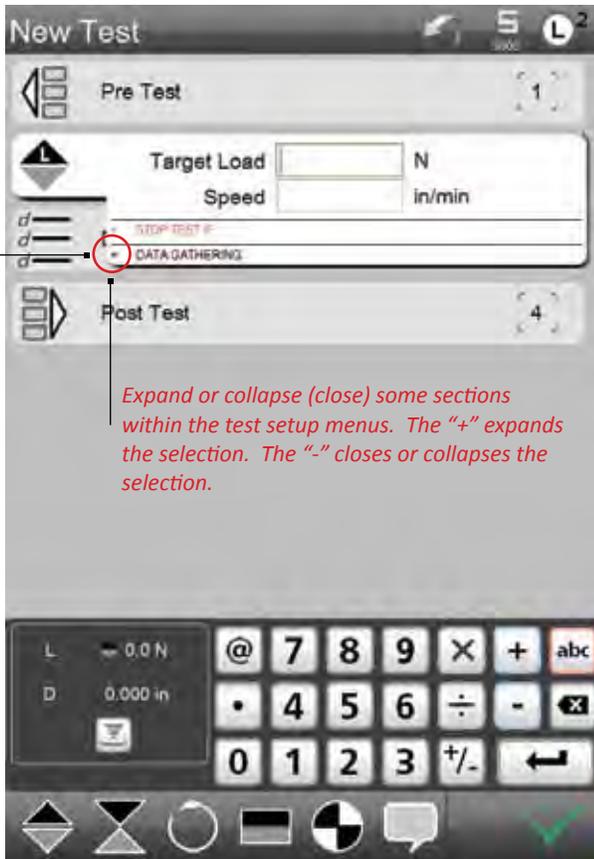
When the Data Gathering = NO, no data is collected. The move changes to a “go to” step. A Go To move collects no data. A Go To step simply causes the crosshead to move without collecting data to your designated target.

You can create a preconditioning step in your test setup using a Go To step.

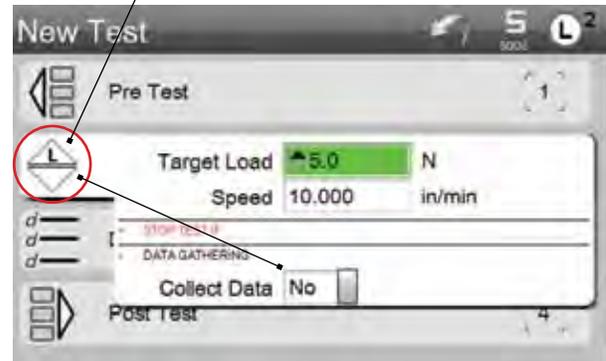


When Collect Data = YES, your system will collect the raw data associated with the move step.

A “Go To” step symbol appears differently than a move step where data is being collected. The symbol is “unfilled” to indicate a “Go To”.



Expand or collapse (close) some sections within the test setup menus. The “+” expands the selection. The “-” closes or collapses the selection.



When Collect Data = NO, your system will not collect raw data associated with the move. This move is now a “Go To” and causes the crosshead to move without collecting data during the move procedure.

Sections within an expanded step may be closed or expanded, including the Data Gathering section. Data gathering is always on by default in the Tension, Compression and Hold steps. Data Gathering does not exist in the Cycle, Datum or Ask steps. Data is not saved for these steps.

8.0 Cycle and Loop Steps

Your L2 controller allows you to perform cyclic testing. Cyclic tests occur between multiple steps where the actions of these steps are repeated either by a number of counts or by using a time period.

8.1 Cycle Count

When you cycle within a test, you must specify the step where you want your cycle to begin. You then specify the number of times you want the cycle to be performed. The minimum cycle count = 2. The maximum cycle count = 1000.

Typically, you will have at least two steps that you wish to cycle between, but you may have a series of steps that you can cycle. When multiple steps are cycled, you specify the first step and then all steps starting with the first step and the last step prior to the cycle move step will be performed.

- Select the Cycle symbol.
- Select the Cycle Count symbol.
- Select the first step where the cycle will begin.
- Specify the number of counts that the cycle shall be performed.

Specify the Step Number where the cycle will begin.

The "link" shows what steps are connected by the cycling step.

Use the Cycle Count step when you want to repeat a step(s) a specified number of times.

Cycle steps

Specify the number of "repeats" that the steps will be performed.
 Minimum = 2
 Maximum = 1000

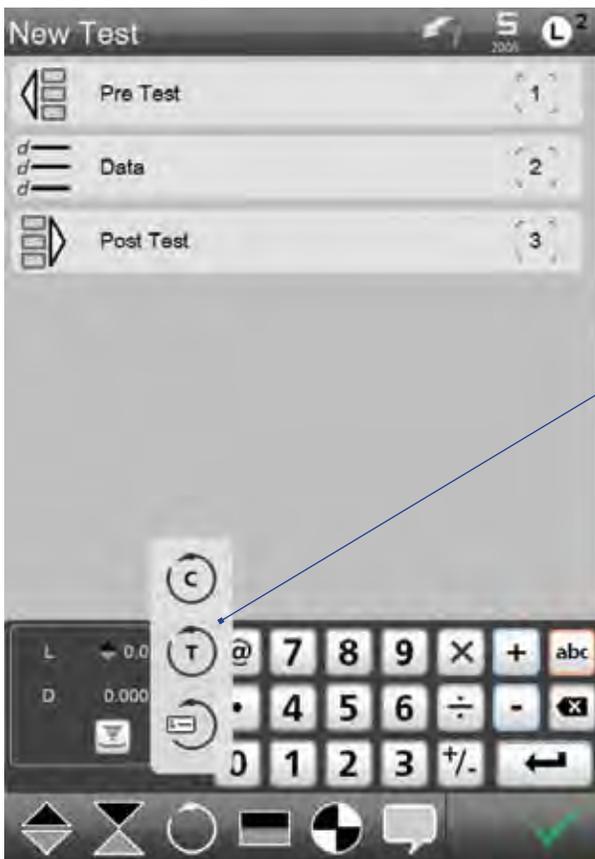
8.2 Cycle Time

Instead for cycling your steps based on a count, you can cycle based on time. You may set a cycle time duration for up to 30 minutes. You enter time using minutes or seconds. If you want a 30 minute cycle time, you would enter the number 1800 (30 min x 60 sec = 1800 sec) or enter 30 then a decimal point.

- Select the Cycle symbol.
- Select the Cycle Time symbol.
- Select the first step where the cycle will begin.
- Specify the Time Duration (in seconds) the cycle shall be performed.

Specify the Step Number where the cycle will begin.

The "link" shows what steps are connected by the cycling step.



Cycle steps



Specify the Cycle Time Duration using MINUTES. Enter the time and then select the decimal point to designate a Minutes unit of time.

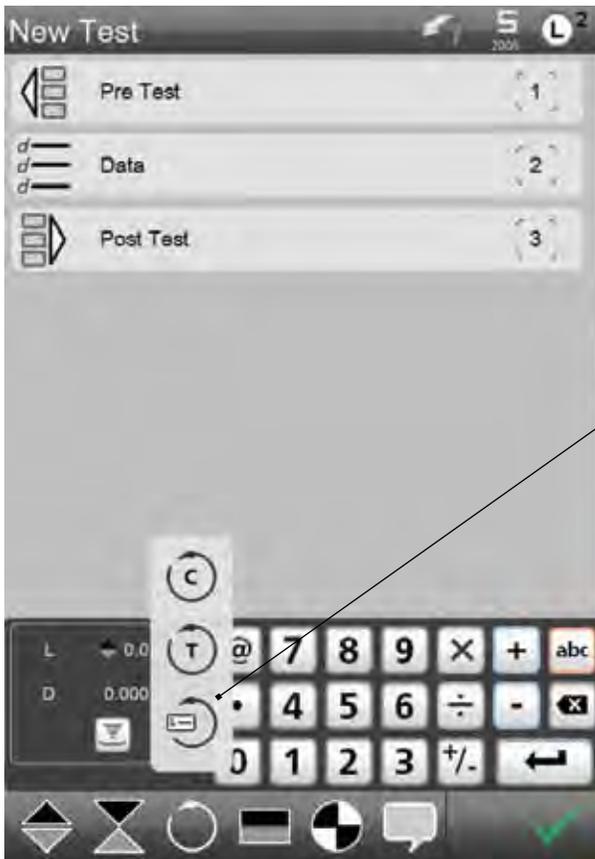
Specify the Cycle Time Duration using SECONDS. 1800 seconds = 30 minutes.

8.3 Loops

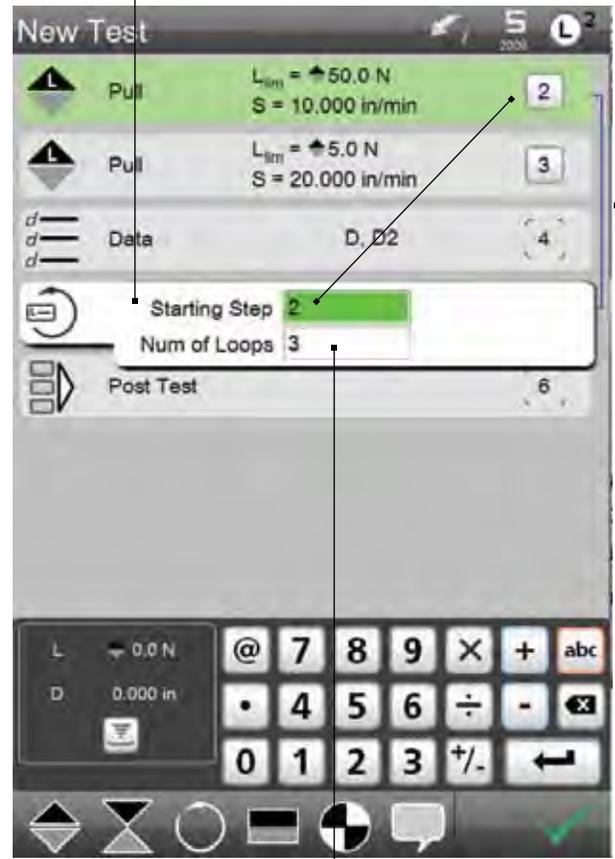
When you use either Cycle Count or Cycle Time, you get a single result for the cycle. However, with a Loop step, you get a result for each step. If a step is repeated three (3) times, you will get three independent results recorded as individual Runs. A Loop step is added after the Data step.

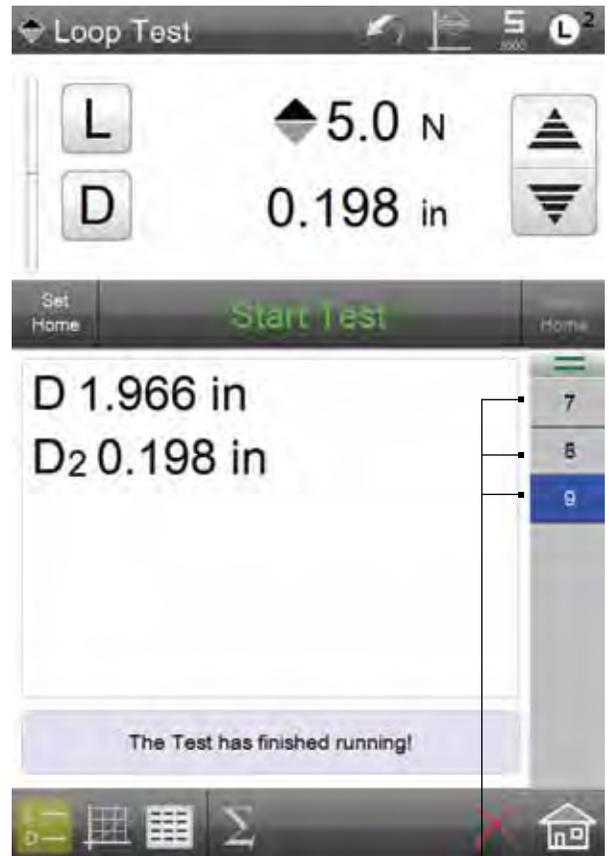
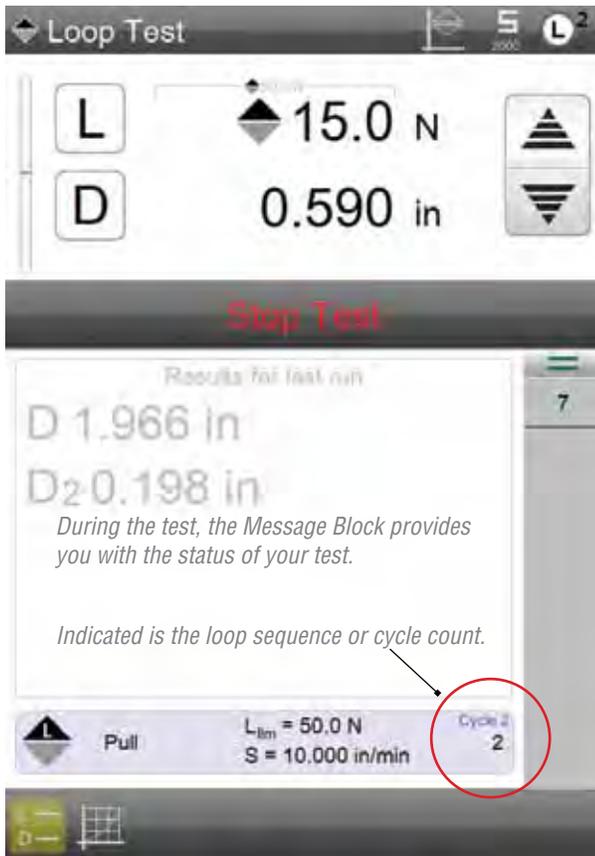
Specify the start Step Number and the Number of Loops that complete the test.

The "link" shows what steps are connected by the cycling step.



Cycle steps





Each Loop specified will result in an independent Run (result).

9.0 Hold Steps

You can perform constant load or constant distance tests using the Hold step. Creep and relaxation are typical applications that use a hold function.

9.1 Load Hold

When you want to hold a load, first create your step with a load variable; either a tension or compression load. Next, select the Load Hold step. Then specify the duration for your hold period. The maximum allowable hold duration is 15 minutes (900 seconds).

- Select the test mode- either Tension or Compression.
- Enter the Load Limit (target).
- Enter the Test Speed.
- Select the Hold symbol.
- Select the Load Hold symbol.
- Enter the Hold Duration value.



Two types of Hold Moves are available: Load Hold or Distance Hold.

Both Holds can be used to collect Data or Not Collect Data during the Hold period.



The maximum allowed hold period is 15 minutes (900 sec).

In our example, we setup a Tensile Load Limit.

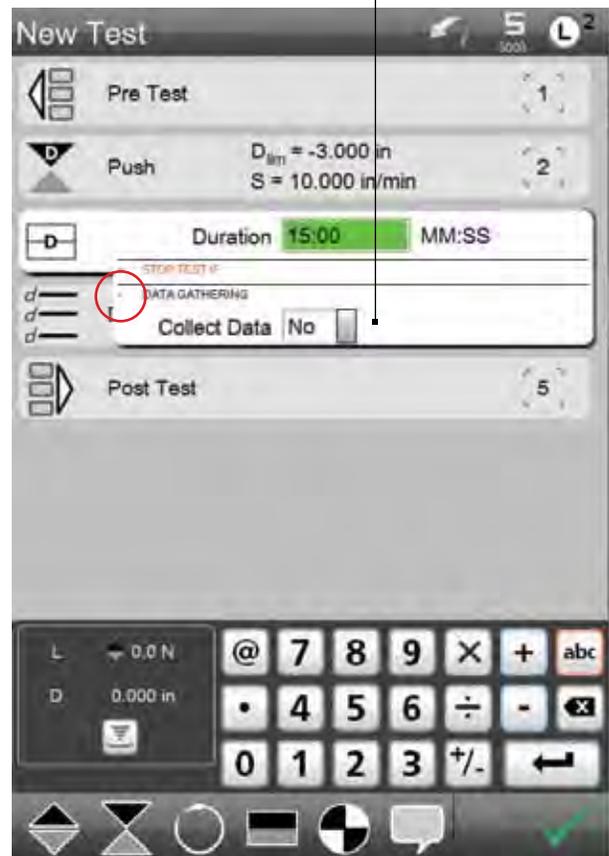
The Load Hold Move is used to hold the load for 15 minutes.

9.2 Distance Hold

You may hold the crosshead at a Distance target to determine the effects the hold time has on the sample's load characteristic. The Distance Hold is performed together with an associated tension or compress to distance step. The maximum allowable hold duration is 15 minutes (900 seconds).

- Select the test mode- either Tension or Compression.
- Enter the Distance Limit (target).
- Enter the Test Speed.
- Select the Hold symbol.
- Select the Distance Hold symbol.
- Enter the Hold Duration value.

In our example, we are NOT GATHERING DATA during the Hold period.



In our example, we setup a Compressive Distance Limit.

The Compressive Hold Move is used to hold the load for 15 minutes.

10.0 Datums

You may datum as part or your test. The primary datum is referred to as Datum #0. A second datum (available only during a test) is referred to as Datum #1. The Datum step sets a datum according to the position and load at the moment the Datum step is executed during a test. The distance and/or load may be preset to display a zero or non-zero value at the time.

You may use a second datum for load or position during a test for more complex applications. For example, Datum #1 may be used to determine the distance that corresponds to a creep rate.

- Pull to a load.
- Datum (set the datum to Datum #1) and zero the distance.
- Hold for 10 minutes.

The distance reported at the end of the Hold step is creep over 10 minutes.

The Preset Load lets you specify the load value that must be met in order to establish the datum.

The Preset Distance lets you specify the distance value that must be met in order to establish the datum.



Specify the Datum type as either "0" or "1".

11.0 Ask Steps

An Ask step can be used to create a question for the operator to answer during a test, or to display a prompt for the user.

The TELL step is used to communicate information to the operator. No response is required.

The ASK step requires a response to the prompt. Responses must be less than 8 character answers.



11.1 Ask Prompt

The Ask step is used to add a question that requires the operator to respond. Questions should always be short and require a single or few word response. The maximum number of characters, including spaces, for your question is 40.

The response is limited to a maximum number of characters, including spaces, to 16. Use the Ask coefficient to display the answer to your question.

*All ASK steps have a reference label.
This allows the step to be reported.*



*Enter the text you'd like displayed
during the prompt.*

11.2 Tell Prompt

A prompt, or Tell statement, is a message displayed for the user. Prompts can be used as reminders to the operator or use to give the user instructions during the test procedure. A prompt does not require an operator response.

When a prompt is used, you have the option to specify how long (duration) the prompt is to be displayed during your test procedure.

A prompt may have up to 27 characters (including spaces). The prompt duration (length of time displayed) may be up to 8 hrs. A step does not complete until the prompt has been displayed for its full duration or the user selects the checkmark.

You may specify the length of time your TELL prompt is displayed.



Your TELL prompt may be up to 27 characters in length.

12.0 Data (Coefficients)

Coefficients or results are selected from a list of values in the Data menu. These data elements are the results you want reported for your test setup.

Table 13
Coefficient/Data Table

Label	Name	Description
L	Load	The measured load value from the load cell sensor.
Lbreak	Break Load	The measured load where a break condition occurred based on a % drop in load from a measured maximum (peak) load value.
Lave	Average Load	The average load measurement.
Lpeak	Maximum (Peak) Load	The maximum (greatest) load achieved during a test run.
Lmin	Minimum Load	The minimum (smallest) load achieved during a test run.
Ldelta	Change (Delta) in Load	The measured change between two load values.
D	Distance	The measured distance value from the encoder representing the distance your crosshead has traveled. Distance is not an absolute distance. Distance is a relative distance from zero.
Dbreak	Distance at Break	The amount of crosshead travel where a sample break has occurred. It is the distance where the break event occurred based on a % drop in load from a measured peak, or from a specified drop in load.
Dmax	Maximum (Peak) Distance	The maximum distance (peak) obtained. Often used with a load target test.
Dmin	Minimum Distance	The minimum distance obtained during a test.
Dmaxl	Distance at Peak (Max) Load	The associated distance value that corresponds with the maximum (peak) load measurement obtained during a test.
Dminl	Distance at Minimum Load	The associated distance value that corresponds with the minimum load measurement obtained during a test.
Ddelta	Change (Delta) in Distance	The change in distance measurement often used in creep or relaxation test setups.
Dur	Duration	Reports the duration of the test sequence. May be the duration for the entire test or the duration between a step range: begin at step X and end at step Y.
S	Speed	Reports the speed of the associated step. The speed is the velocity of the crosshead at the associated step.
Date	Date	Reports the date the test run was performed. The format depends on the Date Settings. May be MM/DD/YY or DD/MM/YY.
Time	Time	Reports the time when the test run was started. Time is reported as HH:MM:SS.
Ncyc	Number of Cycles	Reports the number of cycles completed.
Ans	Answer	Reports the answer for a specified ASK step in your test.

12.1 Add Data

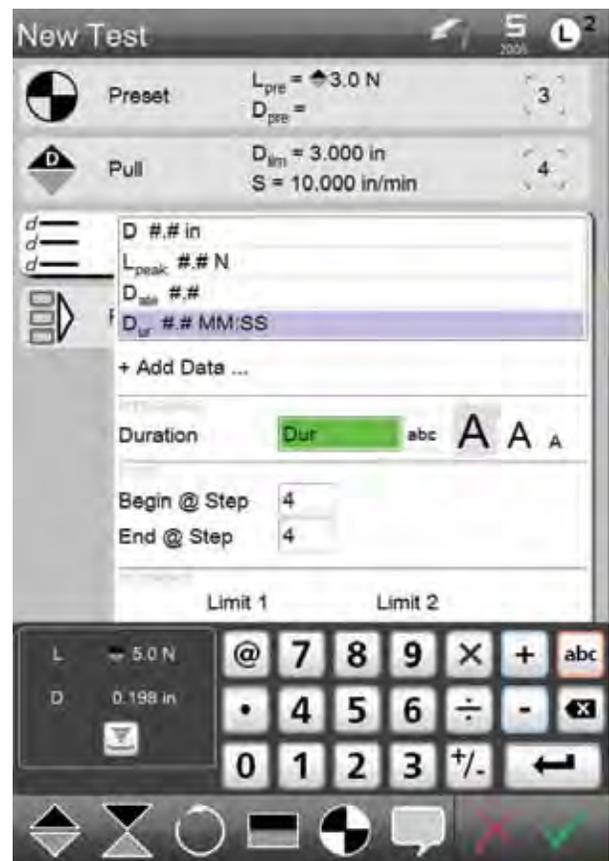
All test setups are based on a series of steps that are performed in a sequence. Your test setup can have as many steps as you desire within a test setup.

Coefficients are results that are reported for a step or for a range of steps including the completed test. You must specify the coefficient to be reported however.

Use the + Add Data touch target to access the list of coefficients. Press the coefficient you want reported as a result.

12.2 Delete Data

Use the red delete (X) symbol to permanently remove the coefficient that is highlighted in the Data menu.



12.3 Data Appearance

Once you select a coefficient, the coefficient name and label are displayed in the Appearance menu. You may rename the label and you may size the label.

If you rename the label, you may use up to 8 characters using your virtual keyboard (select the abc touch target) or a keyboard connected to your L2 controller.

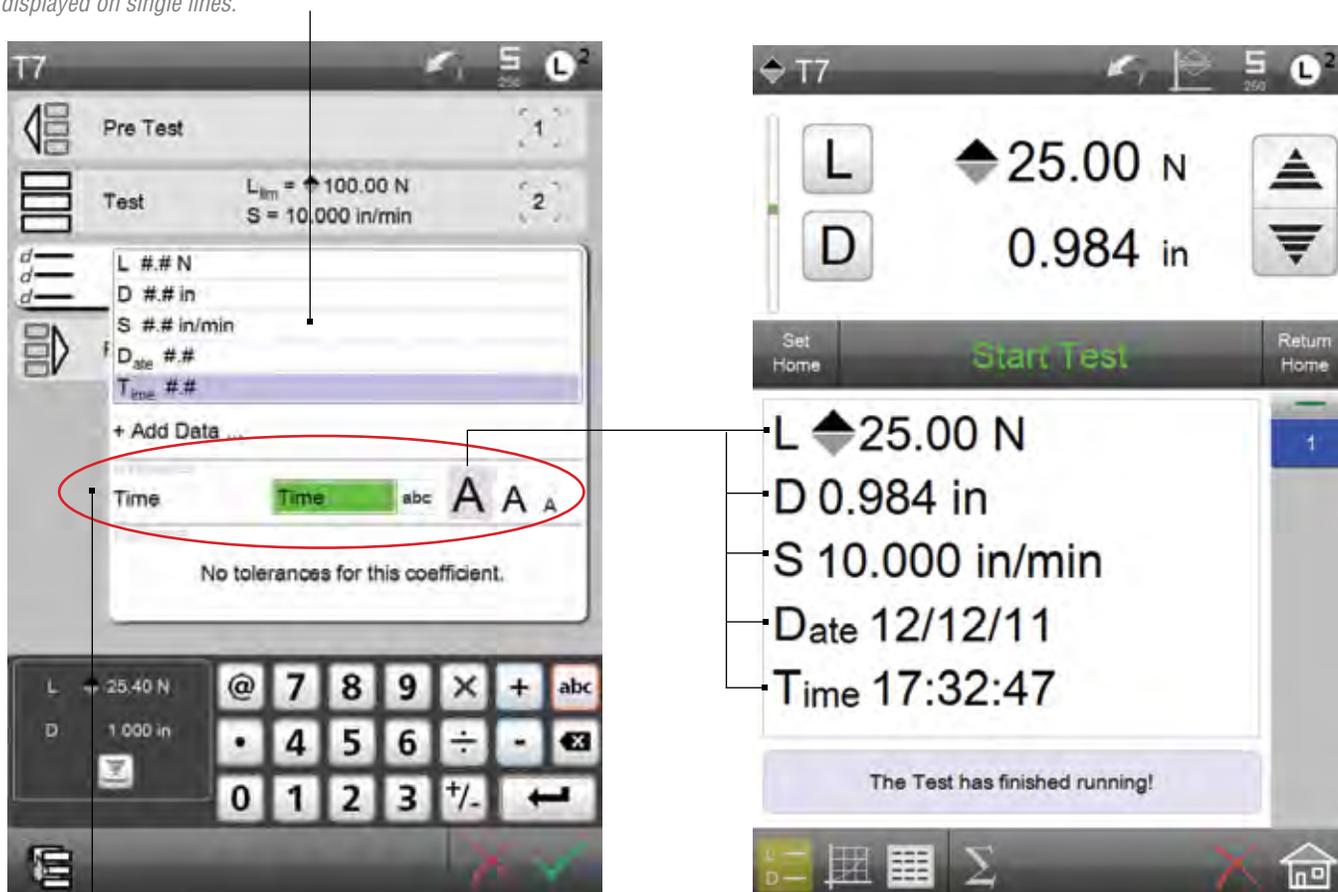
You may also size your label. You have three sizes available: large, medium and small. The size of the label also defines how the label

will appear on your display view. A large format will display your coefficient in a large text format and on a single, independent line. The medium format will display using medium-size text and will display your coefficient in a 2-column format. If the small format is selected, the coefficient is displayed in the smallest text and formatted in a 3-column format.

To change or configure your coefficient's appearance, select the coefficient from the result list on your Data menu. Once the coefficient is highlighted, rename or specify the text size by pressing the A, A or A touch target.

Your coefficients are displayed on the Data menu in the format you select.

In our example, all coefficients are shown in the large format and displayed on single lines.



The Formatting options let you Rename your coefficient and format the size of the coefficient on the Data View.

The "large" format displays a coefficient on a single line, in a single column, and in the largest text size.

13.0 Scope

Scoping is a post test data analysis feature where you can report results from within all of the raw data acquired for a step.

For example, suppose you create a test setup using a tension to distance step. Your distance limit is 10 inches. Normally, you would report the load at 10 inches using the Load (L) coefficient. During this test, the system acquired all of the time-based raw data for load and distance from the Start Test event to the End Test event (10 inch limit). Suppose you wanted to know the load at 250mS after the start of your test or 5 seconds from the end of the test? Suppose you wanted to know the load values at 2 inch, 4 inch, 6 inch or 8 inch? Suppose you wanted to know the distance at 5 lbf? Scoping can be used to answer each of these questions.

All steps have a beginning, an end and a duration. When a step is collecting data, the data is collected at the start of the step until the step's conclusion. The data collected during a step forms an array of data: loads, distances, and time.

Most coefficients may use a scope. A list of the available coefficients, and whether or not they have a scope, is shown below.

There are two types of scopes: a single scope and a scope range. A single scope references only one Step # while a scope range references a "Begin Step # and an End Step #".

Coefficient Symbol	Definition	Scope
L	Load	@ Step #
Lbreak	Break Load	@ Step #
Lave	Load Average	Begin @ Step #; End @ Step #
Lpeak	Peak Load	Begin @ Step #; End @ Step #
Lmin	Minimum Load	Begin @ Step #; End @ Step #
Ldelta	Delta Load	Begin @ Step #; End @ Step #
D	Distance	@ Step #
Dbreak	Distance @ Break Load	@ Step #
Dmax	Maximum Distance	Begin @ Step #; End @ Step #
Dmin	Minimum Distance	Begin @ Step #; End @ Step #
Dmaxl	Distance @ Peak Load	Begin @ Step #; End @ Step #
Dminl	Distance @ Minimum Load	Begin @ Step #; End @ Step #
Ddelta	Delta Distance	Begin @ Step #; End @ Step #
Dur	Duration	Begin @ Step #; End @ Step #
S	Speed	@ Step #
Date	Date	None
Time	Time	None
Ncyc	Number of Cycles	@ Step #
Ans	Answer	None

Table 13
Coefficient and Scope Settings

13.1 Scope Properties

Your scope is always associated with a step and with the coefficient related to the step. You are not restricted to the number of coefficients that can be assigned to a single step. In other words, you can have multiple results (coefficients) for a single step.

Your scope has five basic properties:

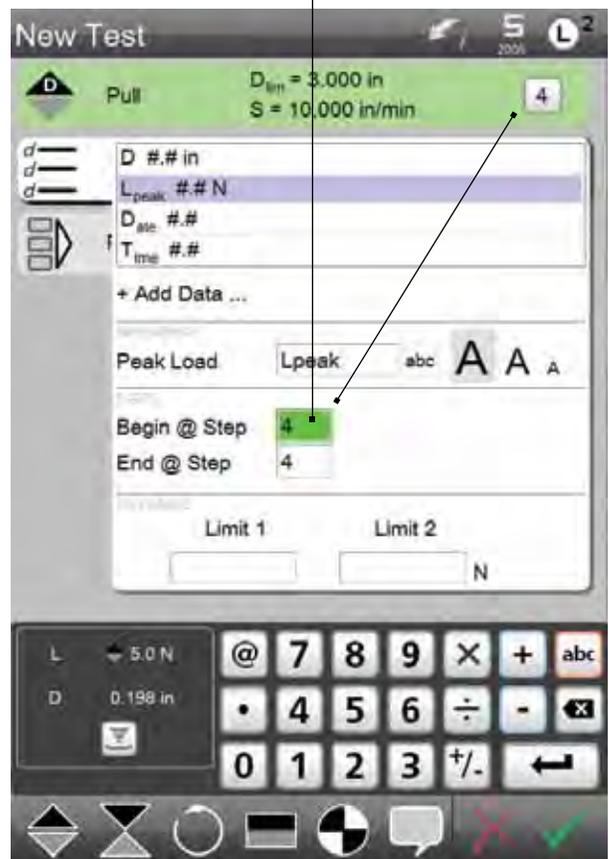
- Step Type
- Step Reference
- Scope Connector Type
- Scope Value
- Scope Units

Scope Type

A scope may be either a single scope or a scope with a Begin and End. The scope type for each coefficient is listed in the Table 13.

The coefficient selected for scoping is Lpeak. Lpeak has a Begin and End Step.

Our example shows a Begin @ Step 4, which is where the peak load will be calculated from.



Step Reference

A coefficient is always associated with a Step Reference. Therefore, a scope is always associated with a Step Reference.

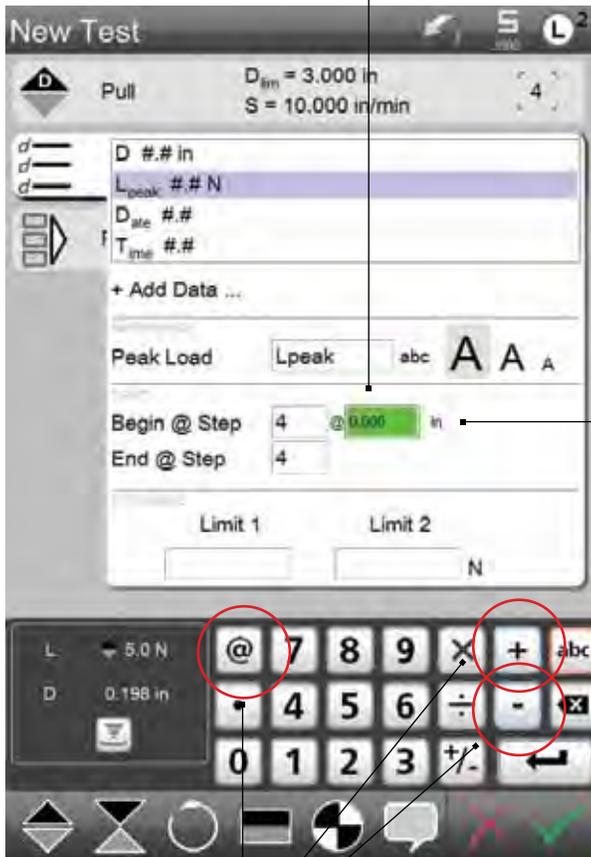
A single scope coefficient references a single step, e.g. @ Step 2.

Some coefficients, such as have a Begin @ Step reference and an End @ Step reference. These coefficients allow you to obtain results from the data array created using either a single step or through a range of steps.

Scope Connectors

There are three types of scope connectors: @, +, and -. The @ connector is an absolute scope that defines a specific point within the data array for a step. The "+" connector determines the point based from the Begin Step (looks at the array from the beginning of the step). The "-" connector determines the point based from the End Step (looks at the array from the end of the step).

You can specify the scope value which is the numeric criterion for your scope operation.



Select the target for the units to be scoped. Load, Distance, Time and Cycles are some of the units that may be used for scoping.

Select the Scope Connector that defines how the scope is calculated.

Scope Value

Your scope needs a value. This value is used to find the data point within the array of data created by the start and completion of a step or range of steps.

When an absolute (@) connector is used, the system looks for the data point in the array “at” the scope value you specified.

When the (+) connector is used, the system looks for the data point in the array starting from the beginning of the step. For example, if + 1.0 in (inch) is the scope definition for a single step coefficient, the point is defined as the points in the array associated with the 1 inch crosshead direction.

The (-) connector looks for the data point in the array starting from the ending of the step.

Scope Units

Scope units may be a force, distance, time or cycle.

13.2 Using a Single Scope

To illustrate how scope can be used, we’ll use the following example to demonstrate how to setup a single scope.

Example

Create a load to distance tensile test.

- Create a New Test using the Test Builder.
- Select the Tension Distance symbol.
- Set the Tension Distance Target at 6 inches.
- Set the Speed at 30 inches per minute.

Normally, with a distance limit test like our example, you would select the Load (L) coefficient in order to report the load result at the target distance limit of 6 inches. Therefore,

- Select the Data menu.
- Select the + Data touch target.
- Select the Load (L) coefficient.

Selecting the Load (L) coefficient will display the load value at the distance limit.

The new coefficient is displayed as L2.



- Resize the L2 coefficient to the middle size text.
- Rename the L2 coefficient to L@1inch
- Go to the Scope menu.
- Select the Step “2” text block.
- Select the “+” key in the virtual numerical keypad.

Selecting the “+” key will invoke the scope function. Selecting the “+” key instructs the system to find and report the point starting from the beginning of the step. Selecting the “+” key displays the scope value box with units.

- Select the scope value and touch until the displayed units is [in].
- Enter the numeric 1.0 in the scope entry box.

With this entry, you have assigned the L2 coefficient, now called L@1inch, to report the load value at the 1 inch tension distance from the start of step 2.

- Select the + Data touch target.
- Select the Load (L) coefficient.

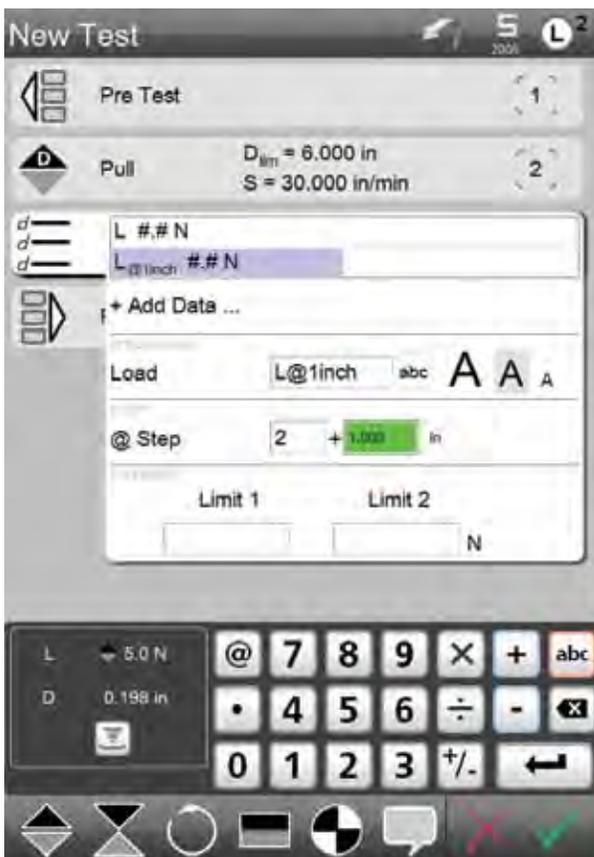
The new coefficient is displayed as L3.

- Resize the L3 coefficient to the middle size text.
- Rename the L3 coefficient to L@5inch
- Go to the Scope menu.
- Select the Step “2” text block.
- Select the “-” key in the virtual numerical keypad.

Select the “-” key to invoke the scope function. Selecting the “-” key instructs the system to find and report the point starting from the end of the step. Selecting the “-” key displays the scope value box with units.

- Select the scope value and touch until the displayed units is [in].
- Enter the numeric 1.0 in the scope entry box.

With this entry, you have assigned the L3 coefficient, now called L@5inch, to report the load value at the 1 inch tension distance from the end of step 2. Since the end of the step 2 is 6 inches, the 1 inch tension distance from the end of step 2 is the load at the 5 inch distance.



- Select the + Data touch target.
- Select the Distance (D) coefficient.

Selecting the Distance (D) coefficient will display the distance value.

The new coefficient is displayed as D.

- Resize the D coefficient to the middle size text.
- Rename the D coefficient to D@10sec
- Go to the Scope menu.
- Select the Step “2” text block.
- Select the “@” key in the virtual numerical keypad.

Select the “@” key to invoke the absolute scope function.

- Select the scope value and touch until the displayed units is [S.s].
- Enter the numeric 10.0 in the scope entry box.



With this entry, you have assigned the D coefficient, now called D@10sec, to report the distance value after 10 seconds from when the step began.

- Select the checkmark to save your settings.
- Rename your test setup to “Scope Test”.
- Set Home.
- Zero L and D.
- Start the Test.

At the completion of your test, your setup will deliver the results for:

- L@6inch
- L@1inch
- L@5inch
- D@10sec

You have successfully applied scope to a single step 2.



13.3 Using a Begin and End Scope

Some coefficients have a scope with a defined Begin and End. Load average (Lave) is an example of a coefficient with both a Begin and End step. The following example will demonstrate how scoping can be used with this type of coefficient.

Example

Create a load to distance tensile test.

- Create a New Test using the Test Builder.
- Select the Tension Distance symbol.
- Set the Tension Distance Target at 6 inches.
- Set the Speed at 30 inches per minute.

It's common with some peel tests to average the load within a specified distance range instead of between the actual start and actual end of the test procedure. This is due to "noise" that may be inherent in a peel test on startup perhaps due to frictional characteristics of the sample at startup.

In this test setup, we want to determine the average load for a specific distance range. Therefore,

- Select the Data menu.
- Select the + Data touch target.
- Select the Load Average (Lave) coefficient.

Selecting the Load Average (Lave) coefficient will display the load average value beginning from the start of the test to the end of the test. The load data will be averaged beginning from 0 load to the load value at 6 inches (end of test).

- Select the + Data touch target.
- Select the Load Average (Lave) coefficient.

The new coefficient is displayed as Lave2.

Selecting another Load Average (Lave) coefficient will let me also calculate the load average between the distances 4 inches and 5 inches.

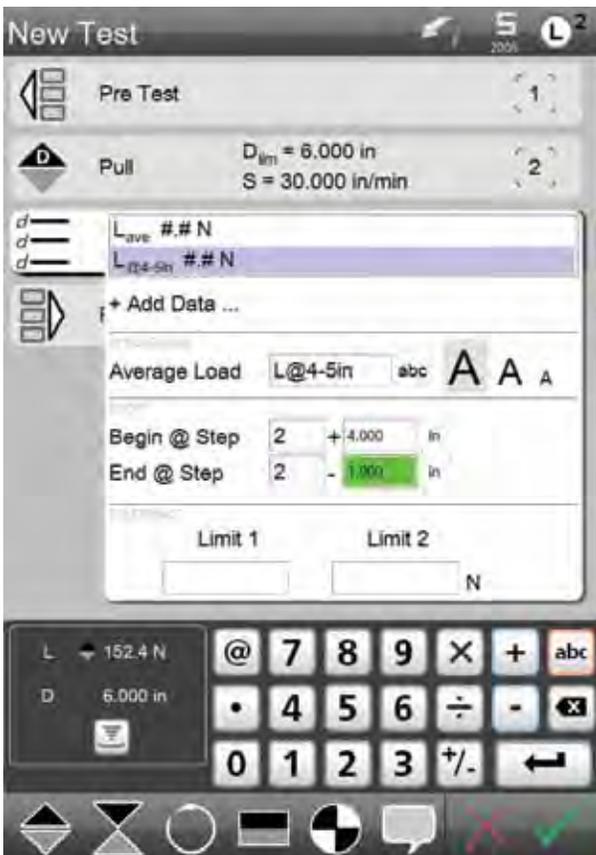
- Rename the Lave2 coefficient to L@4-5in
- Go to the Scope menu.
- Select the Begin @ Step “2” text block.
- Select the “+” key in the virtual numerical keypad.

Select the “+” key to invoke the scope function. Selecting the “+” key instructs the system to find and report the point starting from the beginning of the step. Selecting the “+” key displays the scope value box with units.

- Select the scope value and touch until the displayed units is [in].
- Enter the numeric 4.0 in the scope entry box.

With this entry, you have assigned the Lave2 coefficient, now called L@4-6in, to report the load value at the 4 inch tension distance from the beginning of step 2.

- Select the End @ Step “2” text block.
- Select the “-” key in the virtual numerical keypad.



Select the “-” key to invoke the scope function. Selecting the “-” key instructs the system to find and report the point starting from the end of the step. Selecting the “-” key displays the scope value box with units.

- Select the scope value and touch until the displayed units is [in].
- Enter the numeric 1.0 in the scope entry box.

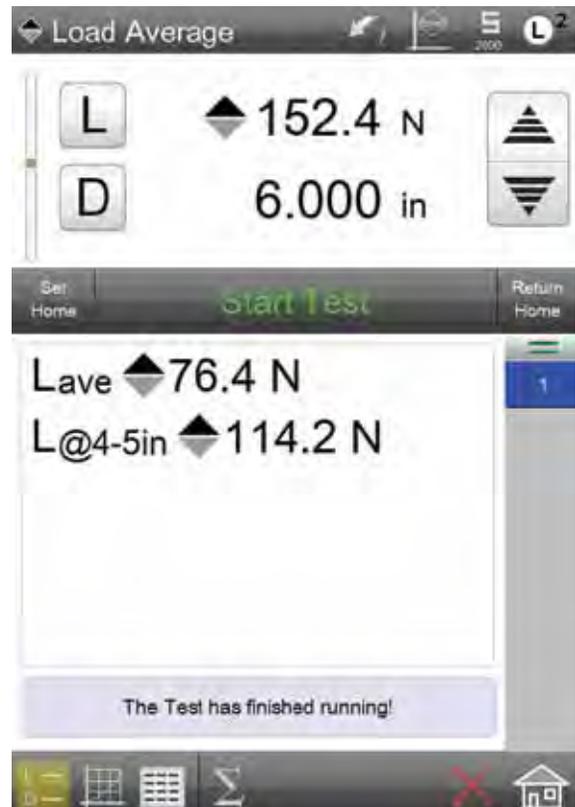
With this entry, you have assigned the Lave2 coefficient, now called L@4-6in, to report the load value at the 5 inch (6 inch - 1 inch = 5 inch) tension distance from the end of step 2.

- Select the checkmark to save your settings.
- Rename your test setup to “Load Average”.
- Set Home.
- Zero L and D.
- Start the Test.

At the completion of your test, your setup will deliver the results for:

- Lave (the average load calculated from the start to end of your test)
- L@4-5in (the average between 4” and 5” in your 6” tensile move)

You have successfully applied scope to step 2 with a Begin and End Scope.



14.0 Using a Tolerance

Coefficients may have a tolerance applied to them. A tolerance represents a “pass” or “fail” result.

When you set a tolerance, you specify two independent limits: Limit 1 and Limit 2. Together, these limits create a range. If the result for this coefficient falls within the range created by the limits, the result is considered “passed”. If, however, the result falls outside the limit range, the result is considered a “fail”. A failed result displays in the color red to distinguish it from a passed result which will display in the color black. If the result equals one of the limit values, the result is also considered passed.

Because you may have a tolerance on a coefficient, including multiple coefficients within your test setup, a run can be classified a fail if any of the coefficients where a tolerance is applied has a result that is outside the tolerance range for that step. If any result for the coefficient is outside the limit range, the entire run is considered a failed run.

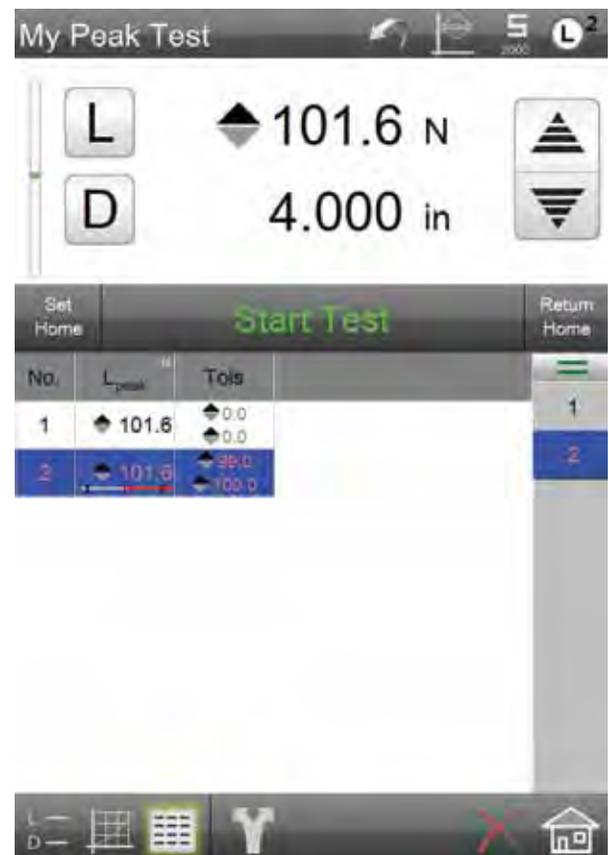
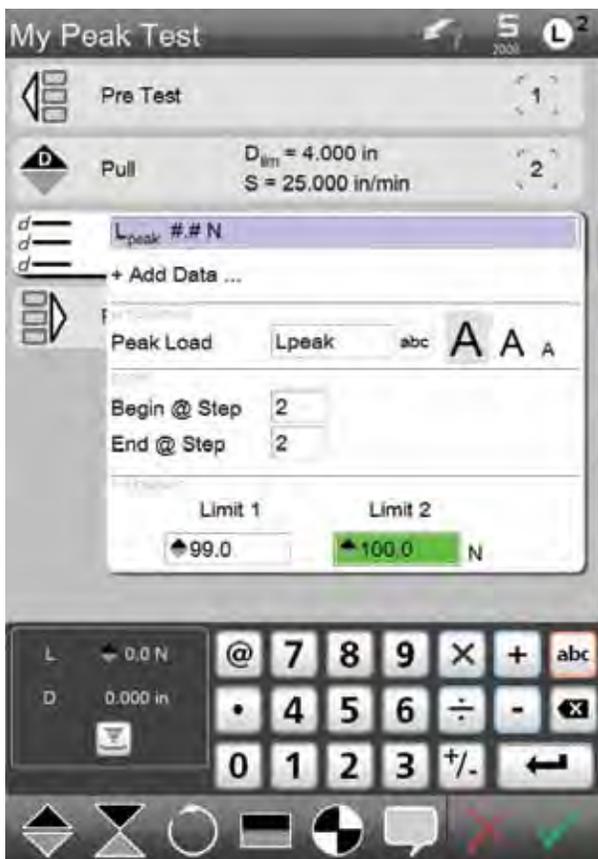
Example

- Select Peak Load (L_{peak}) as the coefficient.
- Specify Tolerance Limit 1 = 15.00 LBF
- Specify Tolerance Limit 2 = 16.00 LBF

If the measured results equals 15 LBF or 16 LBF or falls within this load range, the L_{peak} coefficient will display as a “pass”.

If the measured result falls outside of this limit range, the coefficient will display in red text and represent a “failed” result.

In our example, since the measured result was 17.13 LBF, which falls outside the Limit 2 target of 16.00 LBF, the result has “failed”



15.0 Post Test Options

The Post Test options provide you with functions that are normally performed once a test run has completed. You may setup some, all or none of these options for your test setup. Like all options, Post Test options may also be added later using the Edit test function.

15.1 Return Home Option

Use the Return Home option to automatically return the crosshead to the Home position once a test run is completed. When the option is YES, the crosshead will automatically return to the Home position when the test is completed. When the option is NO, the user will return to the Home position by selecting the RETURN HOME touch target on the Data view.

- Press the touch target for Return Home to Yes.

If the RETURN HOME option is ON, the SET HOME position is automatic once the START TEST target is pressed. At the completion of the Run, the crosshead will automatically return to the established HOME position.



15.2 Export Raw Option

When the Export Raw option = YES, the raw data points for the completed test will be saved as a .csv file and saved to a directory that you designate in the Main Settings option.

- Go to the Main Settings menu.
- Select File Locations.
- Select the Directory where you want your data saved to.

Once you have designated a file location, the user has two options on how to transmit the file to the location:

Overwrite means that the raw data overwrites the previous raw data. A file is transmitted to your directory: [Test Name]_Raw Data.

The Raw Data file displays the Step Number, Time, Load, Units of Load, Distance, Units of Distance, Velocity, Velocity Units and Status for all data points. The number of data points (or rows on your table) correspond to the sampling rate and the duration of your test.

Use the Main Settings function and select FILE LOCATIONS to designate a directory where you want your Raw Data Export to be saved to. Once the test Run is completed, a .csv file is created and saved to your designated directory.



The Results file displays the Test ID, Run Number, Load, Units of Load, Distance and Units of Distance.

Auto Number means that a new file is created for each test run and each export.

Once you have designated a file location, the user has two options on how to transmit the file to the location:

Overwrite means that the raw data overwrites the previous raw data. A file is transmitted to your directory: [Test Name]_Raw Data.

The Raw Data file displays the Step Number, Time, Load, Units of Load, Distance, Units of Distance, Velocity, Velocity Units and Status for all data points. The number of data points (or rows on your table) correspond to the sampling rate and the duration of your test.

The files are sequentially numbered when Auto Number is used.

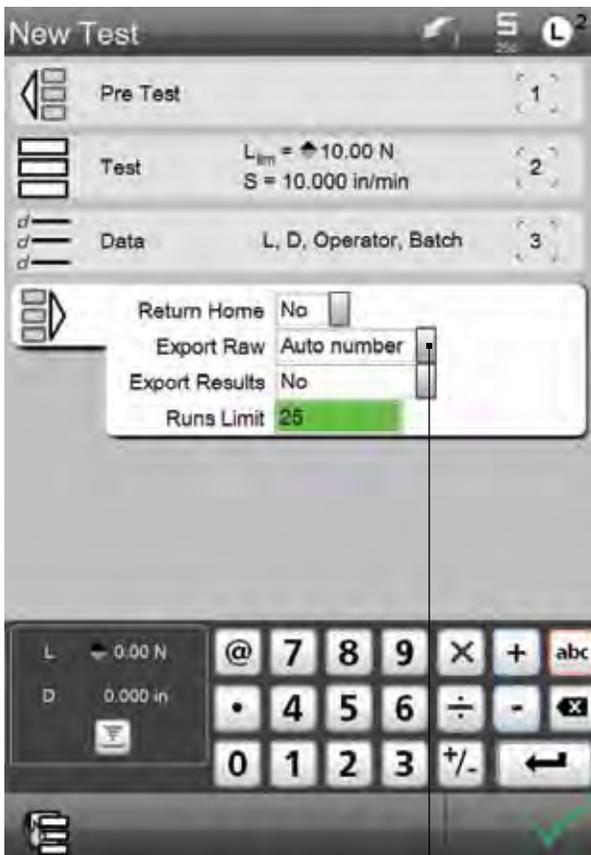
The Raw Data files displays the Step Number, Time, Load, Units of Load, Distance, Units of Distance, Velocity, Velocity Units and Status for all data points. The number of data points (or rows on your table) correspond to the sampling rate and the duration of your test. Each test run has its own separate file. The file is designated as [Test Name]_RawData_000001. Each test run is numbered sequentially.

The Results file displays the Test ID, Run Number, Load, Units of Load, Distance and Units of Distance. A new row is created for each test run when Auto Number is used.

- Go to the Main Settings menu.
- Select File Locations.
- Select the Directory where you want your data saved to.

The Results file displays the Test ID, Run Number, Load, Units of Load, Distance and Units of Distance.

Auto Number means that a new file is created for each test run and each export.



When the AUTO NUMBER option is selected, a new .csv file is created for the test Run. A new .csv file is created for each test Run in the batch. If you performed ten test Runs, then ten files are created with the raw data for each Run.

15.3 Export Results Option

You have four options for your Export Results function.

When Export Results = NO, no results are exported at the completion of a test.

When Export Results = APPEND, results are exported to a .csv file within the Directory you established prior to your test. There is a single file and each result is appended to the file as a new row.

When Export Results = OVERWRITE, results are exported to a .csv file. There is a single file and there is only one row of results. When a new test is completed, the data in the row is replaced with the new data.

When Export Results = AUTO NUMBER, results are exported to a .csv file. Each test result creates a new file and each new file is sequentially numbered for identification.



When the APPEND option is selected, a new row of results data is added to a single Export Results file.

15.4 Runs Limit

The Runs Limit is the number of test runs that will appear on the Data view until the runs are overwritten. Setting the Runs Limit is a data management function.

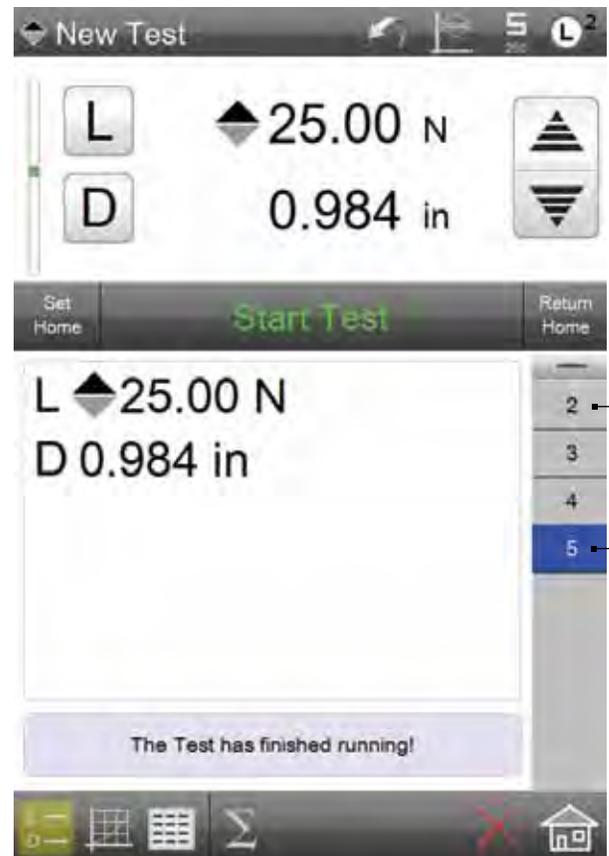
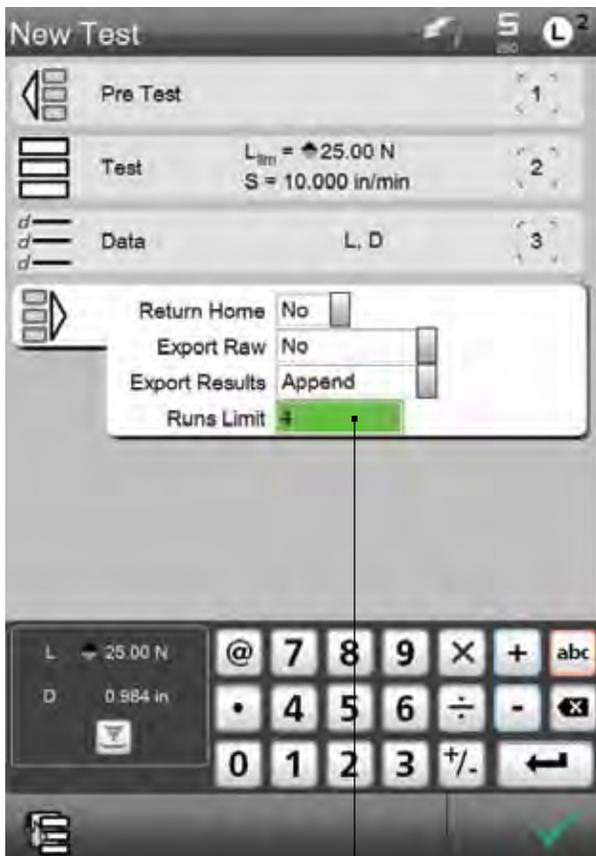
When the Runs Limit = 25, each run will be shown with a sequential number that represents the Runs Number. When the 26th test is conducted, Run #26 will replace or overwrite Run #1.

When the RUNS LIMIT number is exceeded the oldest RUN is permanently erased and replaced by the newest test Run.

In our example, since the Runs Limit is 4, only four Runs will ever be shown in the Runs List.

The oldest Run will be replaced as a new Run is performed.

The Run number sequence will remain however.



The RUNS LIMIT can be set to limit the number of Runs that are displayed on the Data View.

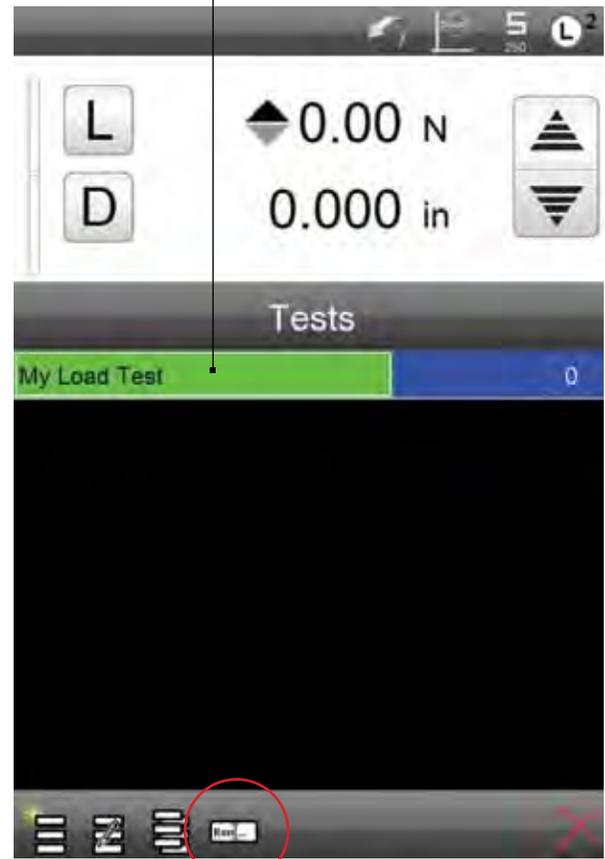
16.0 Naming Your Test Setup

When you create your test, your L2 software will ask you to name the test. Use the virtual keyboard on your L2 Controller display or use a keyboard connected to your system via USB or Bluetooth.

Test Names may be up to 16 characters in length.

You may also use the Rename symbol to rename your test. Open your test, select the Rename symbol and a text block will appear for your current test name. You can then rename the test.

The existing test name is highlighted when the Rename function is selected. This allows you to enter a new name.



Once you complete the test setup, the final step is naming your test. The test name may be up to 16 character. You may use alphabetical or numeric characters only.

Enter the name and select Done.

You may rename a test setup using the Rename function.

Select the test. Select the Rename target. Enter the new test name.

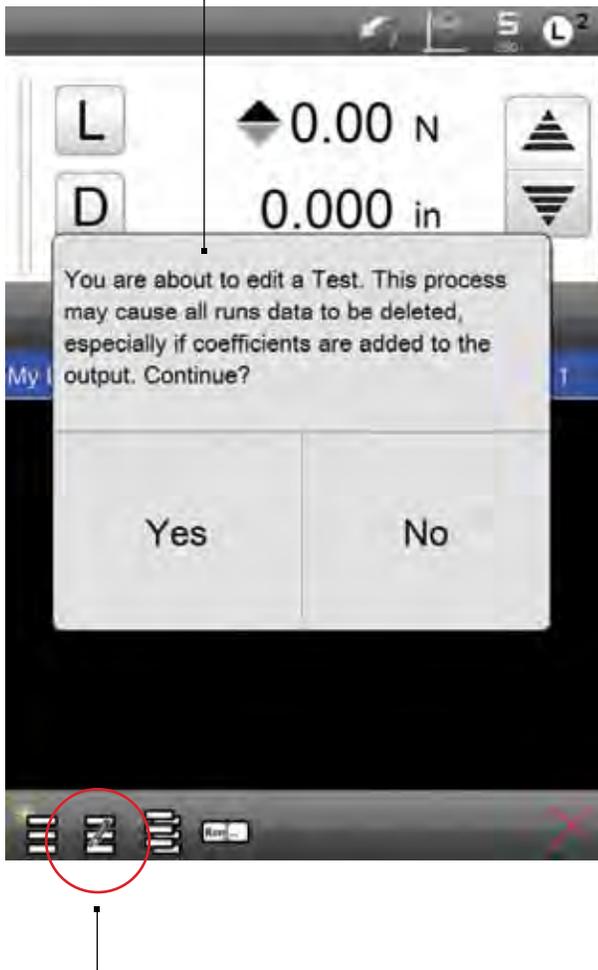
16.1 Editing Your Test Setup

If you find it necessary to make changes to your test setup, you can Edit your test. When you edit a test, you are changing the test setup, therefore, the test runs and data associated with the original test setup are not saved. If you need to save this information, use the COPY TEST function to save your original and to duplicate a copy of your original test setup. You can then Edit this test setup.

- Go to the Main Test Setup menu. Select the test setup to Edit.
- Select YES on the Edit warning message display.
- Change the Target Distance from 2 in to 1 in.
- Select the checkmark.

Whenever you Edit a test setup, any Run data for the existing test will be permanently erased.

If you need to retain the data for an existing test, either copy the test setup or save the data to a file using the Export Results or Export Raw functions.



Use the Edit function to edit a test setup
Select the test. Select the Edit target.

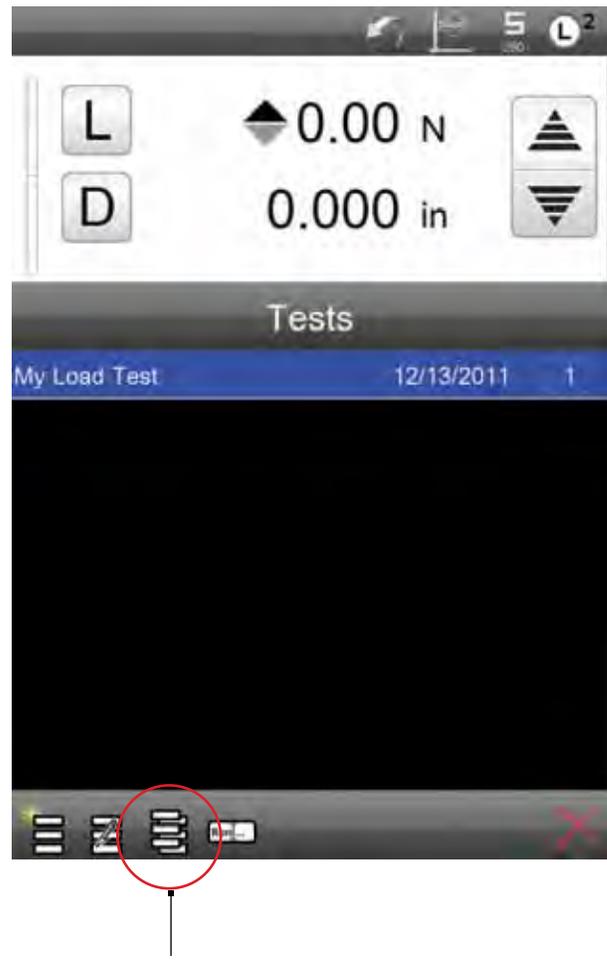
16.2 Copying Your Test Setup

Copy your test to save an original test setup before you edit, or to create a new test setup with the basic settings from the original test setup.

- Go to the Main Test Setup menu.
- Select the test setup you wish to Copy.
- Select the Copy symbol.

A copy of the test you selected will display in the setup view. Make the necessary edits to the test setup.

- Rename your new test setup.



Use the Copy function to edit a test setup.
Select the test. Select the Copy target. The new test setup will open at the Test step. From there, you can make any necessary changes
You will be required to rename the new test setup.

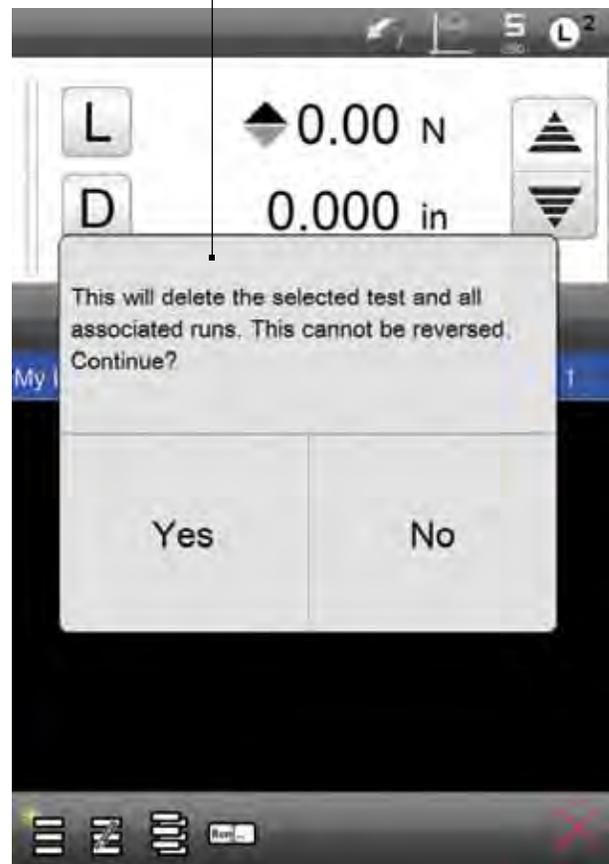
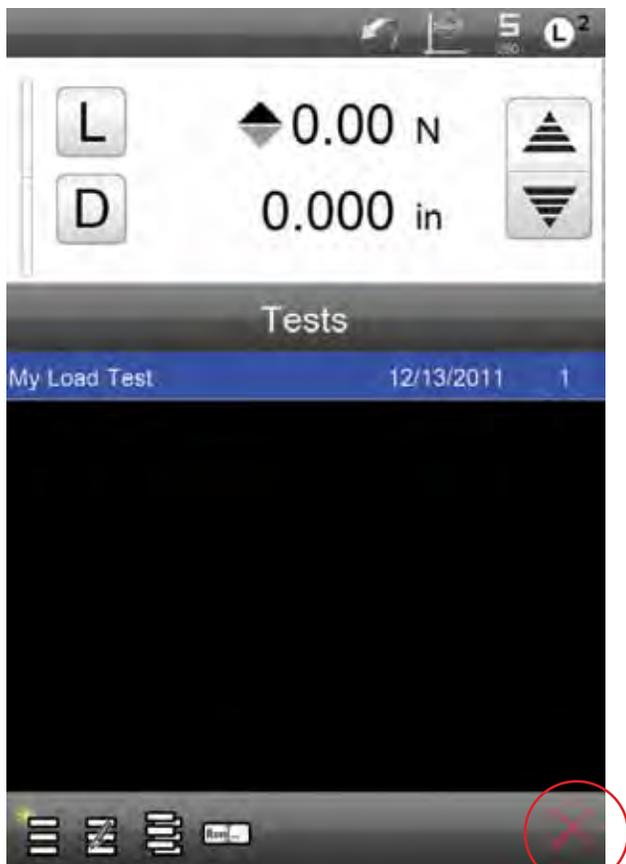
16.3 Deleting Your Test

You delete a test by selecting the test for deletion from the main test setup menu.

- Go to the Main Test Setup menu.
- Select the test setup you wish to Delete.
- Select the red "X" to Delete.

Once a test setup is deleted, all setup information and any data associated with the test setup is deleted permanently.

A warning message is displayed and requires the user to select YES in order to complete the deletion process.



*Select the test setup for deletion from the Main Test Menu.
Select the "X" to delete the test setup.*

17.0 L2 Operation

This section will provide you with an overview of your Starrett force testing system operation using the L2 controller.

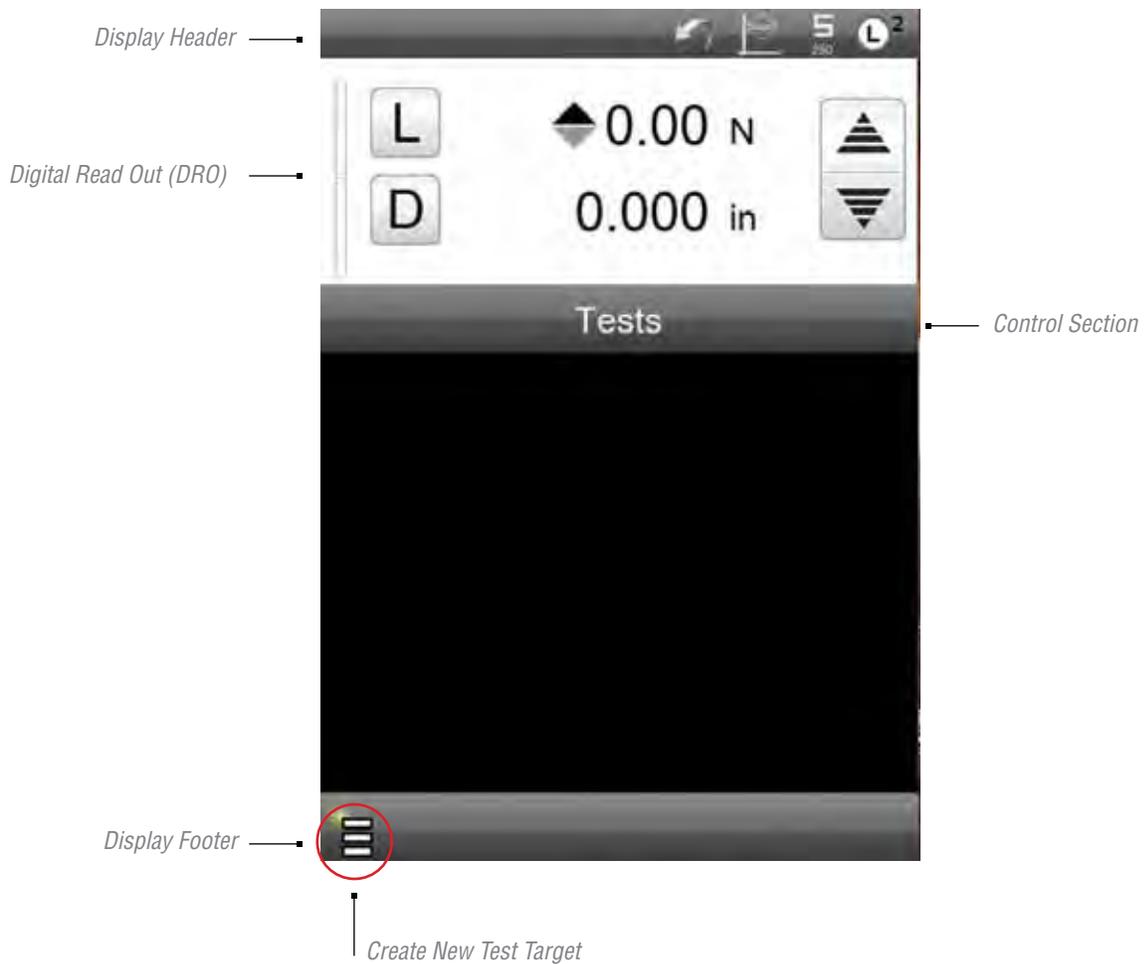
Starrett recommends that you receive training on the safe operation of your force measurement system from your authorized Starrett representative prior to use.

17.1 Display Views

The following sections will describe the many display views used or available to you during normal L2 Controller operation.

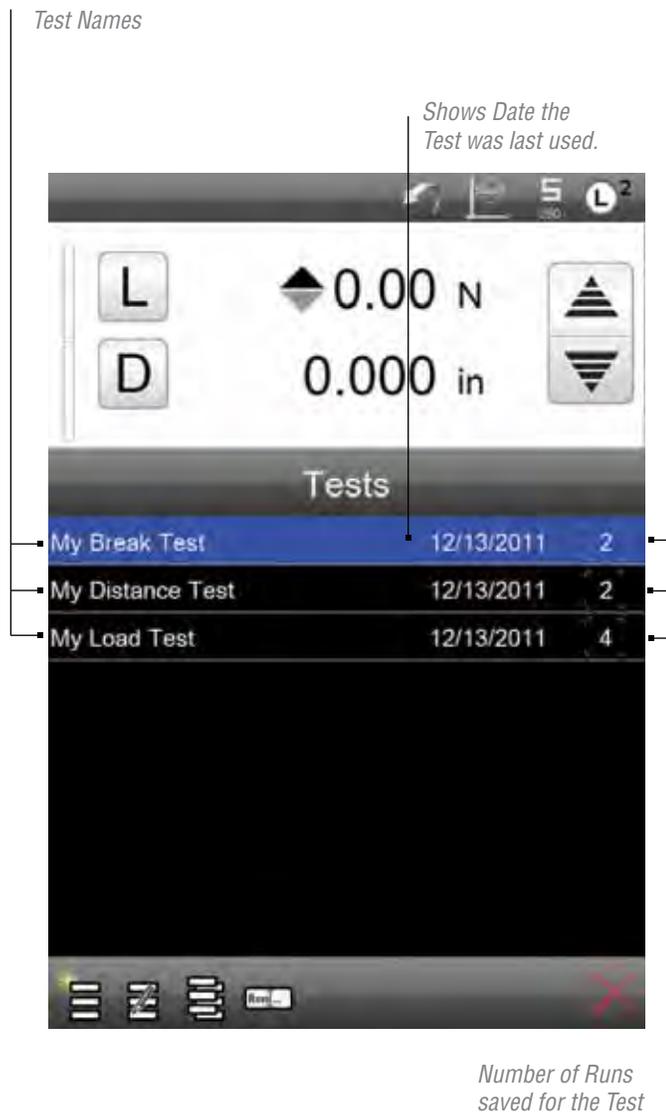
17.1.1 New Test View

When you first launch the L2 Controller, the first display is the New Test view.



17.1.2 Test Menu View

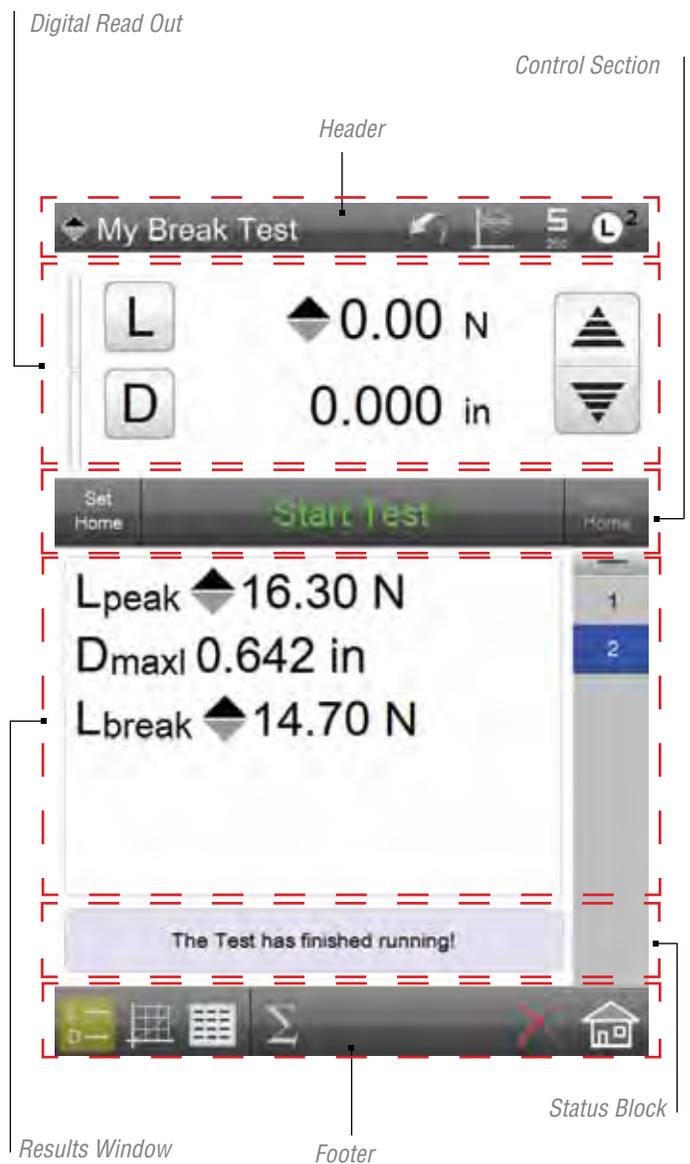
The Test Menu lists the Test Names that are saved on your L2 Controller for use. The Test Name and the last date the test was used are displayed. Additionally, the Test Name shows the number of test Runs for each test.



17.1.3 Data View

The Data View is the default operating display for all test setups. The Data View is the most used operating display. The Data View is comprised of the following sections:

- Header
- Digital Read Out
- Control Section
- Results Window
- Status Block
- Footer



17.1.3.1 Display Header

All views have a Display Header. The header contains the following attributes:

- Test Name
- Test Mode
- Back Symbol
- Test Mode
- Sensor Status
- Main L2 Menu

The Test Name is displayed with the symbol showing the Test Type. The Test Name may be up to 16 characters. The Test Name may be constructed using alphabetic or numeric characters only. Punctuation characters and symbols may not be used.

The Back Arrow symbol is used in two L2 Controller functions only. The Back Arrow is used to:

- It allows you to move from the Test Menu View to the New Test View, or
- to abort a test setup.

Your FMS System may be operated in either Normal Model or Height Mode. When in Normal Mode, the L2 Controller displays crosshead position as Distance. The Distance (D) measurement is relative to a user-specified datum position.

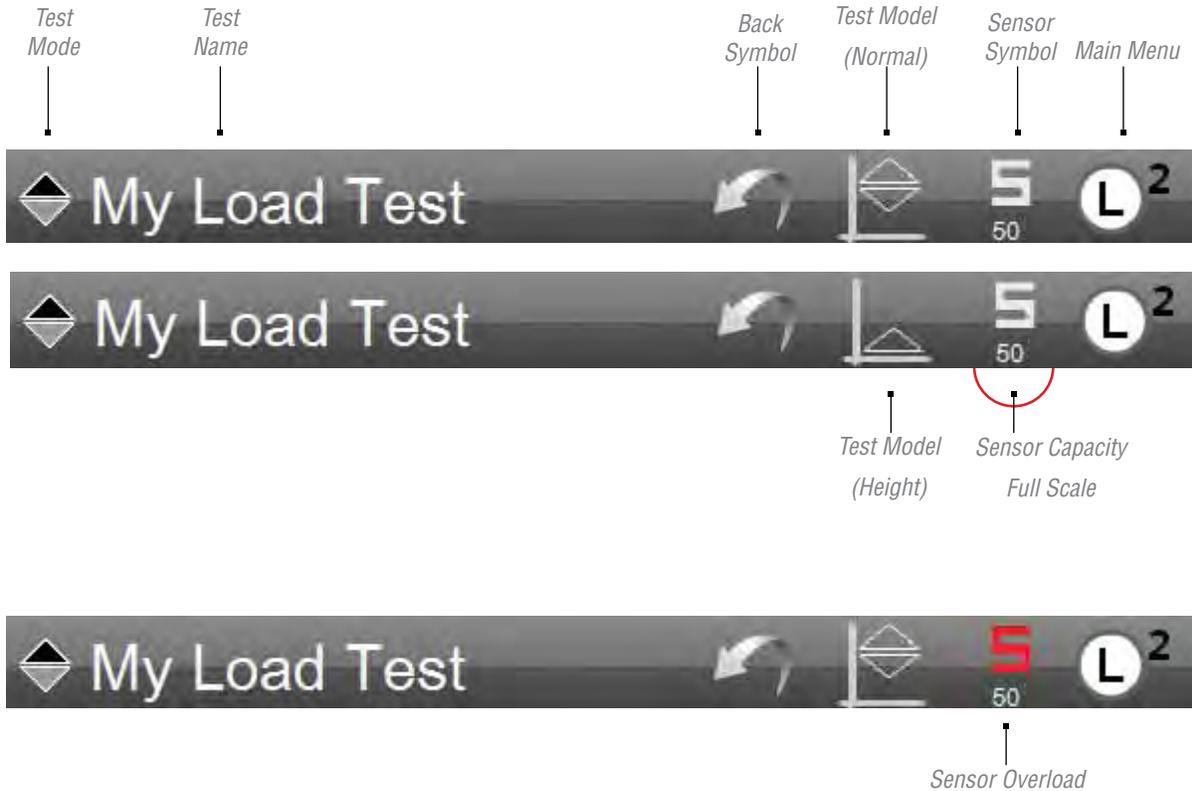
The Height Mode establishes the crosshead head based on an auto- datuming routine. Height mode is commonly used for tests on springs where the free length of the spring needs to be determined in order to determine spring rate.

You may switch between Normal and Height mode by pressing the Test Mode symbol.

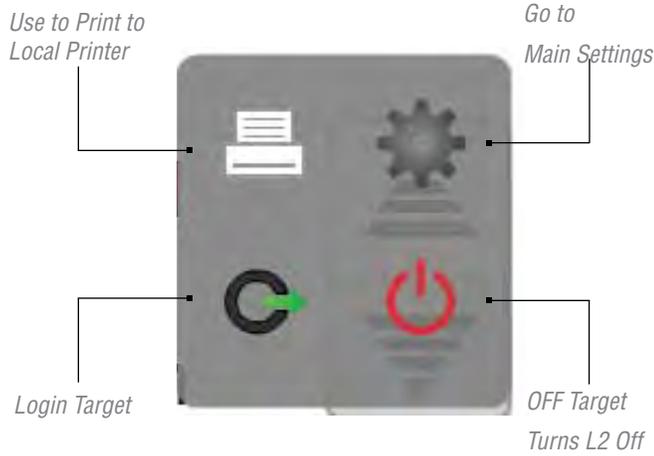
The Sensor symbol identifies the sensor capacity of the load cell that is connected to your FMS frame. Listed below the sensor symbol is the sensor's load capacity in the current units of measure.

The FLC sensors used with the FMS System are TEDS-compatible. They are automatically recognized by the system once the sensor is connected to the frame. Press the Sensor symbol to view the sensor's serial number, calibration status and overload history.

The Sensor symbol also uses the same color status indication as the bar graph. Green, Yellow and Red are used to represent the sensor's currently measured load based on the sensor's rated capacity.



The L2 Main Menu is used to gain access to the System Settings. It also is used to access the Print function for printing reports. The L2 Main Menu also has the On/Off function.



The Load Bar Graph displays the measured load in a graphical format. The bar graph fills from the center (zero) position. Tensile loads fill the bar graph from the center upward, while compressive loads fill the bar graph from the center downward.

The bar graph uses color to indicate the percentage of load being applied to the load cell sensor relative to the sensor's rated load capacity. The bar graph will display normal when the measured load is 0 to 75% of the sensor's rated capacity. The bar graph will display yellow when the measured load is 76% to 90%. The bar graph displays red when the measured load is over 90%.

Caution should be exercised when the bar graph is displaying yellow. This indicates that you are operating at the upper range of the load sensor, which is perfectly acceptable.

The red color indicates that you are operating at the extreme high end of the sensor's capacity. You should exercise extreme caution in order to not overload the load cell sensor.

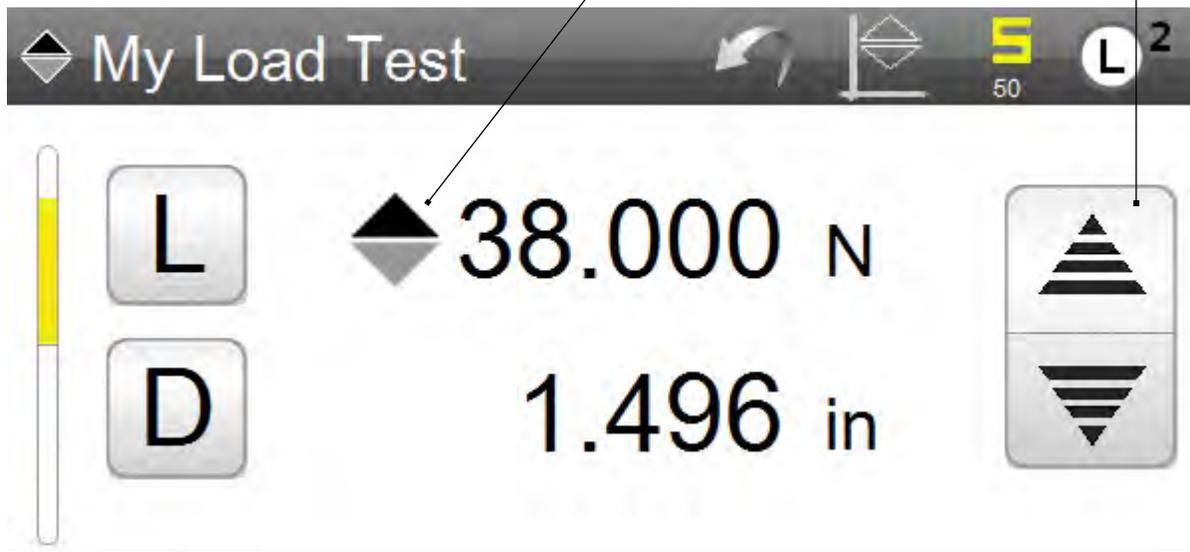
17.1.3.2 DRO Section

The DRO (Digital Read Out) section of the display shows active measurements for load and distance/height. The DRO section contains the following attributes:

- Load Bar Graph
- Load Target, Mode Symbol and Measurement
- Distance or Height Target, Mode Symbol and Measurement
- Status Indicators

Shows the test mode (Tension) and the direction of crosshead travel.

Crosshead status arrows animate when the crosshead is moving and shows the direction of travel.



The Load (L) and Distance (D) targets. Press to zero the measured value being displayed.

The Load (L) target is used to indicate the current measured load coming from the connected load cell sensor. Shown in front of the Load target is the mode indicator arrow which indicate either tension (pull) or compression (push). The measured load is displayed to the resolution for the individual sensor (10,000:1) and the units of measure is also displayed.

If you press the Load (L) target, the measured load is zeroed.

The Distance (D) target or Height (H) target when in Height mode, is used to indicate the current crosshead position as measured by the FMS frame's internal encoder. Associated with the measured distance is the unit of measure, which may be either inches (IN) or millimeters (MM).

If you press the Distance (D) or Height (H) target, the measured distance or height value is zeroed.

The two arrow symbols are used to indicate crosshead motion status. When the crosshead is actively moving, the arrows will animate showing the direction the crosshead is moving. Very slow crosshead travel is not immediately visible, therefore, this animation will help you recognize that the crosshead is active and in motion.

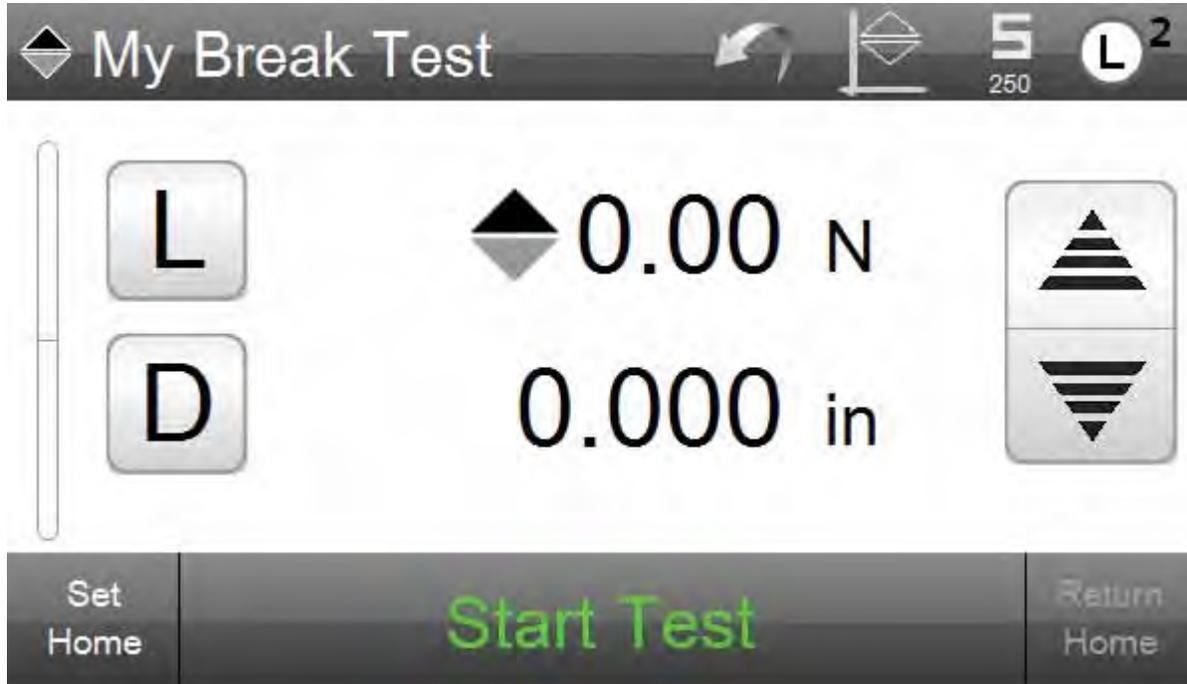
17.1.3.3 Control Section

The Control section is used during test operation to Start at test and Stop a test. The recommended method for Starting and Stopping a test is via the Start/Stop pushbutton on your FMS system's granite base.

The Control section also features the SET HOME and RETURN HOME targets. Both of these target let you manually set the Home position prior to performing the test. The Home position is where the crosshead resides on the column prior to the Start test being performed. When the SET HOME target is pressed and after the test is concluded, you can press the RETURN HOME target. This will automatically return the crosshead to the established HOME position.

The SET HOME function is available in your Pre Test step. When enabled, the Home position is automatically established when the Start test push button is depressed.

The RETURN HOME function is available in the Post Test step. When enabled, the crosshead will automatically return to the Home position once the test concludes.



Press the SET HOME target to manually set the test Home position.

When the SET HOME function is used (manually), at the completion of the test, you may return the crosshead to the Home position by pressing the RETURN HOME target.

17.1.3.4 Results Section

The Results section displays your results for your selected coefficients. This section displays the value and units of measure for each selected coefficient.

If tolerances are used, results that are “outside” the tolerance, display in RED to indicate a “failed” result.

The Results section also displays the Runs List. Each Run is numerically listed. You may select the Run number to view the results for that particular Run.

When the Graph view is being used, the Overlay function can be used to overlay traces for up to five (5) Runs on a single graph for comparison purposes.

The Result section also displays the test status in the Status Block. During runtime, the Status Block will indicate the step being performed and the current status of the test.

During an active RUN, the Limit setpoint is displayed. In this example the tension load limit of 38N is shown above the currently measured load of 14.130N.

The Data View shows the results from the previous test RUN (Run 1).

The Status Block reports the current step being performed for the test setup. Shown is the test direction (tension/pull), the Load Limit (38.000N) and the Test Speed (20.000 in/min). The Step Number (2) is also displayed.

The Runs List shows the current number of Runs performed. In this example, we are running Run 2. Run 1 is listed.

The Overlay target is used during the Graph View. This allows you to select multiple RUNS for graphing together.

This symbol represents the Data View. It is highlighted to show that you are viewing the Data View format.

The other symbol represents the Graph View. You may also perform a test Run while in the Graph View.

17.1.4 Graph View

The Graph View may be used while a test Run is being performed. The Graph View displays a graphical representation of the measured values using a histogram.

The Graph View displays Load versus Distance or Load versus Time. You can change views by depressing the Graph View symbol.

During the first test Run, the graph will automatically determine the X- and Y-axis graduations during the test.

When the OVERLAY function is used, the graph will place a trace for up to five (5) Runs on a single histogram. Each trace is color coded to match the individual RUN.

Press the OVERLAY target. If you press once and the double green line shows, you can then individual select the RUN number you want on your graph.

If you select the target and press and HOLD, all of the RUNS will be overlaid onto you graph. The maximum number of traces is five (5) per a single graph.

The active Run number is highlighted showing which graph data is being presented.



Shows the currently active View (Graph View)

Exports Raw Data for this RUN in a .csv file format

Deletes the highlighted RUN

Go to Data View

Go to Data Summary View

Go to Home View

17.1.5 Data Summary View

The Data Summary View is a batch report for an entire test setup. The Data Summary View looks like a spreadsheet. Each row of information corresponds to a RUN within the test (batch).

The Title Row shows the various titles, which include the coefficients and their units of measure.

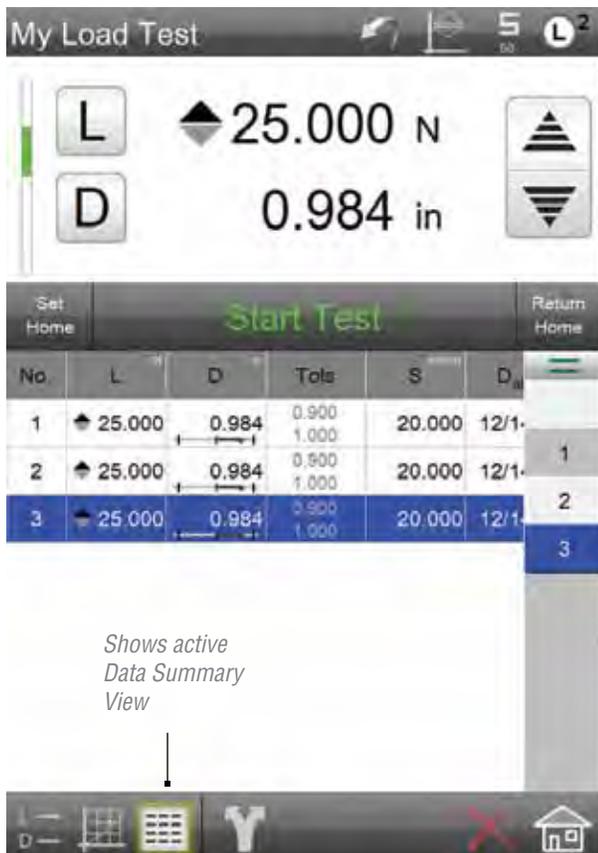
If Tolerances are used, a “tendency graph” is shown depicting the actual result on a line graph relative to the Limit 1 and Limit 2 range. Results that fall outside the tolerance range are displayed in RED text.

The Shared function is listed in the footer. Selecting this function will create and send a .csv file of the Raw Data for a result.

The Title Row shows the Run No., coefficient results with units of measure and tolerance limits (if used).

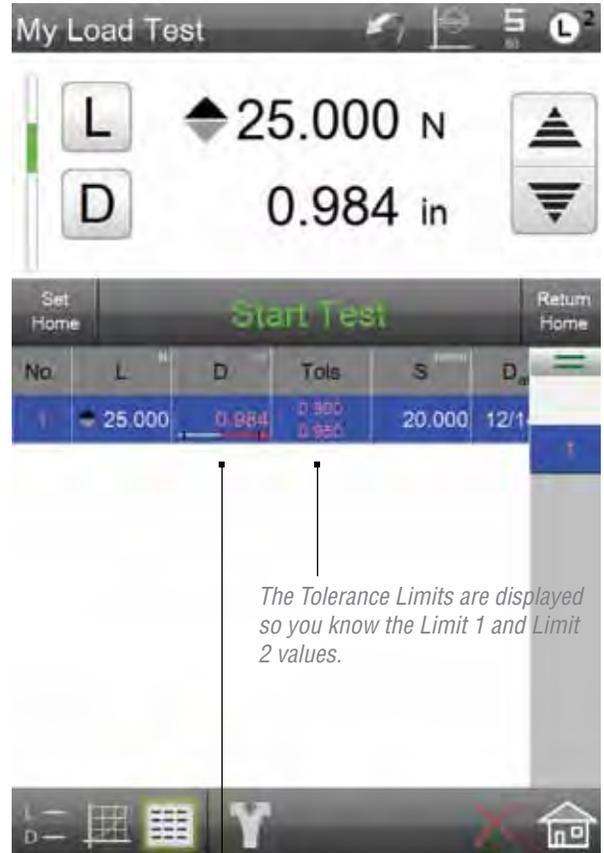
The highlighted (blue) row corresponds to the highlighted Run number in the Runs List.

When an “out-of-tolerance” condition occurred, the RUN displays RED indicating a “failed” result.



Shows active Data Summary View

Exports Raw Data for this RUN in a .csv file format



The Tolerance Limits are displayed so you know the Limit 1 and Limit 2 values.

When tolerance is used, a Tendency graph is used to depict how the measured result compares to the limit range you had established for Limit 1 and Limit 2.

Our example shows that we exceeded the Limit 2 (Upper) tolerance.

17.1.6 Statistics View

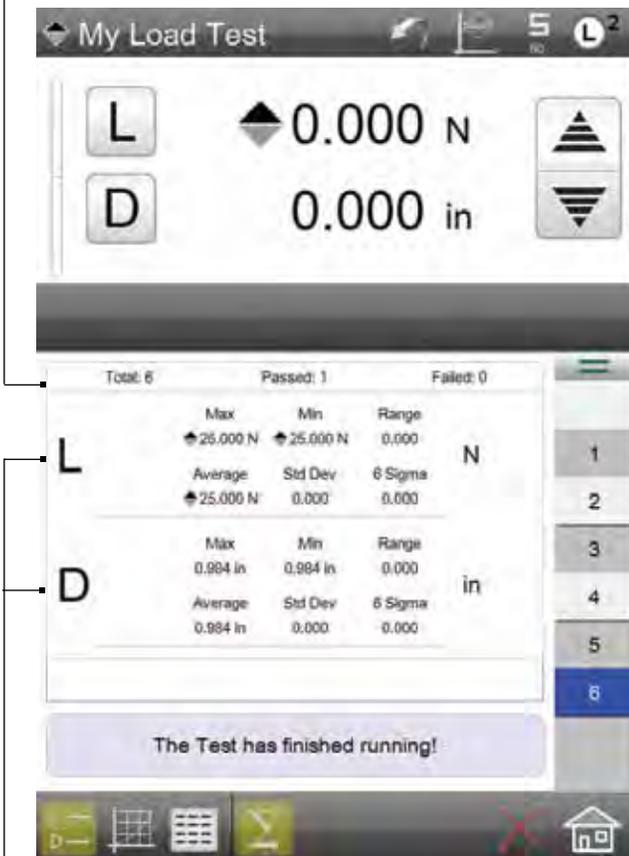
The Statistics View calculates basic statistics for the batch (all RUNS for a test). The Statistics View calculates:

- Total Runs
- Runs “passed”
- Runs “failed”

For each coefficient, the Statistics Views displays:

- Maximum Value
- Minimum value
- Range
- Average
- Standard Deviation
- Six Sigma

The Statistics View header shows the number or RUNS, whether they passed or failed based on your tolerance settings.



Shows active Statistics View accessed via Data View

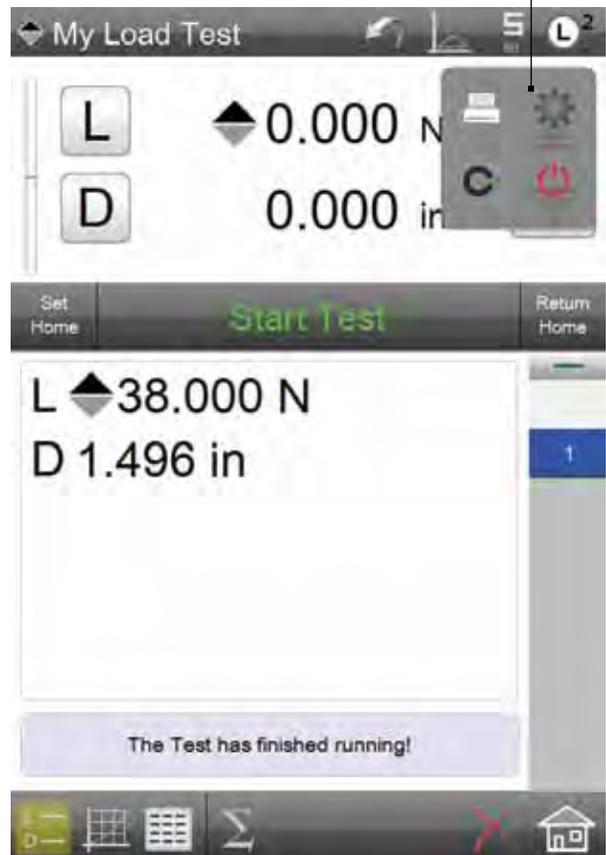
The Statistics View shows the statistics for each coefficient selected within a test setup.

18.0 System Settings

The main System Settings menu is used to set the global settings for your L2 Controller. The main System Settings menu is normally reserved for users with Super Administrator or Supervisor authorization and access.

This section will describe the primary system settings options for your L2 Controller.

From the L2 Menu, select the SETTINGS symbol to launch the SETTINGS options.



18.1 Contact Information

The Contact Information is an optional setting for your Starrett Dealer to complete. This will provide you with contact information should you require service or technical assistance.

18.2 About

The About setting tells you information about your L2 Controller and software. This setting displays software information including the revision level, revision date and lists any options included with your software.

The ABOUT Setting tells you information about your L2 Controller, including software revision date.

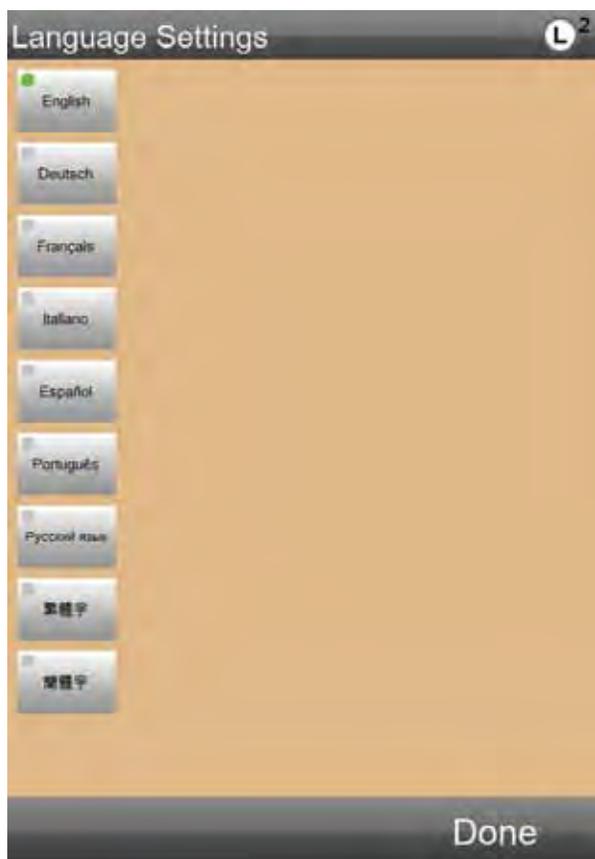
L2 System Settings options



18.3 Languages

When Language Settings = YES, the user has access to the setting that lets you designate the display language for your L2 controller. These languages are supported: English, Deutsch, Français, Italiano, Español, Portugues, Russian, Chinese (simplified) and Chinese (Mandarin).

If the Language Settings = NO, the user cannot change the display language.



ENGLISH is the default display language.

Select the desired language for your location. Language settings remain in their associated format.

18.4 Security

Your L2 controller has three levels of user security. These are:

- Super Administrator
- Supervisor
- User

The Super Administrator is the highest level of authorization. This level has total access to all system functions.

The Supervisor is normally a level below the Super Administrator. Only the Super Administrator can assign the “access rights” to the Supervisor. You may have multiple Supervisors for an L2 controller.

The User level is generally used for the operator with restrictive access to only the functions the operator needs to perform in their normal duties.

All assigned users to a system have these configurable attributes:

- Display Name
- Password
- Max days a password is usable
- Account enabled
- Automatically login as this user

All assigned users have these configurable access rights:

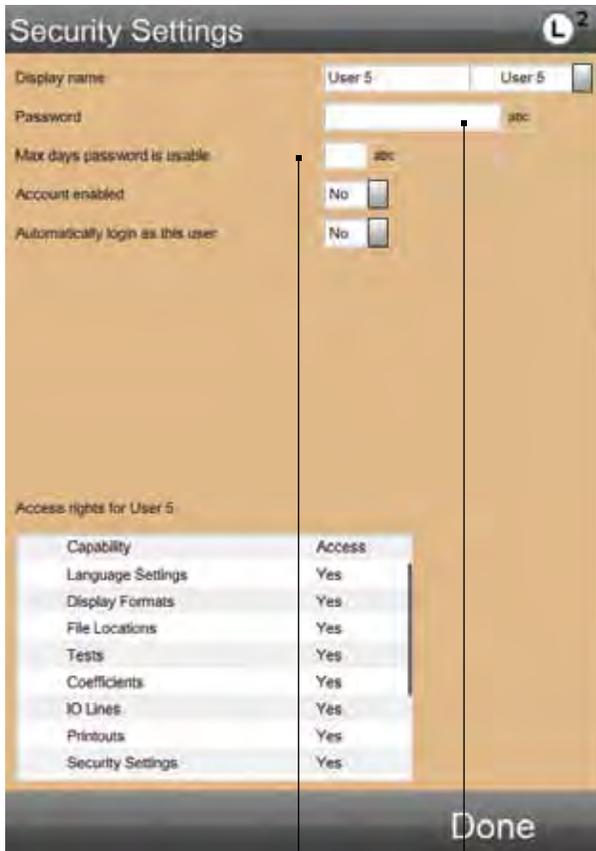
- Language Settings
- Display Formats
- File Locations
- Tests
- Coefficients
- IO Lines
- Printouts
- Security Settings

Access rights are either YES or NO and listed in the Access column. To change the access rights, select the Yes or No status.



The Supervisors can assign Users their access "rights".

The Super Administrator has complete access to all System Settings.
 The Super Administrator can assign Supervisors and Users their access "rights".



You may set the number of days to require a "forced" new Password.

Each User may have a Password constructed using alphabetical and numeric characters. No symbols or punctuations permitted.

Passwords may be up to 16 characters in length.

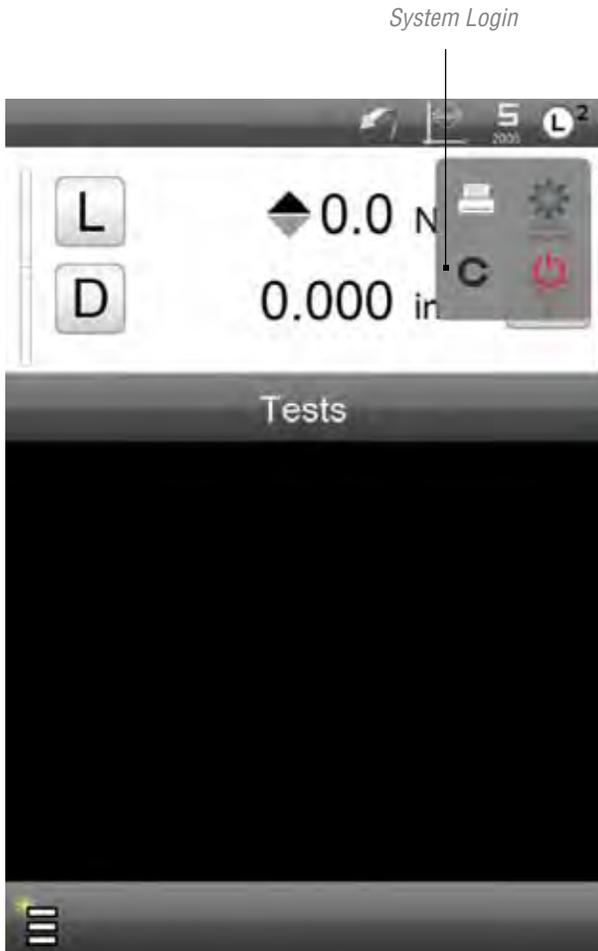


Turn Security "rights" on/off using YES (on) or NO (off).

You may assign "rights" to up to five (5) User levels.

18.5 System Login

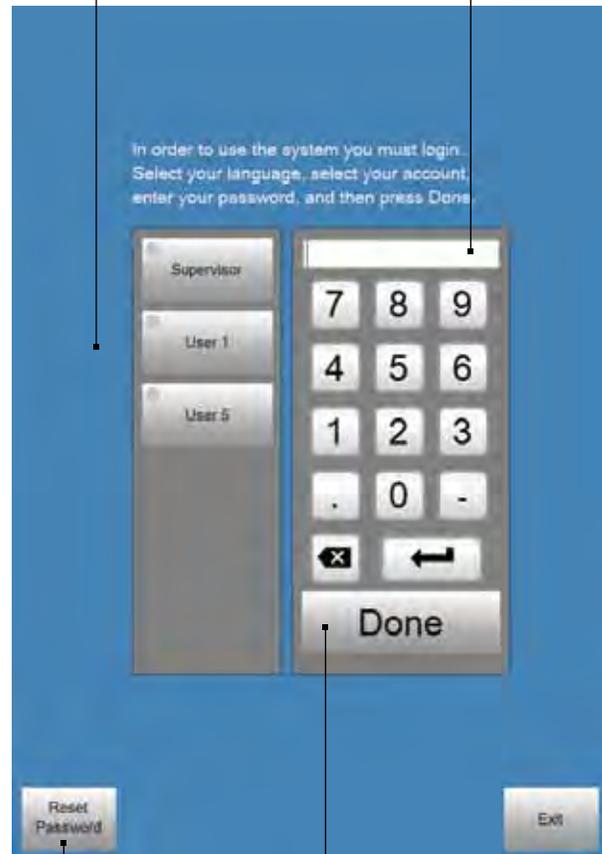
Users may login to the L2 Controller using the login symbol. When passwords are used, the user will be required to enter their password in order to launch the L2 software.



System Login

The authorized users for the system, setup by the Supervisor or Super Administrator, are listed. Select your access name from the list.

Enter your Password to launch the L2 software. Use the numeric keypad and/or a wireless keyboard that is paired to your L2 Controller.



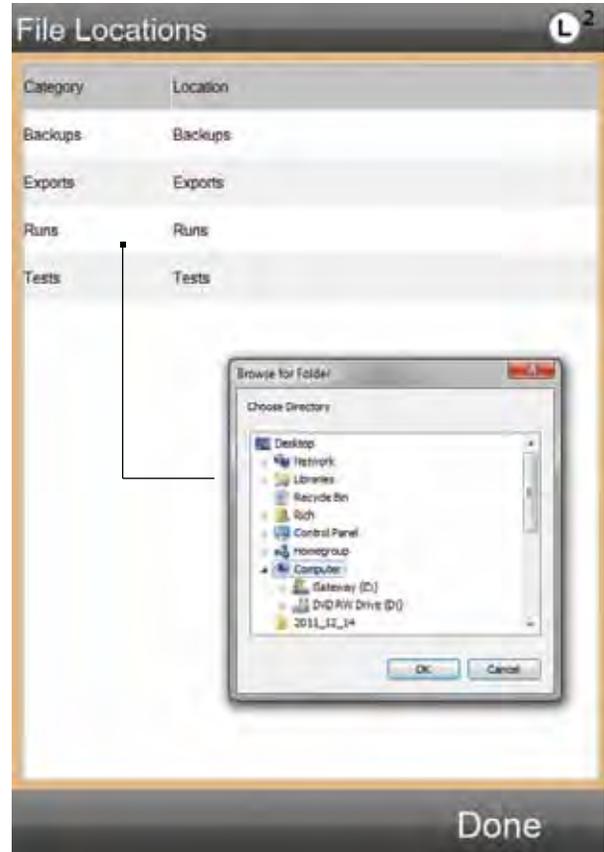
Use this touch target to reset your password.

Select DONE to launch the L2 software.

18.6 File Locations

When File Locations = YES, the user is allowed to setup directories and locations where files can be exported to. Within the File Locations settings, you have the ability to setup and link directories for backups, exports, runs and test files.

If the File Locations = NO, the user cannot assign a file location.



Select the File Type to assign a file directory. Once the directory is assigned, all files will be sent to that directory for archiving or use by other applications or personnel on a network.

18.7 Motion

The Motion setting lets you change the maximum velocity of your FMS frame. The maximum velocity is 60 inches per minute (1525 mm per minute). This velocity is not used for testing. The maximum allowed test speed is 50 inches per minute (1270mm per minute). The maximum velocity is used for the fast jog switch- the crosshead will move at the maximum velocity when the jog switch is pressed and held in position.

The maximum velocity for all FMS frames is 60 inches per minute. The maximum test speed velocity is 50 inches per minute.

When you set the velocity, you are setting the maximum velocity used when the jog switch is pressed and held, e.g. the rate of speed the crosshead can travel when not being used to testing, e.g. return speed.



The Grip Load is used to protect your gripping fixture from damage due to overloading. Set the Grip Load to a load capacity that is less than the capacity of the gripping fixture. If this load is achieved, the crosshead will stop and the test will abort.

18.8 Loads

The Load Settings lets you establish various load measurement attributes and safety options.

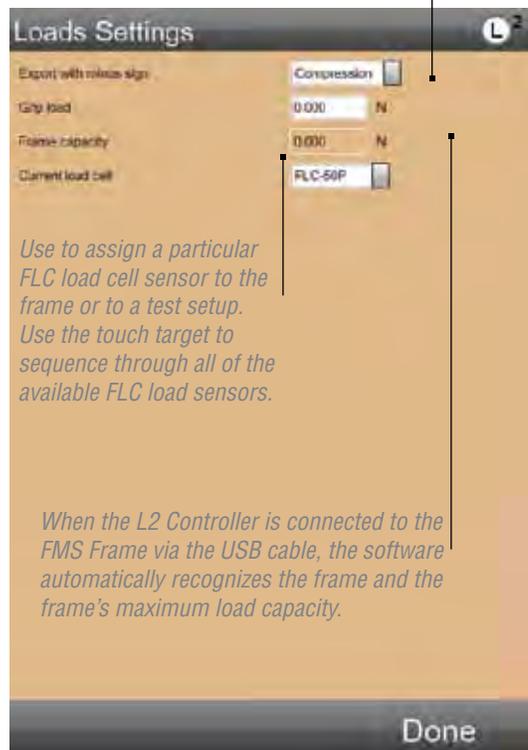
The Export with minus sign is used to designate a sign with either your compression or tension measurement in order to distinguish the two different types of loads. Generally, compression is displayed as a “negative” number.

The Grip load setting provides you with the ability to enter the load capacity for your testing fixtures. At times you may use a test fixture with a much lower load capacity than your sensor’s load capacity. Setting a Grip load will protect your test fixture. If this load is measured, the test will abort.

The Frame capacity is automatic. All Starrett testing frames are self-identifying by your L2 controller. The load capacity of the frame is automatically recognized and saved in the L2 controller. The frame capacity dictates and controls the maximum measurable load for your system.

The Current load cell is automatic. All Starrett load cell sensors are TEDS compliant to IEEE 1451. The sensor plugged into your Starrett load frame is self-identifying and the sensor’s characteristics are automatically recognized by your L2 controller. Load sensor deflection, for example, is automatically compensated for.

Use to assign a “sign” to either tension or compression. Normally, compression is a negative number.



Use to assign a particular FLC load cell sensor to the frame or to a test setup. Use the touch target to sequence through all of the available FLC load sensors.

When the L2 Controller is connected to the FMS Frame via the USB cable, the software automatically recognizes the frame and the frame’s maximum load capacity.

18.9 Calibration

The Calibration section is reserved for authorized personnel involved with calibrating the FMS system and associated load cell sensors.

If set to YES, the user may make changes to unlocked test setups. Tests that are locked via the Security Settings cannot be modified or copied.

If set to YES, the user may make changes to locked test setups.

Unlocked tests can be edited/copied/deleted Yes

Locked tests can be edited/copied/deleted No

Test name prefix T abc

Next test auto-number 3

Done

This lets you use a default name prefix when you create a test setup. For example you may want to use the name of the person who created the test setup, or the facility where the test is being performed or some other naming convention that helps identify the test setup author.

You may specify a test setup numbering sequence by specifying the next number to be used in auto-numbering.

18.10 Tests

The Tests Setting allow you to establish rules for how tests are created, edited, labeled and displayed.

When the Unlocked Tests option = YES, the user has the ability to edit, copy and delete a test setup. If the option = NO, the user cannot edit, copy or delete a setup.

When the option for Locked Tests = YES, an authorized user, normally a Supervisor or Administrator level, may edit, copy or delete a test setup. If the option = NO, the user cannot edit, copy or delete a setup.

When Allow Runs to be Deleted = YES, the user may delete a Run. If the option = NO, the user may not delete a Run.

You have the option to create a common Prefix Name for your tests. A Prefix Name may be the Supervisor who created the test; the facility where the test is to be performed; a Batch ID, etc. You may use up to ten (10) characters.

The Next Test Auto Number option lets you specify a numbering sequence for your test setups. The number you enter is the beginning number of the sequence. If the number is 1, the default test name for your newly created test setup is your Prefix Name and the number 1. If the number was 200, a newly created test setup is your Prefix name and the number 200. The next new test you setup would have the default name Prefix 201, etc. As tests are added to your system, the Next Test Auto Number represents the number of test that have been created.

The Graphing Points lets you determine the resolution of your graph trace. The default is 100 points. This means that 100 points from your data array for your Run will be used to display the trace on your graph. Using the crosshair tool, you can access all 100 points. You may have up to 1000 points for a graph trace. The greater number of points, the higher the graph resolution.

18.11 Coefficients

The Coefficients Settings is a location where you have the option to change how a coefficient is reported and labeled. All coefficients have their own unique label, e.g. Load = L. You may, however, change the global label for Load if you wish. For example you may change Load to “Load” instead of L. Or you may change Peak Load from Lpeak to “Peak”.

You may rename a coefficient using up to 8 characters.

The COEFFICIENT SETTINGS shows all of the available coefficients for your L2 Controller. Most of the coefficients are only available using the Test Builder Application.

Load (L), Distance (D), Peak Load (Lpeak), Distance at Peak Load (Dmaxl), Break Load (Lbreak), Distance at Break (Dbreak), Time (Time) and Date (Date) are used on the Quick Tests. The other coefficients are NOT available for use on a Quick Test.

The screenshot shows a mobile application interface titled "Coefficient Settings" with a "L²" icon in the top right corner. The screen displays a list of coefficients with their corresponding labels and a "abc" placeholder. At the bottom, there is a checkbox labeled "Select coefficient labels first when editing" which is currently checked, and a "Done" button.

Coefficient	Label	Placeholder
Load	L	abc
Break Load	Lbreak	abc
Average Load	Lave	abc
Peak Load	Lpeak	abc
Min Load	Lmin	abc
Delta Load	Ldelta	abc
Distance	D	abc
Dist at Break	Dbreak	abc
Max Distance	Dmax	abc
Min Distance	Dmin	abc
D at Max L	Dmaxl	abc
D at Min L	Dminl	abc
Delta Dist	Ddelta	abc
Duration	Dur	abc
Date	Date	abc
Time	Time	abc
Num of Cycles	Ncyc	abc
Answer	Ans	abc

Select coefficient labels first when editing: Yes

Done

You may RENAME any coefficient. When you rename a coefficient at the COEFFICIENT SETTING view, the coefficient's name changes globally throughout the system.

When this option is set to NO, it allows you to skip the Naming function in the Data Setup menu for Appearance.

18.12 Desktop

The Desktop Settings provide you with options for displaying extra symbols that help you making changes to common attributes. A special Desktop icon is displayed in the footer. Select this icon to reveal the Desktop settings options:

- Display inch/mm button
- Display load units button
- Display keyboard button
- Display height mode button
- Height of list items
- Shutdown computer on Exit

When the Display inch/mm button is set to Extra, you can change the distance units of measurement from your Test Menu view. Normal default is NO.

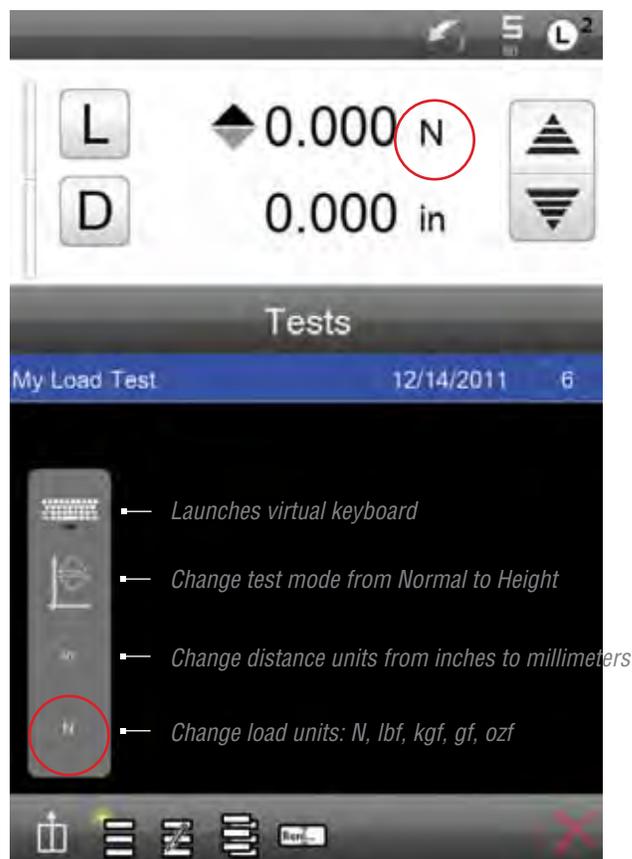


When the Display load units button is set to Extra, you can change the load units of measure from your Test Menu view. Normal default is NO.

When the keyboard button is set to Extra, the keyboard icon is displayed. Touch the keyboard display to launch the virtual keyboard for making alpha-numeric entries.

When the height mode button is set to Desktop, the height mode icon is displayed in the header.

The height of list items may be set to Very Large, Large, Medium or Small. This defines the size of your lists.



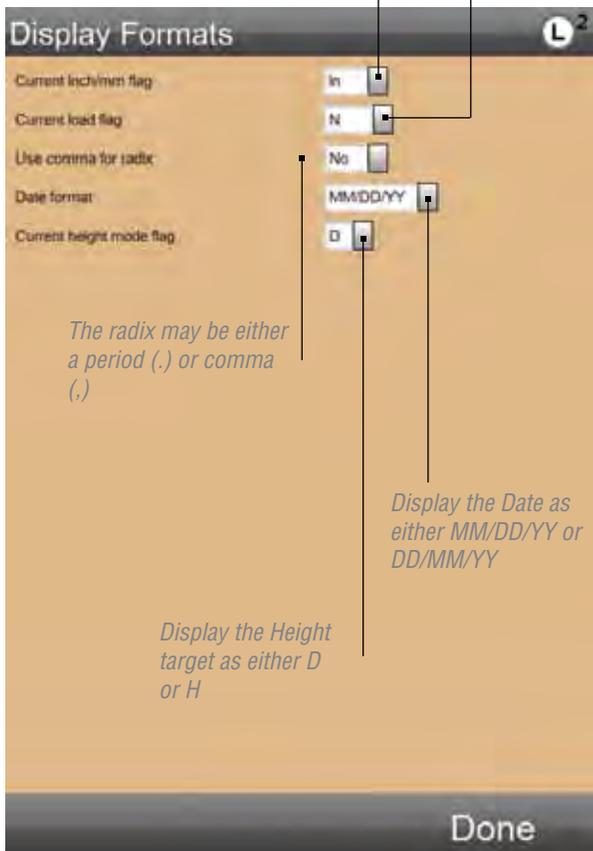
Special Desktop icon. Press to launch options list.

18.13 Display Formats

Use the Display Formats settings to globally establish your units of measure for distance, load, radix, data and height mode.

Set the units of measure for Load to either N (newtons), lbf (pound-force), kgf (kilogram-force), gf (gram-force) or ozf (ounce-force)

Set the units of measure for Distance to either in (inches) or mm (millimeters)

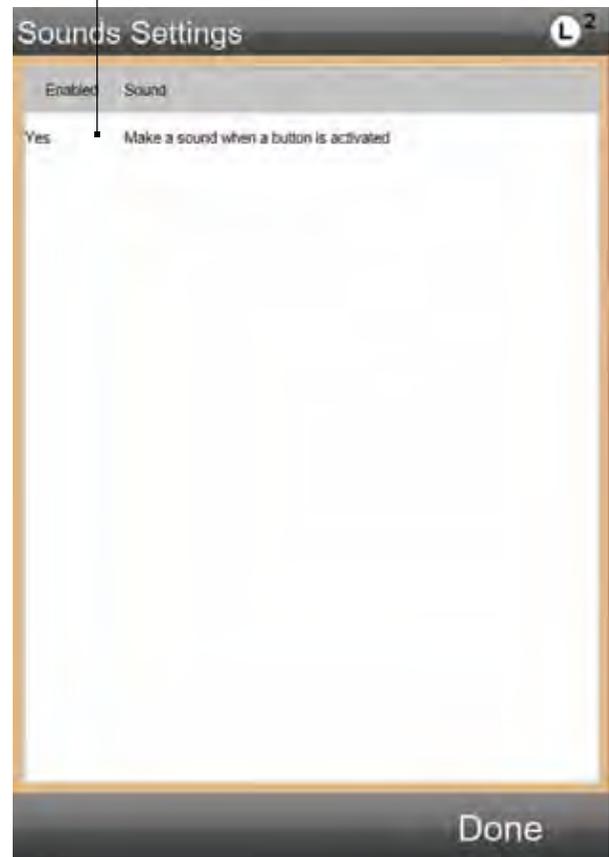


18.14 Sounds

When Sounds is enabled, an audible feedback sound is used on every touch of your L2 Controller. If you disable, there is no sound when you touch a target on your L2 Controller.

When the Sound feature is set to YES, an audible "beep" will be heard when you touch a target on the L2 Controller

If you don't want any sound, turn the feature to NO.



19.0 Reports

Your L2 Controller supports four (4) different standard reports. Reports are generated from each of the four major display views: Data View, Data Summary View, Graph and Statistics.

Your FMS system and L2 Controller can print to most printer models using a USB or wireless connection. Label printers may also be used.

19.1 Run Report

The Run Report derives from the Data View. This report is formatted as a label but can also be printed in portrait style on a standard letter-size document.

Select the PRINT symbol.

The Run Report will print based on your Data View currently displayed.



The Run Report shows result information from a single test Run. The information displayed comes directly from the Data View.

- Go to the Data View for your test Run
- Go to the L2 Main Menu
- Select the Print symbol

19.2 Batch Report

The Batch Report derives from the Data Summary View. It prints as a spreadsheet-style report displaying the results information for each test Run for a batch.

- Go to the Data View for your test Run
- Go to the L2 Main Menu
- Select the Print symbol

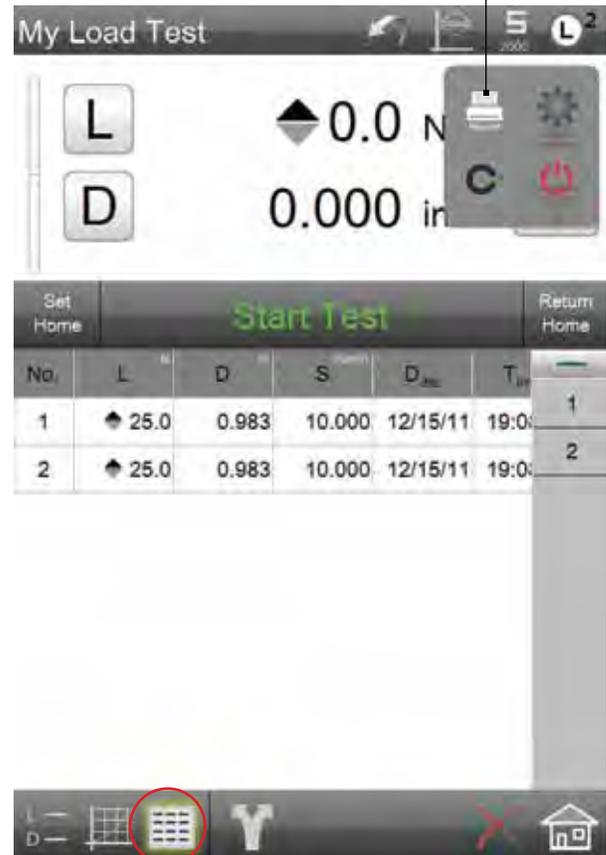
Select Data View.

Select Statistics View.

Select L2 Main Menu.

Select PRINT symbol.

The report will print to the associated printer.



19.3 Graph Report

The Graph Report prints the graph and the results information associated with the graph.

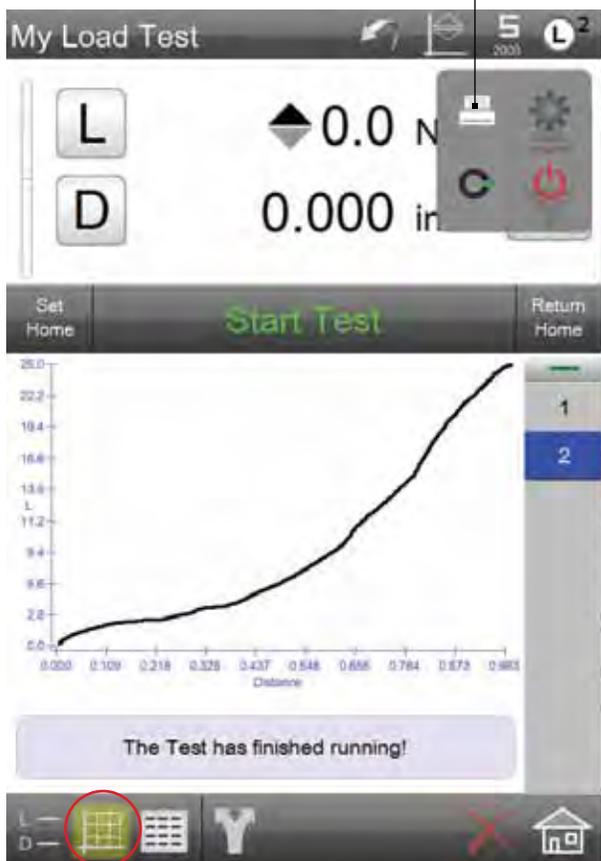
- Go to the Graph View for your test Run
- Go to the L2 Main Menu
- Select the Print symbol

Select Graph View.

Select L2 Main Menu.

Select PRINT symbol.

The report will print to the associated printer.



19.4 Statistics Reports

The Statistics View prints the information from this view. It includes the number of passed, failed and total Runs. It also prints the statistics for each of the coefficients for your test setup.

- Go to the Data View for your test Run
- Go to the Statistics View
- Go to the L2 Main Menu
- Select the Print symbol

Select Data View.

Select Statistics View.

Select L2 Main Menu.

Select PRINT symbol.

The report will print to the associated printer.







Corporate Headquarters

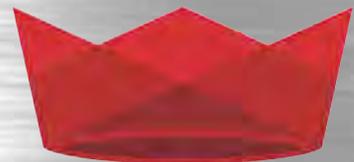
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