L3 Series Software for Material Testing

Introduction

Starrett®

121 Crescent Street
Athol, MA 01331
www.starrett.com

MODEL MLC-50K   S/N: 459447A

CAPACITY 50 kN   OUTPUT: 4.227 mV/V

SN: R2062

Reliant Extensometry.com

Starrett®

The Better Solution

FORCE MEASUREMENT **S**OLUTIONS

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Product Warranty

Starrett force measurement products carry a one-year (from date of purchase) warranty against defects in material and workmanship (parts and labor), subject to factory inspection.

The L.S. Starrett Company will repair or replace, at its option, any part or parts found to be defective in workmanship or material. Starrett warrants repaired or replaced parts for the balance of the original warranty period or 90 days, whichever is longer. Parts returned to the factory under warranty will be repaired at no charge. Freight charges to the factory will be paid by the customer. Return freight charges to the customer will be paid by Starrett.

This warranty does not cover damages from such causes as abuse, accident, neglect, fire or freight damage. It does not apply to defects resulting from modifications made by the customer or improper use of the system or its components.

Disclaimer of Liabilities

The L.S. Starrett Company shall have no liability or responsibility to the customer or any other person or entity with respect to any liability, loss or damage caused or alleged to be caused directly or indirectly by this documentation, or the hardware described in it. This includes but is not limited to any interruption of service, loss of business or anticipatory profits, or consequential damages resulting from the use or operation of hardware or equipment.

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.

Warning Labels

Listed below are the warning labels used in this manual including their definitions. Please pay particular attention to these labels and sections within this manual denoted with a warning label.

HAZARD: This label identifies a potentially dangerous hazard that may lead to serious injury to personnel.

WARNING: This label alerts the user of a potentially serious hazard that may result in injury to personnel and damage to equipment.

CAUTION: This labels advises the user to proceed using caution while performing this action. Failure to do so may harm equipment.

NOTE: This label is used to call-out important information including helpful operating instructions.

Electromagnetic Compatibility

Your MMS and MMD Series material test system is designed to comply with International Electromagnetic Compliance (IEC) standards.

To ensure reproduction of this EMC performance, connect this equipment to a low impedance ground connection. Typical suitable connections are a ground spike or the steel frame of a building.

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. If available, 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

1.1   Starrett L3 Series Material Testing Systems

Starrett L3 Series material testing systems are modular in design allowing you the flexibility to incrementally expand your system as your needs evolve. Starrett offers a full range of testing frames, load cell sensors, extensometers, testing fixtures & jigs, plus our exclusive L3 Series material testing software, operating on an all-in-one, touchscreen computer workstation.

This manual will describe the features, functions and procedures of our L3 material testing software. Included will be brief descriptions of various hardware components that comprise a Starrett L3 Series system.

1.1.1 MMS and MMD Series Testing Frames

Starrett manufactures two models of testing frames with operating capacities from 500N to 50kN (112lbf to 11,250lbf). Both models operate with our L3 Series material testing software. And both are fully compatible with interchangeable load cell sensors, extensometers and test fixtures.

MMS Series Single Column Test Frames

The MMS Series are single column testing frames available in four capacities.

Model	Load Capacities		
	N	KGF	LBF
MMS-500	500	50	112
MMS-1000	1000	100	225
MMS-2500	2500	250	550
MMS-5000	5000	500	1125

FMS Series Force Measurement Testing Frames

MMS Series are ideal for small work areas. Their quiet operation making them ideal for the R&D, Quality or Engineering laboratories

MMD and MMS Material Testing Frames
Capacities from 500N (112lbf) to 50kN (11,250lbf)

MMD Series Dual Column Test Frames

The MMD Series are dual column testing frames available in three capacities.

Model	Load Capacities		
	N	KGF	LBF
MMD-10K	10,000	1000	2250
MMD-30K	30,000	3000	6750
MMD-50K	50,000	5000	11,250

FMD Series Testing Frames

MMD Series are rugged, yet quiet testing frames perfect for the R&D, Engineering and Quality laboratory or where you need extra load capacity.

Whether your application uses the MMS or MMD Series testing frames, your L3 material testing software performs identically for both models.

MMD-50K Series Testing Frame
(50kN, 5000 Kgf, 11,250 lbf)

1.1.2 Load Cell Sensors

Starrett offers a wide range of load cell sensors from maximum precision ULC Series to our FLC "Economy" Series. Your application and your measurement requirements will dictate which sensor is best for your application.

NOTE
All Starrett load cell sensors are supplied with a NIST-traceable Certificate of Calibration.

NOTE
All sensors are "plug & play" and comply with IEEE 1451.4.

NOTE
All sensors meet or exceed ASTM E4, BS 6110, DIN 51221, ISO 7500-1, EN10002-2 and AFNOR A03-501 standards when calibrated on-site by an authorized Starrett service representative.

ULC Series Load Cell Sensors

ULC (Ultra) Series load cell sensors are designed specifically for demanding material testing applications. These low-profile style sensors feature excellent measurement performance to 0.02%. They are supplied with base adapters that ensure precise alignment to the crosshead and load string. ULC Series sensors are temperature and barometric pressure compensated with a safe overload rating of 150% FS. Ideal for tensile or compressive testing. ULC Series are available in the capacities listed below.

Model	Load Capacities		
	N	KGF	LBF
ULC-1500	1500	150	337
ULC-2500	2500	250	562
ULC-5000	5000	500	1125
ULC-10K	10,000	1000	2250
ULC-25K	25,000	2500	5620
ULC-50K	50,000	5000	11,250

ULC Series Ultra Performance Load Cell Sensors

MLC Series Load Cell Sensors

MLC Series are low-profile style load cell sensors ideal for material test or force measurement applications. They feature low full scale deflection with excellent measurement performance to 0.04%. MLC Series sensors are temperature compensated and feature a 150% safe overload rating. Ideal for use on FMS, FMD, MMS or MMD Series testing frames.

| Model | Load Capacities | | |
	N	KGF	LBF
MLC-125	125	12.5	28
MLC-250	250	25	56
MLC-500	500	50	112
MLC-1000	1000	100	225
MLC-1500	1500	150	337
MLC-2500	2500	250	560
MLC-5K	5000	500	1125
MLC-10K	10,000	1000	2250
MLC-25K	25,000	2500	5620
MLC-50K	50,000	5000	11,250

MLC Series Material Test Load Cell Sensors

FLC Series Load Cell Sensors

FLC Series load cells are available in three types: Premium Series, Sealed Series and Economy Series. These S-beam sensors are temperature-compensated, full-bridge resistance sensors ideal for force measurement applications.

Starrett premium FLC Series load cell sensors feature a 1000% safe overload protection. Available capacities are listed below.

| Model | Load Capacities | | |
	N	KGF	LBF
FLC-05P	0.5	0.05	0.1
FLC-1P	1	0.1	0.2
FLC-2P	2	0.2	0.5
FLC- 5P	5	0.5	1
FLC-10P	10	1	2
FLC-25P	25	2.5	5
FLC-50P	50	5	11
FLC-100P	100	10	22
FLC-250P	250	25	56

FLC Series PREMIUM Load Cell Sensors

Starrett sealed FLC Series load cell sensors are environmentally sealed making them more suitable for applications where dirt, dust and other environmental conditions may be present.

| Model | Load Capacities | | |
	N	KGF	LBF
FLC-500	500	50	112
FLC-1000	1000	100	225
FLC-2000	2000	200	450
FLC-2500	2500	250	560
FLC-5K	5000	500	1125
FLC-10K	10,000	1000	2250
FLC-20K	20,000	2000	4500

FLC Series SEALED Load Cell Sensors

Starrett economy FLC Series load cell sensors are ideal for most force measurement applications and feature a safe overload of 150% FS.

| Model | Load Capacities | | |
	N	KGF	LBF
FLC-50E	50	5	11
FLC-100E	100	10	22
FLC-200E	200	20	45
FLC-500E	500	50	112
FLC-1000E	1000	100	225
FLC-2000E	2000	200	450
FLC-2500E	2500	250	560
FLC-5000E	5000	500	1125

FLC Series ECONOMY Load Cell Sensors

MLC Series Load Cell Sensor

1.1.3 Test Fixtures

Starrett offers hundreds of different types of testing fixtures for tensile, compressive, flexural, shear, cyclic, peel, and friction testing.

1.1.4 L3 Series Computer Workstation

Our L3 Series material test software operates on Windows®-based all-in-one personal computers with touchscreen functionality. The software may also be used on non-touchscreen computer systems.

> **NOTE**
> Starrett recommends using an all-in-one desktop computer system with touchscreen functionality and a minimum vertical display resolution of 1080p.

1.2   L3 Series Material Test Software

L3 Series software is designed to fulfill the needs of the technician, engineer and manager having responsibilities for accurate testing of all types of material, components and products.

L3 Plus Series software has four basic functional components:

- Test Setup
- Test Performance
- Test Analysis
- Data Management

MMD Series operating with L3 Series Software on L3 Workstation

Test Setup

You can build your force measurement test using templates based on commonly performed test methods, or using the powerful, yet easy to use L3 Test Builder application.

With the L3 Test Builder application, you construct your test using steps. There are a set of step types for tension, compression, holds, cycling and more. Steps have attributes that you configure such as limits and speed, plus exceptions that cause the test to stop if an event occurs. With the L3 Series software you can construct simple single step tests, e.g. go to a break, or you can create sophisticated multiple steps tests such as go to a limit, hold, go to the next limit hold, end when the sample breaks or the time duration ends.

Test Performance

Performing an L3 Series test is as simple as pressing a push button. Once you create your test, or select the test setup from your directory of tests, just select START TEST on the touchscreen or press the Start/Stop push button on your test frame. The test will begin. You may stop your test at any time by selecting the STOP TEST target or by pressing the Start/Stop push button on your test frame. You may also PAUSE a test to remove an extensometer prior to sample break if necessary.
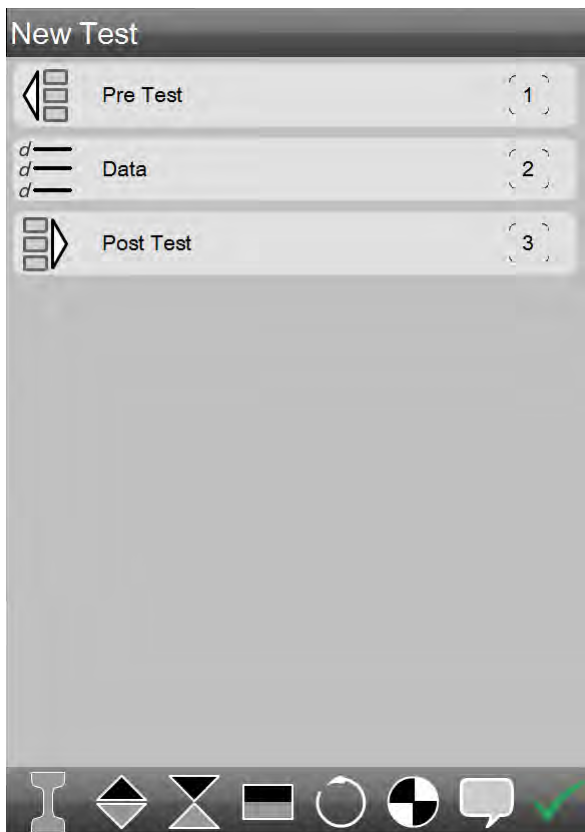

Start//Stop Test Soft Targets on Controller View
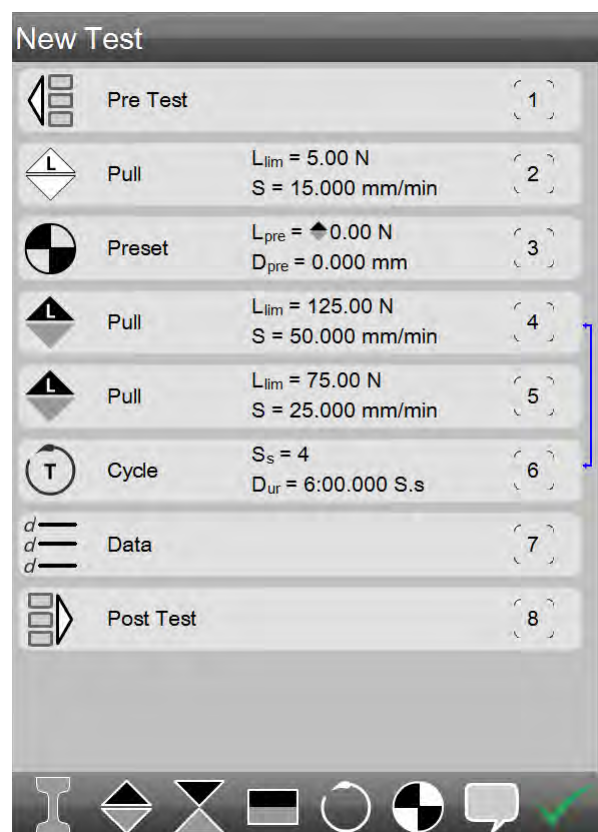*No Extensometer being used*
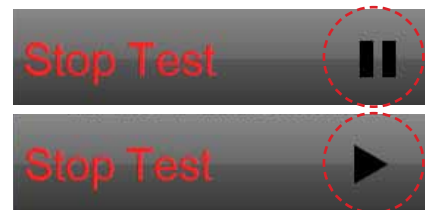
Pause

Re-Start

Start/Pause/Stop Test Soft Targets on Controller View
Pause is available since an Extensometer is being used

Pre Test		1
Data		2
Post Test		3

Single Step L3
Test Setup

Pre Test		1
Pull	$L_{lim} = 5.00$ N $S = 15.000$ mm/min	2
Preset	$L_{pre} = 0.00$ N $D_{pre} = 0.000$ mm	3
Pull	$L_{lim} = 125.00$ N $S = 50.000$ mm/min	4
Pull	$L_{lim} = 75.00$ N $S = 25.000$ mm/min	5
Cycle	$S_s = 4$ $D_{ur} = 6:00.000$ S.s	6
Data		7
Post Test		8

Multi-step L3
*Test Setup*

Test Analysis

Test analysis is a strength of L3 Series software. Rather than requiring you to specify the results you need prior to performing your test (which you can do in L3 Plus if you'd like), you can also analyze your test using special graphical analysis tools using your graph trace that was created.

You can select points on the trace and get stress, strain, load, distance or time measurements. You can specify a point by requesting the stress measurement at 100mS after the maximum stress was measured. You can specify any point, using any method you desire for your complete test or for a segment or segments within your test.

You can find the elastic modulus with a single press on your stress-strain curve. You can use tangent slope or chord slope to determine the stress-strain values anywhere on your curve. You can determine the rate of change and determine the spring rate for a spring using the curve.

If you are performing a peel test, you can specify the criteria of a peak and find the first peak that meets that criterion; you can count peaks; you can average peaks; you can measure the delta load from one peak to another peak.

Test analysis is easy to perform and your measurements can be displayed in the Results view, on your graph or in your detailed Data view. You can apply tolerances on your results and your results will display differently showing you were a result is "out of tolerance".
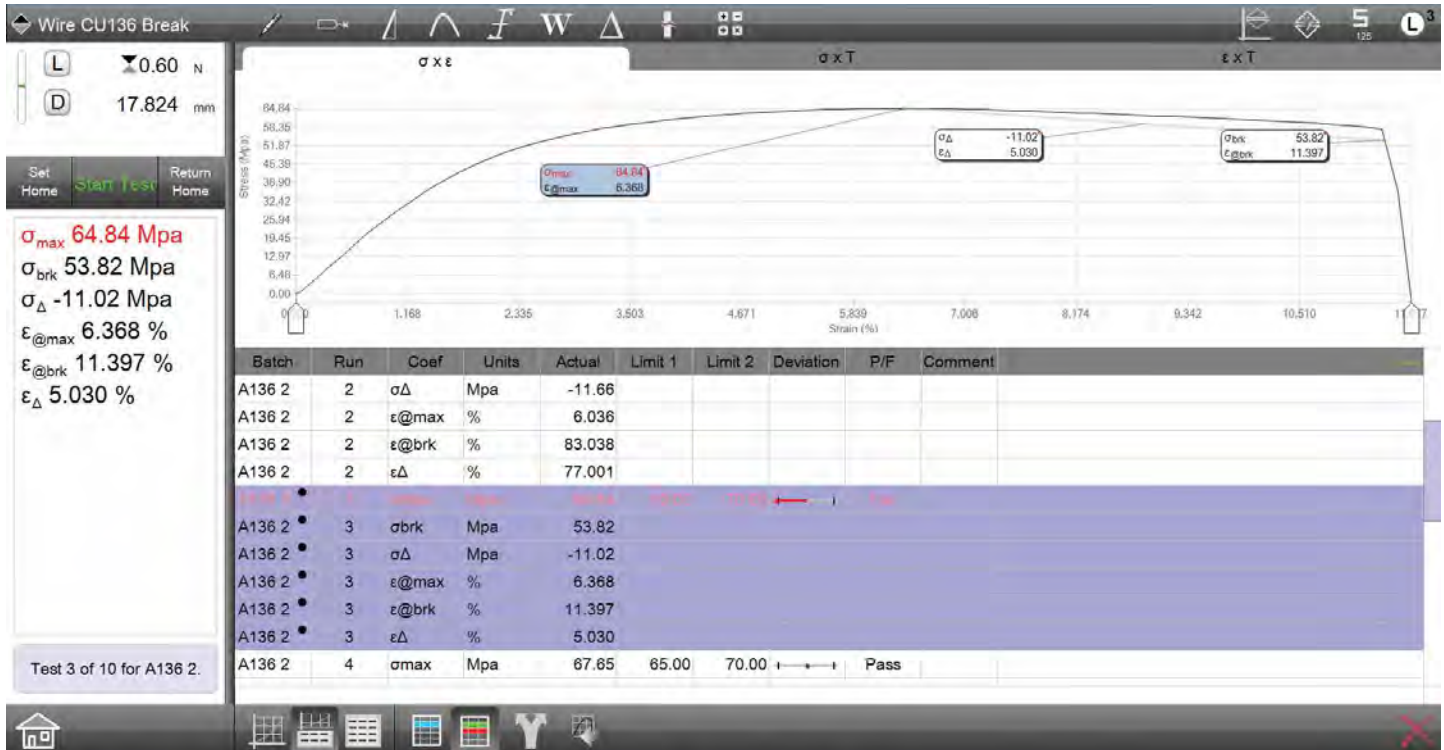
L3 Graph-Data view
Break test result showing graph and data view with Tolerance

Data Management

L3 Series systems can sample data at a rate up to 2000Hz. During the test, data is captured and used to draw the stress-strain-time curves in real time. Least squares fit is used to eliminate noise and provide you with an accurate depiction of your test graphically with the supporting data saved in a .csv format.

You can export results or export your entire data stream to a designated location, including on a network if your system is connected to your company's LAN. Data can be exported automatically at the completion of a test or you can copy and paste the data file for a batch or for individual runs that comprise your batch.

You can export your data to Microsoft® Excel®, Access® or Word® for customized reports, or you can use our standard report formats included with your L3 Series software.

L3 Settings File Locations
Setup Exports to route automatically to Locations on your network
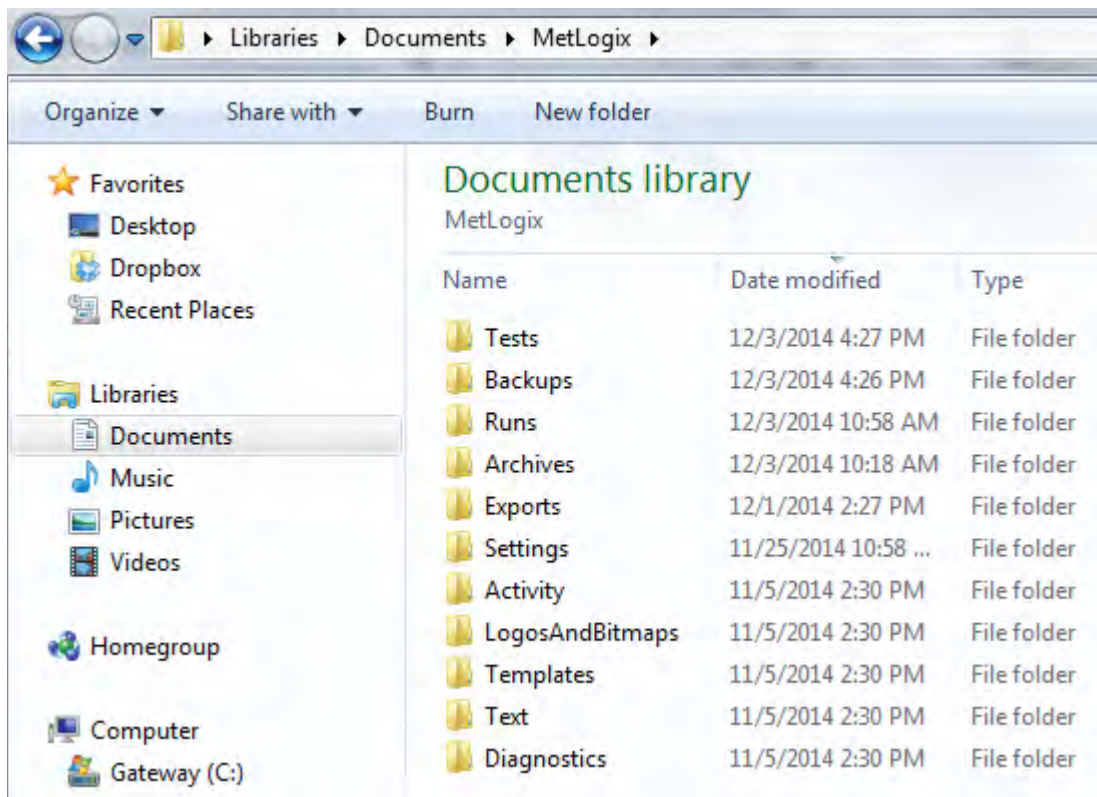
Metlogix Directory
Stores Tests, Results, Exports and other files locally on the Desktop Computer

1.2.1 L3 Series Software Architecture

L3 Series software is modular in its architecture. The basic L3 Series software includes the L3 Test Builder application. This application is used to created your test setups and to provide you with the various display views and report formats on which to measure and analyze your test results.

The L3 Automation Builder application is optional and must be ordered separately. The L3 Automation Builder application can be used to integrate ancillary equipment that uses analog and digital I/O. The L3 Automation Builder may also be used to incorporate command logic within your test setup (IF, ELSE)

1.2.2 L3 Test Builder Application

The L3Test Builder application is supplied with your L3 Series software. The L3 Test Builder lets you construct any type of test using a graphical configuration process that uses easy-to-understand steps.

All L3 test setup have four stages to their construction:

- Pre Test Stage
- Test Stage
- Data Stage
- Post Test Stage

Pre Test Stage

The Pre Test stage allows you to perform certain setup functions that you want to occur BEFORE the test is performed. Pre Test functions include establishing what units of measure are used; what data sampling rate to use; what load cell sensor to use for this particular test, and more.
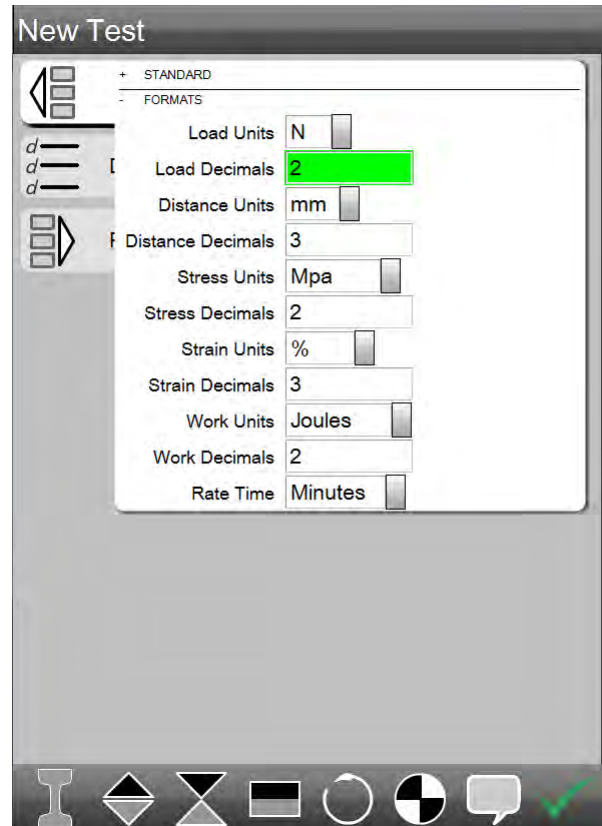
The Pre Test stage has two sections: Standard and Formats.

The Standard section is used to setup a variety of standard operating functions.

The Formats section is used to defined your units of measure and their associated display resolutions.
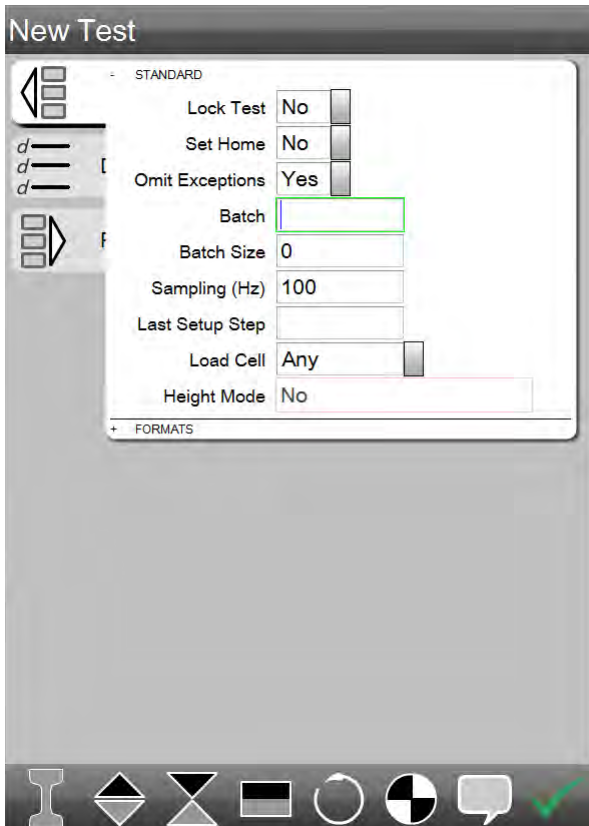
L3 Pre Test Stage
STANDARD options and attribute setup

L3 Pre Test Stage
FORMATS options and attribute setup

Test Stage

The Test stage is where you construct your test procedure. It uses different types of steps. Each step type has a set of attributes or options that you configure by entering a value or by simply enabling or disabling the option.

All L3 tests are performed by telling the crosshead to move to a load or distance value at a given velocity. Stress and Strain are not used for crosshead control since these are derived results. Load is determined by the load cell sensor while distance and velocity are measured for the test frame's encoder.

L3 Test steps are:

- Sample Definition Step (Material, Sample Dimensions)
- Tensile Step (Load, Distance, Break)
- Compression Step (Load, Distance, Break)
- Hold Step (Load, Distance)
- Cycle Step (Count, Duration, Loop)
- Datum Step (Load, Distance)
- Prompt Step (Ask, Tell)

For more information about L3 test steps, please read User Guide 3, Creating a Test.
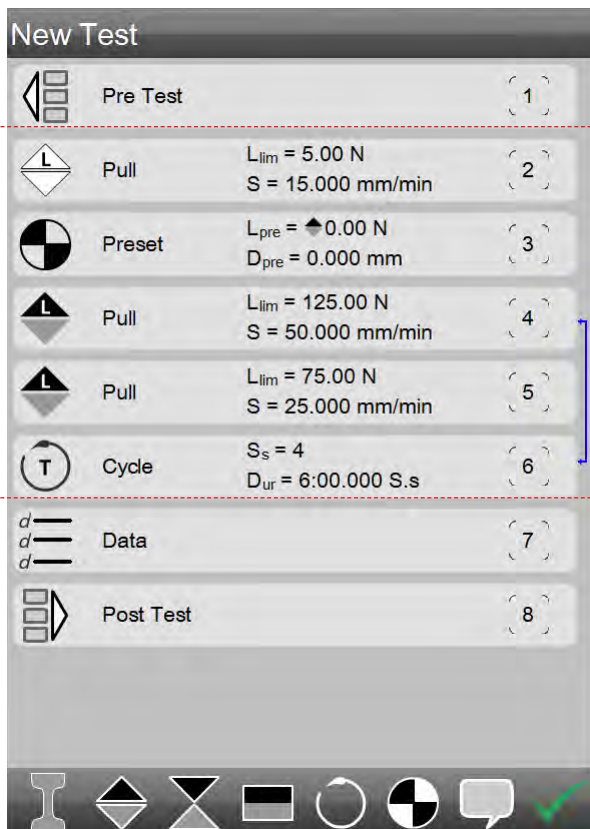
Data Stage

The Data Stage is where your measured results may be specified prior to performing the test and instead of using the graphic analysis tools. Your results can be specified before you perform your test, however, most users will find it easier to specify the results after the test is completed using the graph trace of the test. There are a wide variety of data types available, so you have virtually unlimited ways to find the result from your data stream and graph trace.
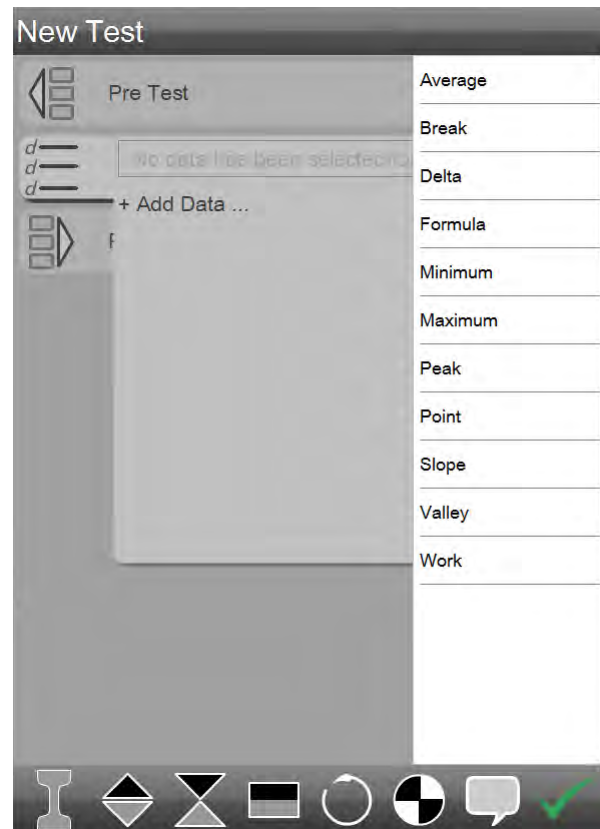

L3 Graph Analysis Tools
Located above the graph window

*Shows test steps used to construct a multiple step test setup.*

L3 Test Stage
Shows multiple step test setup

L3 Data Stage
Shows Data options for measurement

Post Test Stage

The Post Test stage are the options you have available that are preformed after the test has completed. The Post Test stage is used to define what data gets gathered and where the data is stored, whether locally on the workstation or archived to a network server, or transmitted to a location where another program may use the data for detailed quality control statistics and SPC functions.
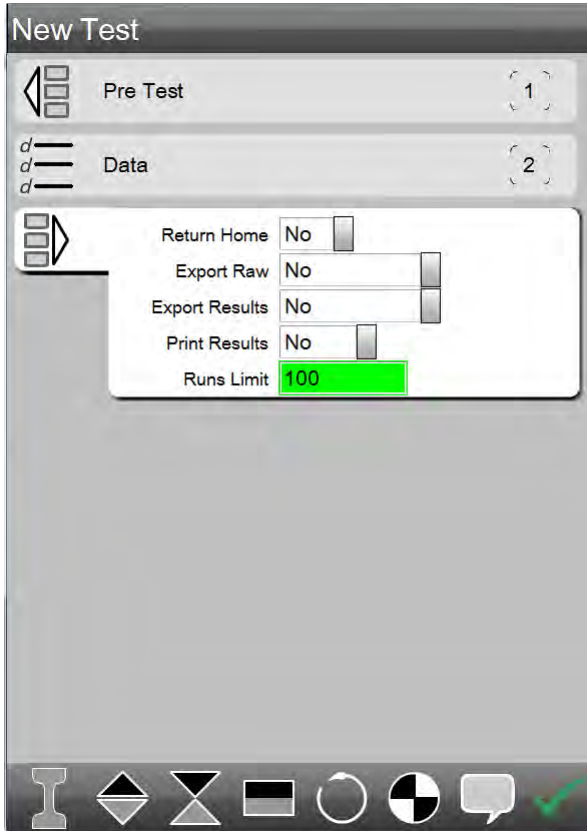
L3 Post Test Stage
Shows Post Test options and attributes

1.2.3   L3 Automation Builder Option

The L3 Automation Builder is a software option that may be purchased and added to your standard L3 Series material test system. It operates with the standard L3 Test Builder application.

The L2 Plus Automation Builder provides these added functions to your L2 Plus testing system:

- Utilize analog input and outputs;

- Utilize digital input and digital outputs;

- Use and incorporate command control logic functions to your test setups, e.g. If, Then, Else

With the L3 Automation Builder, you can add more sophisticated measurement and control functionality.

NOTE
The L3 Automation Builder is an optional "add-on" software application that may be used with your L3 Series system. This application is not provided standard and must be purchased separately.

NOTE
The functions, procedures and operations available with the L3 Automation Builder software are NOT discussed in this User Guide.

Shows digital output step using the optional Automation Builder application
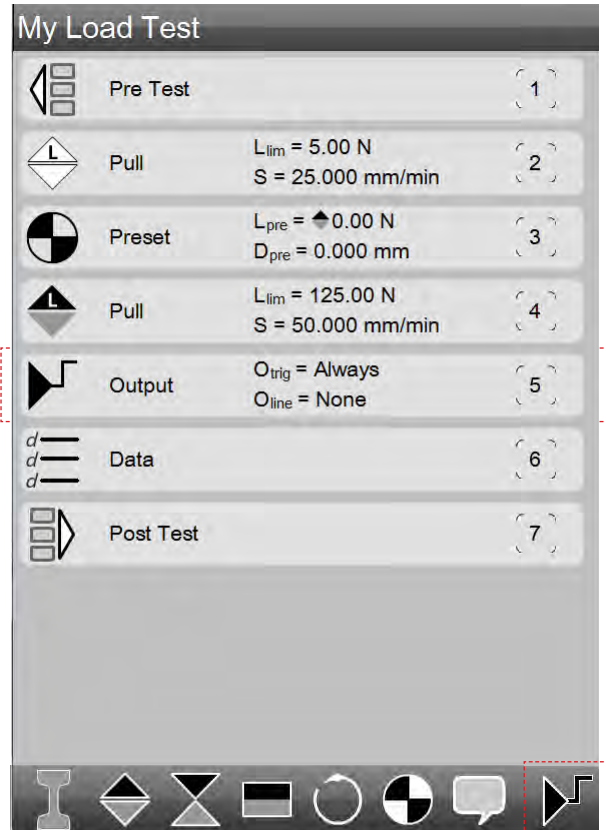
L3 Test Stage
Shows Digital Output step using optional Automation Builder

1.3   Installing L3 Series Software

L3 Series material testing software is installed by Starrett and checked to make sure that when your system arrives, all that is needed is to connect system components and power the system.

L3 Series software uses a Windows® operating system and is compatible with Windows 7 and Windows 8.

When the L3 Series software is installed, two (2) basic operations occur:

•   A shortcut is setup on the L3 workstation that is used to launch the L3 Series software;

•   The Metlogix directory is created, that resides on the L3 Workstation's Libraries/Documents location.

NOTE
L3 Series software should reside on an L3 Series Workstation that is dedicated to advanced force testing and used exclusively with a Starrett MMS or MMD test frames.

CAUTION
Anti-virus software may effect the operation of your L3 System- it can cause "USB heartbeat errors" between the workstation and the testing frame.

During testing operations, Starrett recommends that you deactivate anti-virus software if present on the work station.

1.3.1 L3 Series Software Registration

L3 Series software may be used with one (1) Starrett test frame. The software is security protected and is registered to the hardware the software is being used with.

Starrett does not supply additional licenses for our L3 Series software. Users must purchase an additional copy of the software if it is required to be used on another Starrett testing machine.

NOTE
Please make sure to register your software on-line at starrett.com. This ensures we have a way to send you software updates.

NOTE
Starrett does NOT sell additional licenses, nor does it allow that a single application be permitted to operate on multiple computers or workstations. Lx Series software from Starrett may reside on one workstation only.

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