Description: Load Calibration for Material Testing Systems

Reference Standard: ASTM E4-10

Reference Documents: Calibration Kit Certificates of Calibration (All artifacts)
Interface 9840 Digital Indicator User Guide CD

Equipment Necessary:
Starrett Calibration Kit containing the following items and with current and valid Certificates of Calibration traceable to NIST:

- Interface Model 9840 Digital Indicator
- Interface 1600 Series Load cell Sensors
- Deadweights for International Gravity
- Personal Computer with Load Calibration Worksheet (Excel Form)
- Mechanical Adapters: grip pins, clevis alignment spacers
- Digital Thermometer and Humidity Indicator

Personnel: Individuals who have received authorized training by The L.S. Starrett Company on this Work Instruction are certified to perform this Work Instruction.

Procedure:

1.0 Starrett Material Test System "Warm-up".

System should warm-up for at least 15 MINUTES before carrying out your calibration.

1.1 Connect the Starrett load cell to be calibrated to the Starrett Material Test Frame.

1.2 Place the Starrett load cell in a horizontal position on top of the test frame's crosshead to compensate for zero offset.

DO NOT INSTALL LOADCELL TO THE CROSSHEAD.

1.3 Turn Material Test Frame to ON using the power On/Off switch located on the test frame's back panel.

1.4 Turn on the Starrett user interface device (tablet or all-in-one personal computer) that is used with this Starrett load cell and material test system.

1.5 Set the Material Test frame's jog switch speed to **SLOW POSITION**.

1.5.1 On tablet devices using Starrett L2 software, select the arrow icons displayed on the tablet. Select until the arrows are shown with a thick line denoting SLOW SPEED mode.

1.5.2 On all-in-one personal computer devices using Starrett L2 Plus software, select the speed indicator icon in the upper tool bar until the pointer displays pointing to the left indicating SLOW SPEED mode.

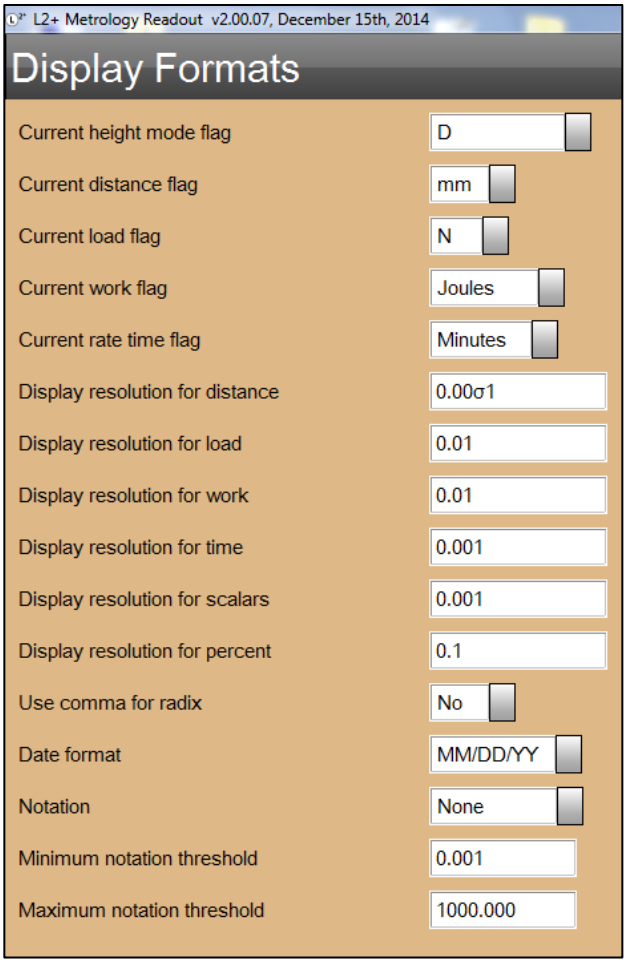
Procedure:

2.0 Lx System Settings Adjustments

Select Lx to setup SETTINGS prior to calibration.

IMPORTANT

It is recommended you use SI units for calibration, e.g. Newtons (N) for load and millimeters (mm) for displacement/distance. However, if your customer prefers USA/Imperial units, e.g. pounds-force (lbf) for load and inches (in) for displacement/distance, make the necessary changes as required on your Lx System and your Calibration Worksheet.



2.1 Select the Lx icon to display the Main Settings dialog.

2.2 Select the SETTINGS icon.

2.3 Select the DISPLAY FORMATS target to launch the Display Formats settings options.

2.4 Verify and change if necessary your Display Formats Setting.
Display Format settings should be:
- Current inch/mm flag = mm
- Current load flag = N

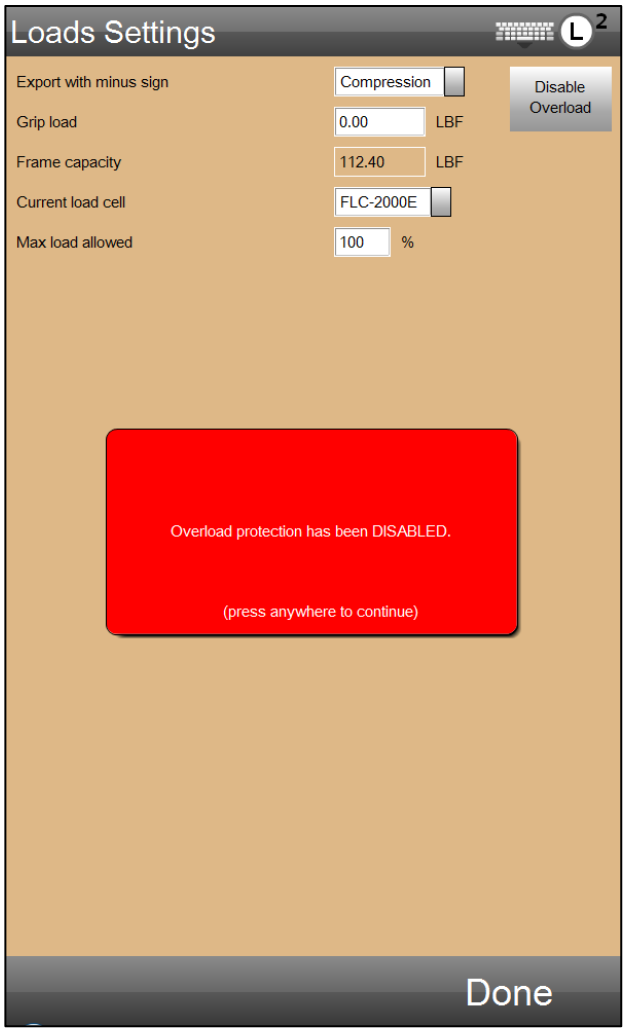
Select DONE on your Lx software. This will take you to the main Settings view again.

2.5 Select the LOADS target to launch the Load settings options.

2.6 Select the DISABLE OVERLOADS target.

IMPORTANT

Disabling Overloads removes all inherent protection on your Starrett Lx System. The Starrett load cell and the Starrett frame are no longer protected from damage due to overloading. **USE EXTREME CAUTION WHEN POSITIONING THE CROSSHEAD AND WHEN APPLYING A LOAD TO YOUR LOAD STRING.**



2.7 A dialog box will display asking you to "Enter overload password:"

2.8 Enter the Starrett password that permits you to Disable Overloads. This password was supplied to all authorized Starrett Service personal that are certified to perform Load Calibrations per this Work Instruction.

NOTE

If you do not know the Starrett password, contact Starrett Technical Support.

IMPORTANT

You should not continue with the calibration if you have not Disabled Overloads.

2.9 After you enter the Starrett Password, a message will display on the Lx System: "Overload protection has been DISABLED."

2.10 Select DONE. This will return you to the main Settings view.

Procedure:

3.0 Document your Calibration

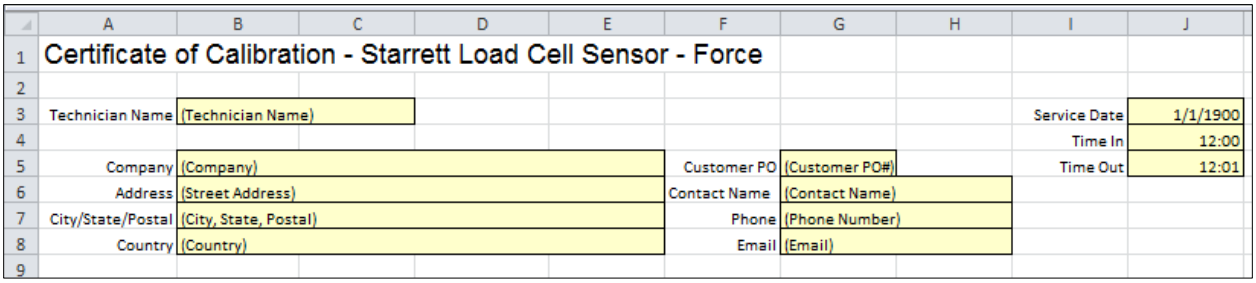
Setup on your Calibration Worksheet for Load per ASTM E4-10.

3.1 Record Starrett Service Representative information onto Calibration Worksheet. Enter the following:

- Technician Name
- Service Date
- Service Time In
- Service Time Out

3.2 Record the Customer information for your calibration. Enter the following on to your Calibration Worksheet:

- Company
- Address
- City/State/Postal
- Country
- Customer PO
- Contact Name
- Contact Phone
- Contact Email



	A	B	C	D	E	F	G	H	I	J
1	Certificate of Calibration - Starrett Load Cell Sensor - Force									
2										
3	Technician Name	(Technician Name)							Service Date	1/1/1900
4									Time In	12:00
5	Company	(Company)				Customer PO	(Customer PO#)		Time Out	12:01
6	Address	(Street Address)				Contact Name	(Contact Name)			
7	City/State/Postal	(City, State, Postal)				Phone	(Phone Number)			
8	Country	(Country)				Email	(Email)			
9										

3.3 Record the Instrument information for your calibration. Enter the following on to your Calibration Worksheet:

- Starrett Load cell being calibrated Model No.
- Starrett Load cell Serial No.
- Starrett Load cell FS Capacity
- Starrett Load cell Type (T, C or T/C)

NOTE

All Starrett load cells are calibrated in both directions T (tension) and C (compression), so you would specify T/C. If you are only calibrating one direction at the customer's request, enter the direction as either T (tension) or C (Compression).

- Starrett Test Frame Model No.
- Starrett Test Frame Serial No.
- Starrett Test Frame FS Capacity
- Starrett Test Frame FS Travel
- Starrett User Interface, specify interface is either a Tablet or an All-in-One (AIO) computer.
- Starrett Lx Type, specify the system as either: L2, L2Plus, S2, or L3 system.
- Lx Software Revision Number

	A	B	C	D	E	F	G	H
10	Instrument							
11	Load Cell Model	(Load Cell Model	Serial No.	(Serial Number)	FS Capacity	(FS Capacity (N))	Type	T/C
12	Test Frame Model	FMS-500	Serial No.	0004-A332-5FA8	FS Capacity	(FS Capacity (N))	FS Travel	380mm
13	User Interface	(Tablet/AIO)	Lx Type	(L2, S2, L2Plus, L3)	SW Rev	(SW REV.)	Firmware Rev	(Firmware Rev)
14								
15	Test Conditions							
16	Temp (F) Start	100	Humidity	100%	Local Gravity	9.7919 m/s2	Excitation	10V
17	Temp (F) End	100						

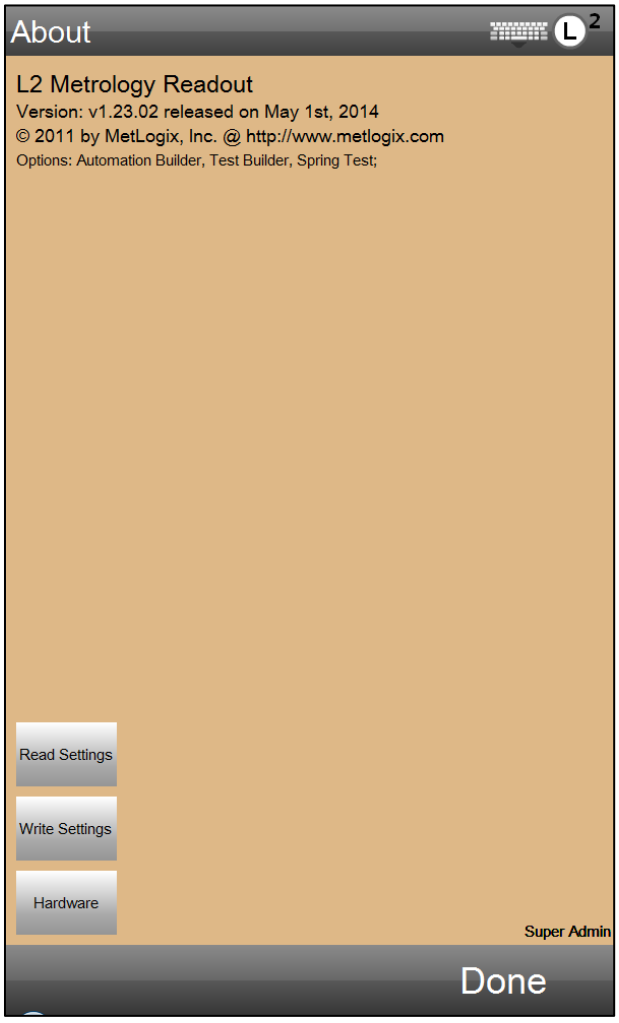
NOTE

Locate the Lx software revision level by selecting ABOUT at the main Settings page.

- Starrett Lx Firmware Revision Number

NOTE

Locate the Lx firmware revision level by selecting ABOUT at the main Settings view, the selecting the HARDWARE target.



3.4 Record the Test Conditions for the location where the calibration is being performed. Enter the following on to the Calibration Worksheet:

- Room Temperature

NOTE

Record the Room Humidity using the certified instrument supplied in your Calibration Kit.

- Room Humidity

NOTE

Record the Local Gravity using the certified instrument supplied in your Calibration Kit.

- Local Gravity

NOTE

The Excitation Voltage for all Starrett load cells and for the standard load cells is 10V.

- Excitation = 10V

3.5 Enter the Traceability information for all standards and artifacts being used for your calibration.

	A	B	C	D	E	F	G	H	I	J
21	Verification	Make	Model	Cal Agency	Cal Date	Due Date	ID	Units	Resolution	Accuracy
22	Load Cell	Interface	1600-1500N	NVLAP	5/17/2013	5/17/2014	123456	N	10,000:1	+/-0.05% FS
23	Distance Indicator									
24	Thermometer									
25	Humdity									
26	Clock									

IMPORTANT

All standards and artifacts must be the property of the L.S. Starrett Company and be a component within your Starrett Calibration Kit.

All standards and artifacts must be current, e.g. their calibration date must be within one year of the Last Calibration Date and before the Next Calibration Date.

Your Calibration Kit will include copies of the Certificate of Calibration traceable to NIST (or your local accrediting body). If these copies of the Certificate of Calibrations are not included in your Calibration Kit, contact Starrett Technical Support immediately for this information.

3.6 Enter the Calibration Test Method and Standard being used for the calibration. The recommended standard is ASTM E4-10; however, other recognized standards and methods that are identical or reciprocal to the ASTM standard may be used.

- Test Method being used = ASTM (may differ in locations outside the USA)
- Standard = E4-10 (may differ in locations outside the USA)

3.7 Enter Verification Identification of Artifacts/Standards used in this calibration. Each standard or artifact used must have the following information:

- Make (Manufacturer)
- Model Number (Manufacturer's Model Number)
- Cal Agency (the agency that calibrates this standard or artifact for the L.S. Starrett Company)
- Cal Date (the current Cal Date located on the Certificate of Calibration)
- Cal Due Date (the date when the standard or artifact is due for re-calibration and certification)
- Standard or Artifact Identification Number (ID is the serial number of the device located and recorded on its Calibration Certificate).
- Cal Units of Measure (what the units of measure are that the standard or artifact was calibrated with, if recorded).
- Standard or Artifact Resolution (identify the standard or artifacts resolution capability recorded on its Calibration Certificate).
- Accuracy of the Standard or Artifact as stated on the Certificate of Calibration.

Record the Verification Identification information for each of the following standards or artifacts that are possibly used for this Work Instruction:

- Standard 1600 Series Load cell
- Standard Deadweights info (if used)
- Standard 9840 Digital Indicator
- Standard Thermometer
- Standard Humidity Reader
- Standard Clock used for Time

Procedure:

4.0 Document the Load Calibration Points

Select the load cell from the drop down list, the Load Calibration points will automatically populate on to the Calibration Worksheet

	A	B	C	D	E
28	Select Load Cell Size (N) from drop down list:			Select Load Cell	
29	Load Measurement			1500	SETUP
30	Direction	Points	Target	2000 2500 5000 10000 25000 50000 Select Load Cell	Observed
31	Tension	1	-		
32	Tension	2	-		
33	Tension	3	-		
34	Tension	4	-		

NOTE

Lx systems have ten (10) calibration points for both the tensile direction and compression direction. So there are a total of twenty (20) possible points, plus Zero for a standard force measurement calibration.

Procedure:

5.0 Starrett Load cell Zero Offset

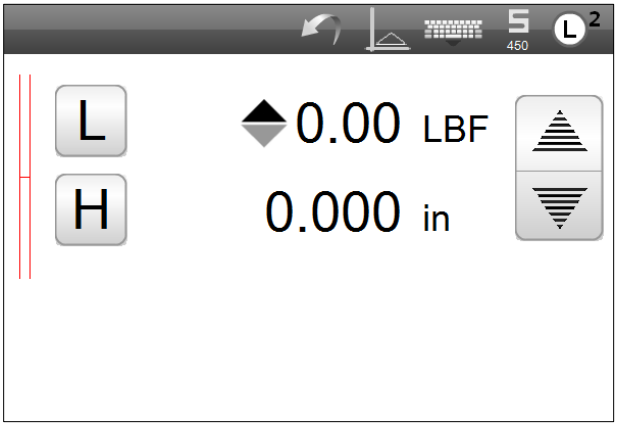
This procedure will zero any offset that may be present on the Starrett load cell prior to calibration.

NOTE

Perform the Zero Offset step after the 15 minute "warm-up" period.

6.1 Remove the clevis assembly from the Starrett load cell being calibrated.

6.2 Position the Starrett load cell so that it is lying horizontally on the top of the test frame's crosshead.



Procedure:

7.0 Corrections Settings Adjustments

Verify your LOADCELL CORRECTIONS settings by selecting the CORRECTIONS target on the main Settings view.

7.1 Go to the Lx LOADCELL CORRECTIONS setting.
- Select the Lx icon on the Home view.
- Select the Settings icon.
- Select the CORRECTIONS setting.

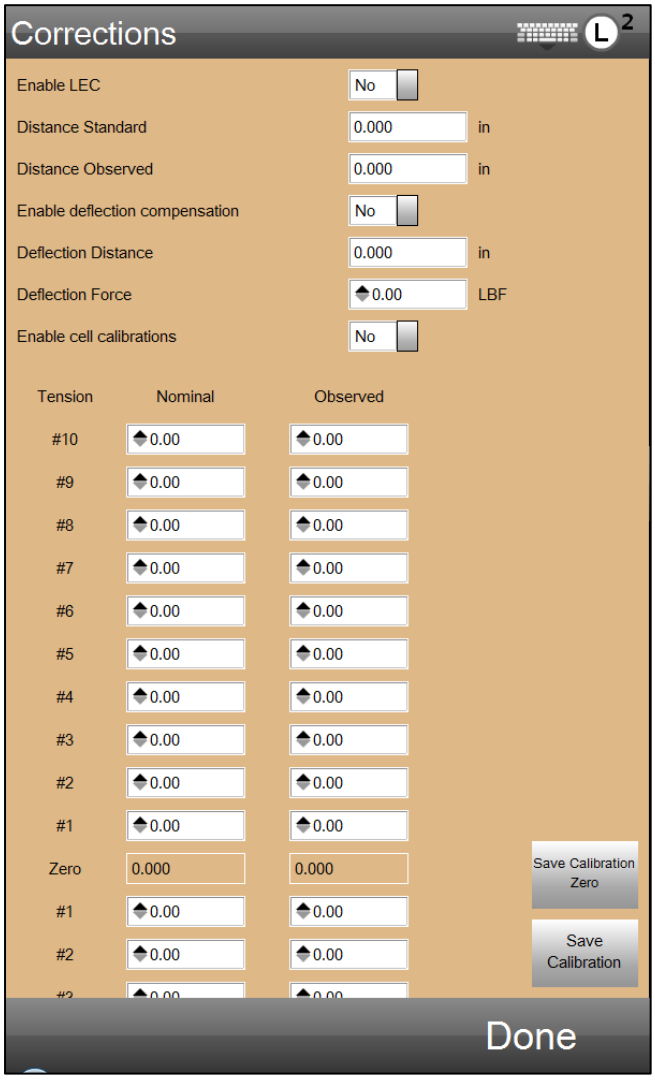
7.2 Verify the Corrections currently set for your Lx System. They will read as follows:
- Enable LEC = No
- Distance Nominal = 0.00mm (Note: this may have a value if corrections were made at the last calibration).
- Distance Observed = 0.00mm (Note: this may have a value if corrections were made at the last calibration).
- Enable deflection compensation = No (Note: if this is enabled “YES”, change to “NO”.
- Deflection Distance = 0.00mm (Note: change to 0.00mm if a value is present)
- Deflection Force = 0.0N (Note: change to).0N if a value is present)
- Enable cell calibrations = No

Select DONE

7.3 Zero the LOAD on the Starrett load cell by selecting the L target on the user interface, e.g. tablet or AIO computer.

7.4 Return to the Corrections Screen and Press SAVE CALIBRATION ZERO

Select DONE



Procedure:

8.0 Measure Calibration Points - TENSION

8.1 Mount the Starrett load cell to the cross head and thread in the hanging weight hook

8.2 Zero the Lx software by pressing L on the DRO

IMPORTANT

Never handle more than 1 dead weight at a time

When not hung on the load cell weights must be returned to the case NEVER left on a bench or other work surface

8.3 Hang the first weight on the hook mounted on the load cell, wait for the Lx load reading to stabilize

8.4 Record the first tensile reading of the dead weight (nominal) and the measured value on the Lx system DRO (observed) into the calibration worksheets for Setup Run, Point 1

8.5 Record the first tensile reading of the dead weight (nominal) and the measured value on the Lx system DRO (observed) into the calibration worksheets for Setup Run, Point 2

8.6 Repeat for all necessary points as indicated on the Calibration Worksheet

8.7 Repeat for Runs 1 through 3

Procedure:

9.0 Measure Calibration Points – COMPRESSION

9.1 Mount the Starrett load cell upside down on the top of the crosshead, thread in centering cone and hang the load cell box & hook.

9.2 Zero the Lx software by pressing L on the DRO

IMPORTANT

Never handle more than 1 dead weight at a time

When not hung on the load cell weights must be returned to the case NEVER left on a bench or other work surface

9.3 Hang the first weight on the hook mounted on the load cell, wait for the Lx load reading to stabilize

9.4 Record the first compression reading of the dead weight (nominal) and the measured value on the Lx system DRO (observed) into the calibration worksheets for Setup Run, Point 1

9.5 Record the first tensile reading of the dead weight (nominal) and the measured value on the Lx system DRO (observed) into the calibration worksheets for Setup Run, Point 2

9.6 Repeat for all necessary points as indicated on the Calibration Worksheet

9.7 Repeat for Runs 1 through 3

Procedure:

10.0 Complete the Calibration Worksheet for All Calibration Runs 1, 2 and 3.

Make sure all Nominal and Observed measurements for Tension and Compression, for all four (4) Runs, have been entered accurately into the Calibration Worksheet.

10.1 Double verify all values entered into Calibration Run 1, Calibration Run 2 and Calibration Run 3 for each Calibration Point. The Calibration Worksheet will automatically calculate the Error (N) and the Error (%).

10.2 The Calibration Worksheet will calculate the Corrections to be used for the Starrett load cell. The Corrections for the Starrett load cell are an average of Calibration Runs 1 and Calibration Runs 2. Calibration Run 3 is important because it is used to calculate the Uncertainty Statement that will appear on the Certificate of Calibration for the Starrett load cell.

10.3 Percent Error greater than 10% could be a result of an improper calibration or a damaged load cell which may not be possible to calibrate. A well preforming load cell should be less than 1%.

Procedure:

11.0 Enter Calibration Nominal and Observed values into the Lx System's CORRECTIONS setting for the Starrett load cell that was calibrated.

Use the calculations performed in your Calibration Worksheet to enter the Correction values for each of your calibration points.

11.1 Go to the Lx System's CORRECTIONS setting.

11.2 Enter the NOMINAL values at each calibration point for Tension and Compression.

IMPORTANT

The Nominal values are the values recorded and taken from the 9840 Digital Indicator.

12.3 Enter the OBSERVED values at each calibration point for Tension and Compression.

IMPORTANT

The Observed values are the values recorded and taken from the Lx System.

12.4 Select the SAVE CALIBRATION button.

12.5 Change the "Enable cell calibrations" option to YES.
- Select DONE.
- Select DONE.

12.6 Power cycle your Lx System as follows:
- Log out of your Lx software.
- Turn power OFF on your Lx test frame.
- Wait 10 seconds before power-up.
- Power-up your Lx test frame.

- Launch you Lx software.

12.7 Verify that the Field Calibration Date displayed when selecting the load cell icon on your Lx System is displaying the calibration date that the Starrett load cell was just calibrated on.

12.8 Verify that no zero offset is present on the calibrated Starrett load cell. The bar graph should not display green at either the tensile or compressive directions with no load applied. A very slight green line indication is acceptable; however, a larger green bar indicates a zero offset problem which may mean:
- the load cell must be re-calibrated
- the load cell is physically damaged and must be replaced if another calibration does not remove the indication
-Greater than 10% of the bar could indicate either an improper calibration or a permanently damaged load cell

Procedure:

13.0 Take as Left readings

Repeat Steps 1, 2, 8, 9 and 10
Record As Left reading on calibration sheet

Procedure:

14.0 Affix Calibration Sticker to Lx System

Once all calibration information is recorded and securely saved, the Starrett technician can complete the Calibration Sticker.

15.1 Prepare the Starrett Calibration Sticker as follows:
- Enter the Calibration Date
- Enter the Starrett Technician's Name (Print)
- Enter the Starrett Technician's Signature

15.2 Remove any existing Calibration Sticker.

15.3 Place the Calibration Sticker where it can be easily viewed. The Calibration Sticker must be firmly affixed to the Starrett Load cell.

Procedure:

16.0 Submit Calibration Worksheet to Starrett for Certificate of Calibration Document for Customer.

In order for a Certificate of Calibration to be prepared for your customer, you must save your Calibration Worksheet with data and submit via email to L.S. Starrett.

The information on your Calibration Worksheet will be used to generate and print the Certificate of Calibration for this load cell for your customer.

The Certificate of Calibration will be mailed to your customer contact within 48 hrs.

Starrett will retain the Calibration Worksheet for your customer and this calibration service, and Starrett will retain a pdf of the Certificate of Calibration for this load cell. The pdf will be identified as an "Uncontrolled Document" using a watermark.

IMPORTANT

The Calibration Worksheet with data should be archived in a secure, password-protected area, e.g. server, cloud, etc. The Calibration Worksheet with data should be archived for three (3) years.