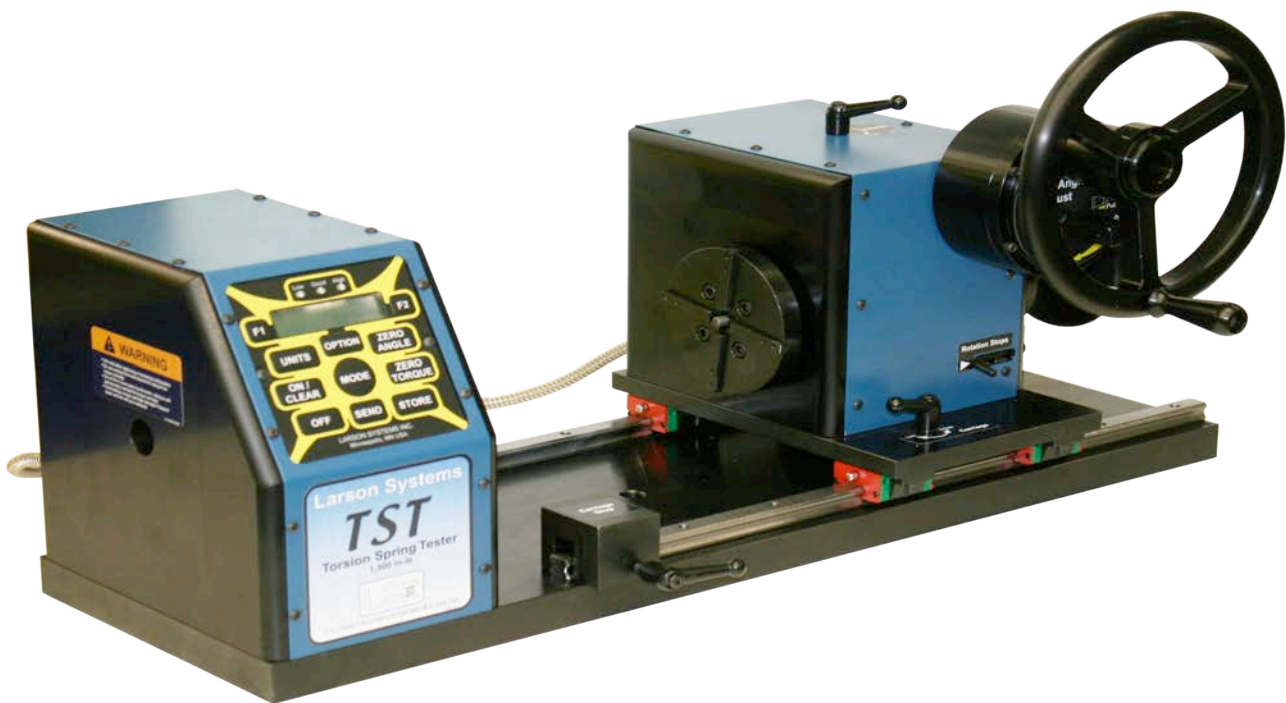# Larson Systems Inc.

Torsion Spring Tester
User Manual
Covering the TST 200 and TST 1300

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About This Manual

This manual could contain technical inaccuracies or typographical errors. Changes are periodically made to the information contained herein. These changes will be incorporated in new editions of the manual.
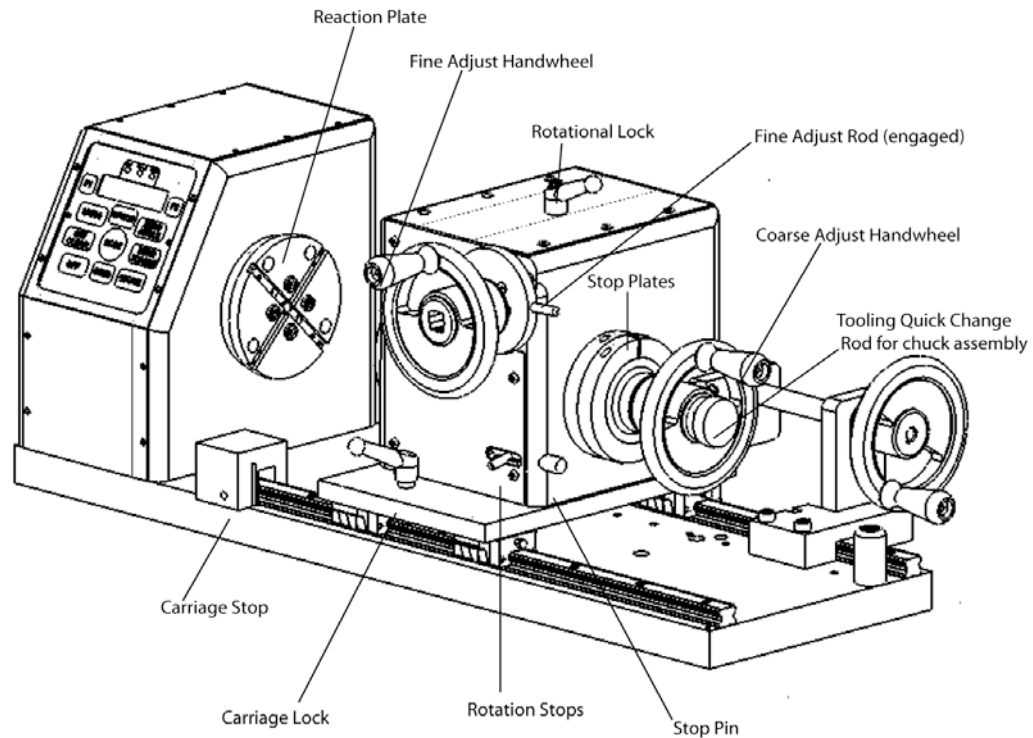
Table of Contents

1 INTRODUCTION

The TST 200 is a manually-operated torque / angle tester available in six force ranges: 0.3, 3, 25, 100 and 200 in-lb. The TST 1300 is available 0.3, 3, 25, 100, 200, 500 and 1,300 in-lb force ranges. The solid steel base and durable aluminum frame can stand up to many different testing environments. NIST traceable certificate of calibration is standard on all LSI testers including the TST.

1.1 Features

1.1.1 Absolute Zero

Take the guesswork out of testing with LSI's revolutionary absolute zeroing technique. Used with custom interchangeable tooling, this technique improves repeatability of setups and results during testing. Parts are measured against the nominal dimensions according to the drawing or specifications, not to a relative point requiring intuition and guesswork.

Mandrel size made to 80% of free state or per customer specification

Mandrel & wear surfaces hardened to RC 60/62

Stamped with your part number

LSI angle zeroing is accurate to ± 0.1°

1.1.2 Interchangeable Tooling

- Machine tooling blanks ready to mount on our reaction plate
  Designed to allow you to do custom tooling quickly and inexpensively without complex machining.
- Custom tooling is used for repeating parts or specific spring "types" or "families."
- 30-second changeovers without tools from type to type.
- Identical setups each time.
- Enhanced repeatability.
- Pre-machined blanks make tooling inexpensive and standardized.
- Standard angle zeroing built into the fixture--setup within ± 0.1° every time.
- Better data matching between source and user because of standardized testing and tooling.
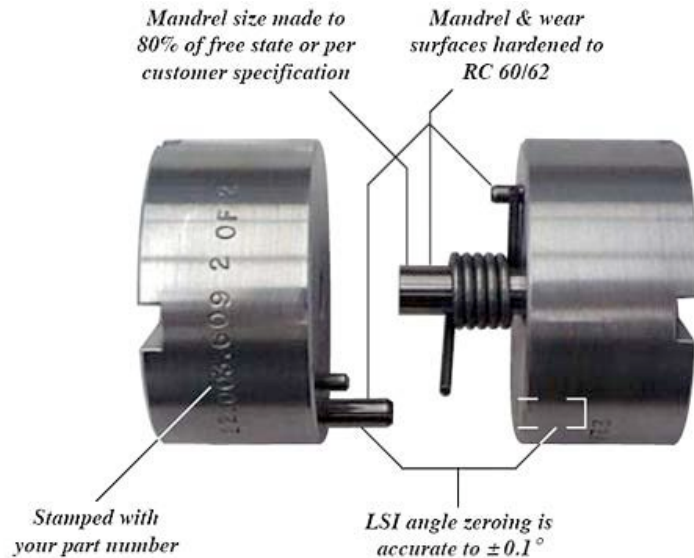
1.1.3 Rapid Changeovers

Change custom and universal tooling in seconds and maintain your repeatability and reproducibility. Make setups within ± 0.1 degree of accuracy.

1.1.4 Digital Control Panel

The TST has a built-in mean, standard deviation, range, statistical summary and data logger that can store up to 1,800 test points. It also has automatic deflection compensation, which corrects for torque windup and always displays accurate angle measurements. Soft keys give you access to digital calibration, linearization and features such as user-programmable force filter, programmable length offset, user-customized print headings, automatic calculation of mean, standard deviation and range of data. Use the standard RS 232 port for statistical printouts or talking to a PC. It works great with LSI's SSS, a PC-based Statistical & Spreadsheet Interface Software, which features dynamic data exchange, allowing you to communicate to spreadsheets such as Excel. Measure torque in in-lb, N-mm, gm-mm, kg-m, in-oz, ft-lb, N-m, kg-mm and kg-cm.

1.1.5 Three Rotational Stops

For repetitive applications requiring multiple test points on a given spring, the Torsion Spring Tester comes equipped with three stops that can be preset to a given angle.

1.1.6 Battery or 115V AC Powered

Tester includes an internal, rechargeable battery pack (approximately 8-10 hours of continuous operation), and a 115V AC charger.

1.1.7 Loading Capability

The TST 200 comes standard with two cranking ratios, giving the operator testing flexibility. Use the 1:1 ratio for light springs or coarse movements. Choose the 40:1 micro adjust feature to fine-tune measurements.

1.1.8 Interchangeable Torque Cartridges

Switch from one torque cartridge to another in just minutes, allowing you to use a single tester to test a wide range of capacities quickly and accurately. Lower capacity torque cartridges have an overload-preventing lock mechanism. Interchangeable Torque Cartridges with different force ranges are available: 0-.3 in-lb, 0-3 in-lb, 0-25 in-lb, 0-100 in-lb, 0-200 in-lb, 0-500 in-lb and 0-1300 in- lb.

1.2 Options

1.2.1 Limit Lights / Statistical Analysis

Offered as an option, these features specify a range or tolerance in load or deflection angle. With the convenient LED light indicators as a guide, you can determine if the item tests low, good or high. Print a full statistical analysis clearly showing the results.

1.2.2 Universal Tooling Assembly
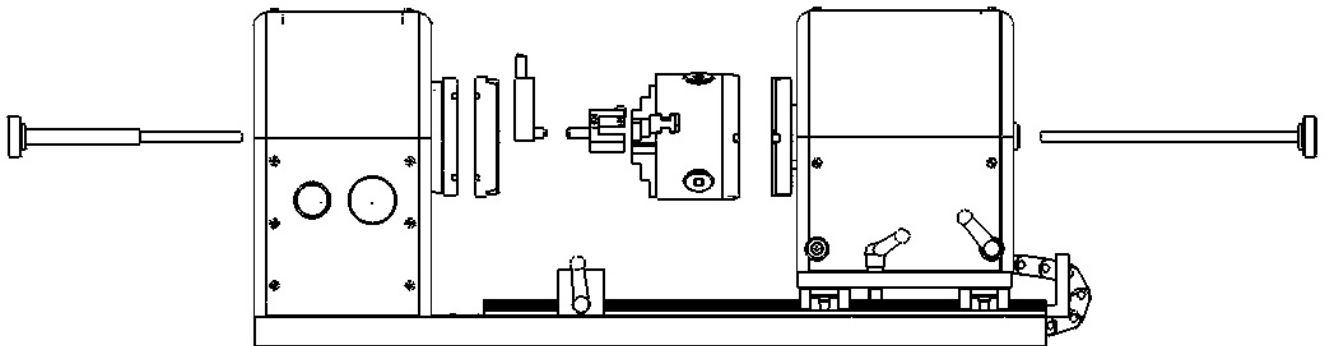
Test many parts without special fixtures. Great for unique or one-time job runs with a minimum of setup time.
- 2", 3" & 4" universal fittings.
- A conventional approach that has good flexibility in making setups.
- Includes chuck, mandrel set to 17/32" diameter, and reaction plate.

1.2.3 Two Point with Rate

Two Point With Rate is a tester software feature that allows you to calculate the rate (or spring constant) between two points. A PC is not needed to run this software.

1.2.4 Automatic Spring Rate Calculation

Two-point testing with automatic spring rate calculation. Test it, then print out a statistical summary.

1.2.5 Other options
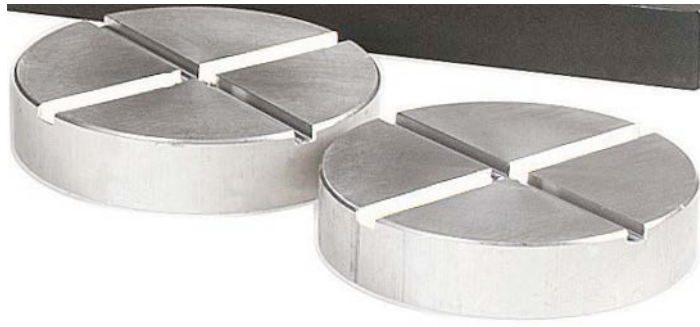
- Custom Tooling Blanks.
- Calibration Core Sets.
- Calibration Weight Sets.
- Vibration Damping Pad.
- Tester dust cover.
- SSS, computer statistical software. Histograms, X-Bar, R-Bar charts via computer.

1.2.6 Printer

Epson Stylus C88+ inkjet printer prints single-feed 8.5" x11" paper. Laser sharp text.

Printout example:

Your Company Name
Anytown, USA

Larson Systems Inc. Tester

Model : Torsion Tester

Version Number : 4.25

Load Cell : 3 in lb

Operator: _____

Manual Mode

Test l Number l	Angle (degrees)	Torque (in lb)	Date (mm/dd/yyyy)	Time (hh:mm:ss xm)
1 l	1.8	1.404	04/10/2009	06:29:28 am
2 l	3.7	1.472	04/10/2009	06:29:32 am
3 l	6.0	1.582	04/10/2009	06:29:34 am
4 l	8.7	1.622	04/10/2009	06:29:36 am

END OF DATA

SUMMARY DATA

	Angle (deg)	Torque (in lb)
Mean	5.05	0.26635
Standard Deviation	2.98	0.12106
High Range	8.7	0.4188
Low Range	1.8	0.1380
Range	6.9	0.2808

END OF SUMMARY

1.3 Control Keypad

The TST has built-in mean, standard deviation, range, statistical summary and a data logger that stores up to 1,800 test points. It also has automatic deflection compensation, which corrects for torque windup and always displays accurate angle measurements. Soft keys give you access to digital calibration, linearization and features such as user-programmable force filter, programmable length offset, user-customized print headings, automatic calculation of mean, standard deviation and range of data.

1.3.1 <On/Clear>

Turn the TST on with this key. It also resets the tester to clear the last peak reading.

1.3.2 <Units>

Set the unit of measurement for your test. Choose from ft-lb, N/M, Kg/M, mm/N, in-lb or Kg/cm with degrees or revolutions.

1.3.3 <Option>

Choose the function you'd like to perform: Store/EndPrint; Limit On/Off; Offset/Power; Calibration Check; User Setup; Diagnostic; Calibration Menus*; Factory Setup.*

*Calibration Menus and Factory Setup are set at the factory and require user passwords. **Adjustments made by unauthorized personnel void the warranty.**

1.3.4 <Zero Angle>

Zeroes or initializes the angle at a reference point before testing.

1.3.5 <Zero Torque>

Zeroes or initializes the torque at a reference point before testing.

1.3.6 <Mode>

Choose the test mode: Manual, Peak, Two Point with Rate, or Two Point with Free Angle.

1.3.7 *<Store>*

Store your test information for later output.

1.3.8 *<Send>*

Sends data to your computer, data logger or printer via the RS 232 interface.

1.3.9 *<F1> and <F2>*

These keys serve various functions in different test modes.

1.4 Safety and Use Considerations

Remember that a torsion spring under load has stored potential energy proportional to the spring constant. Use care, and release this energy in a controlled manner to avoid possible injury.

Before using your TST, read this manual to gain an understanding of its proper operation to measure torque/angle relationships of an object and observe the following important operating considerations.

• Do NOT apply more force than the tester is designed to handle. The tester has overload stops to protect it, but damage can result from excessive loads. Force readings are not accurate above the rated limit.
• Be sure the operating location is clean and dry and all springs to be tested are free of oil and contaminants.
• Keep your equipment away from any source of liquid.
• Keep these instructions handy for reference.
• Follow all instructions and warnings concerned with the use of the TST.

1.5 Torque/Angle Specifications

1.5.1 Torque Specifications—TST 200

Part No.	Capacity	Resolution 0-20% FS	20-100% FS
025-0000-0475-00	0.3 in-lb 3 g-mm 34 N-mm	0.00002 in-lb .2 g-mm 0.002 N-mm	0.0002 in-lb 2 g-mm 0.02 N-mm
025-0000-0475-01	3 in-lb 35 g-mm 339 N-mm	0.0002 in-lb 2 g-mm 0.02 N-mm	0.002 in-lb 20 g-mm 0.2 N-mm
025-0000-0475-02	25 in-lb 288 kg-mm 2,825 N-mm	0.002 in-lb 0.02 kg-mm 0.2 N-mm	0.02 in-lb 0.2 kg-mm 2 N-mm
025-0000-0378-05	100 in-lb 1,152 kg-mm 11,299 N-mm	0.005 in-lb 0.05 kg-mm 0.5 N-mm	0.05 in-lb 0.5 kg-mm 5 N-mm
025-0000-0475-02	200 in-lb 2,304 kg-mm 22,597 N-mm	0.01 in-lb 0.1 kg-mm 1 N-mm	0.1 in-lb 1 kg-mm 10 N-mm

Accuracy = +- Resolution x 2

1.5.2 Torque Specifications—TST 1300

Part No.	Capacity	Resolution 0-20% FS	20-100% FS
025-0000-0475-00	0.3 in-lb 3 g-mm 34 N-mm	0.00002 in-lb .2 g-mm 0.002 N-mm	0.0002 in-lb 2 g-mm 0.02 N-mm
025-0000-0475-01	3 in-lb 35 g-mm 339 N-mm	0.0002 in-lb 2 g-mm 0.02 N-mm	0.002 lb-in 20 g-mm 0.2 N-mm
025-0000-0378-05	100 in-lb 1,152 kg-mm 11,299 N-mm	0.005 in-lb 0.05 kg-mm 0.5 N-mm	0.05 in-lb 0.05 kg-mm 5 N-mm
025-0000-0378-06	200 in-lb 2,304 kg-mm 22,597 N-mm	0.01 in-lb 0.1 kg-mm 1 N-mm	0.1 in-lb 1 kg-mm 10 N-mm
025-0000-0378-07	500 in-lb 5,761 kg-mm 56,493 N-mm	0.05 in-lb 0.5 kg-mm 5 N-mm	0.5 in-lb 5 kg-mm 50 N-mm
025-0000-0378-08	1,300 in-lb 14,978 kg-mm 146,883 N-m	0.1 in-lb 1 kg-mm 10 N-mm	1 in-lb 10 kg-mm 100 N-mm

Accuracy = +- Resolution x 2

1.5.3 Angle Specifications—TST 200

Range	Resolution		Accuracy (+-)	Deflection Compensation (5%-95% FS)
	<100,000° >100,000°			
100,000°	0.1°	1.0°	.2°/3,600°	<0.2°

1.5.4 Angle Specifications—TST 1300

Range	Resolution		Accuracy (+-)	Deflection Compensation (5%-95% FS)
	<100,000° >100,000°			
100,000°	0.1°	1.0°	0.2°/3,600°	<0.2°

2 FIRST STEPS

2.1 Unpacking your tester

Check to make sure you have all the items your ordered:
- Torsion Spring Tester (TST)
- Calibration Report
- User Manual (this book)
- Custom Tooling Blocks, if ordered
- Battery charger
- Additional torque cartridges
- Universal Tooling Assembly, if ordered

2.2 Setting up your TST

- Place your tester on a level and stable work area where you can easily perform tests, remove test items and the display is easy to see and read.
- Although the load cells have overload protection, **they can be damaged easily if excessive torque is applied**; this is most apt to occur with lighter load cells. Use care when you remove or replace reaction plates that are mounted to the load cell.
- Your TST can be used with a universal tooling assembly or custom tooling. To change tooling assemblies, remove the Reaction Plate by unscrewing the Tooling Quick Change Rod on the left side of the tester. Next, remove the Chuck Assembly by unscrewing the Tooling Quick Change Rod on the right side of the tester. Replace with the new tooling assembly and re-insert the Tooling Quick Change Rods on both sides of the tester.

Reaction Plate
Fine Adjust Handwheel
Rotational Lock
Fine Adjust Rod (engaged)
Coarse Adjust Handwheel
Stop Plates
Tooling Quick Change Rod for chuck assembly
Carriage Stop
Carriage Lock
Rotation Stops
Stop Pin
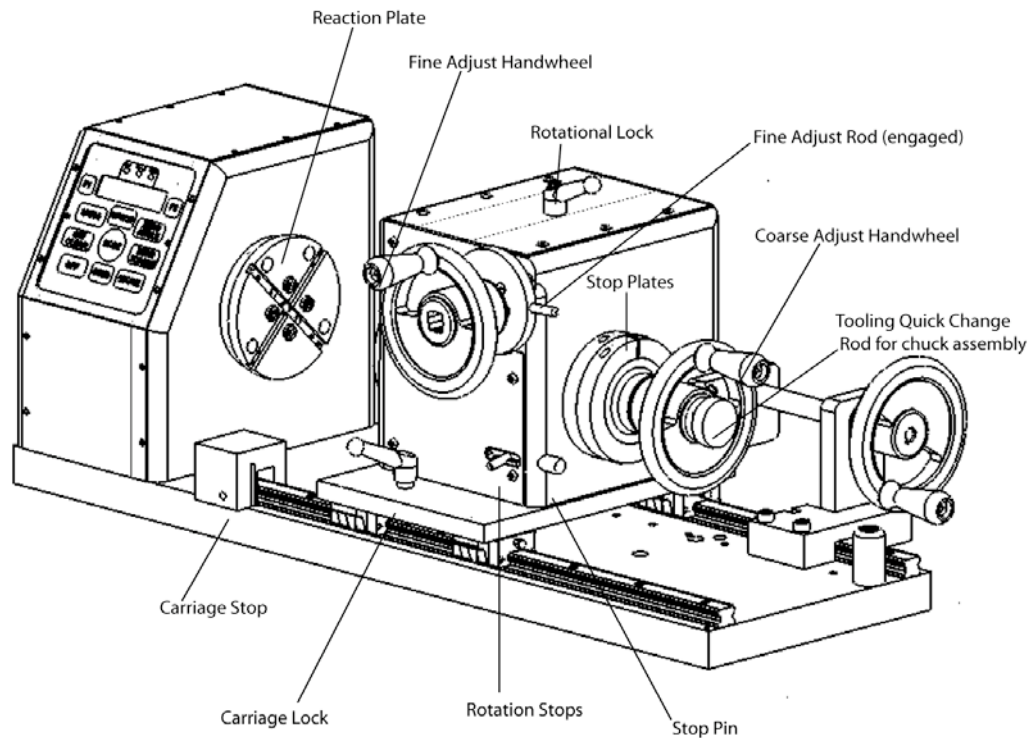
3 HOW TO OPERATE YOUR TESTER

3.1 Power on

Turning on your tester is as easy as pushing the <ON> button. When you do this, the LCD screen displays the name and location of the manufacturer (which you can change to your company's name and location –see Section 6.5, p. 34), software version number (in this case, Torsion Tester 4.25), followed by the tester's serial number, cartridge type, and cartridge number. The LED lights flash Low, Good, High, then the tester displays date/time (which you can set to your time zone and preferences—see Section 6.4, p. 34), mode and units of measurement.

3.2 Power off

Turn the power off by pressing <Off>. The tester is equipped with a power-off timer and a backlight timer to conserve battery life. If the tester sits idle for a period of time, a built-in timer begins. If a backlighting timeout occurs, the backlight on the display panel shuts off until a button is pushed or there is angle rotation. You may resume testing at this point. If the tester has shut down, press <On/Clear> to re-initialize the angle and torque.

3.3 Torque and Angle Initialization

The torque and angle of the tester must be initialized or zeroed at a reference point prior to testing. Larson Systems has equipped the TST with an absolute zeroing technique that improves the repeatability of setups and test results. The following two steps can be performed in any order.

3.3.1 Angle Zeroing

After pressing <On/Clear>, mount the part to be tested in the tooling assembly. Line it up at a zero reference point and press <Zero Angle>. The tester will automatically set this point at zero.

3.3.2 Torque Zeroing

After pressing <On/Clear>, mount the part to be tested in the tooling assembly. Line it up at a zero reference point and press <Zero Torque>.

3.3.3 Selecting Units of Measurement

The TST displays measurements in the following units, with degrees or revolutions: ft-lb, N/M, Kg/M, N/mm, in-lb, in-oz or Kg/cm. To select the units you want to work with, press <Unit> to scroll through the different choices. See Section 6.6 to disable units that you don't use in your testing procedures.

Note: Units cannot be changed if there is test data stored in memory, or during printing. See Section 3.13, "Send Stored Test Data" or "Clearing Stored Data" (also in 3.13) to clear stored data.

3.4 Mode Selection

Your Torsion Spring Tester operates in two standard modes: Manual and Peak. Two Point with Angle and Two Point with Rate are optional modes which you may purchase. The tester powers up in Manual Mode. To change modes, press <Mode>.

Standard

Manual

```
A        0.0      deg
T    0.0000      in lb
```

Peak

```
A        0.0      deg
P    0.0000      in lb
```
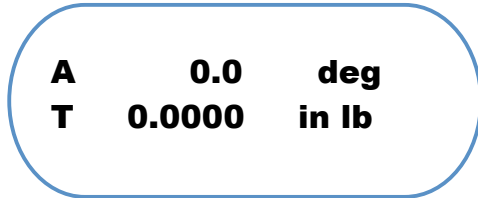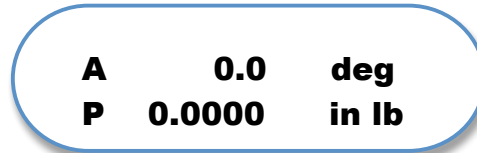
The display tracks or follows the current angle and torque.

The display freezes, showing peak torque and the corresponding angle. Press <On/Clear> to reset.

Optional

Two Point with Rate

```
A   90.0     dg  Tp1
T   5.6360      in lb
```

```
A      120.0   dg  Tp2
T    10.3210      in lb
```

```
Rate          in lb
0.1562        /deg
```

Two Point with Free Angle

```
A     23°    Tp1
T  8.152  *kg  M
```

```
A     39°      Tp2
T  14.9  *kg  M
```

```
Free Angle
2° 20' deg
```
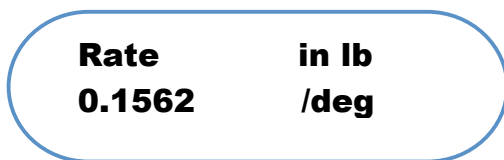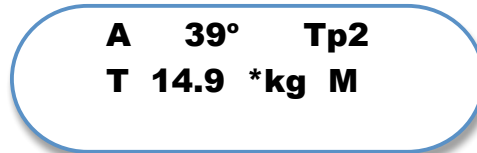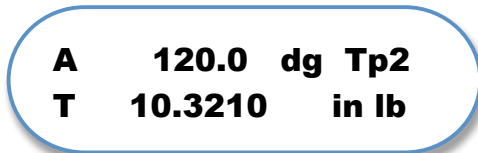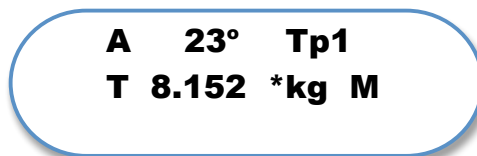
The tester captures and saves two points and calculates the rate between these angles. Press <F1> or <F2> to capture the data and view the Rate. Press <Store> to save the data and perform another test, or press <Send> to send data to a printer, data logger or computer.

The tester captures and saves two points and calculates the Free Angle between them. Press <F1> or <F2> to capture the data and view the Rate and Free Angle. Press <Store> to save the data and perform another test. Press <Send> to send data to a printer, data logger or computer.

3.5 Carriage Lock and Stop

3.5.1 Carriage Lock

To unlock the carriage, turn the carriage lock to the right. Slide the carriage along the rails until it reaches point at which you want to mount your spring for testing. Lock the carriage in place by turning the carriage lock to the left.

3.5.2 Carriage Stop

The carriage stop also slides along the front rail of the tester. For repetitive testing, set the carriage stop to repeat the exact carriage position each time you mount or dismount a spring.

Carriage Stop

Carriage Lock
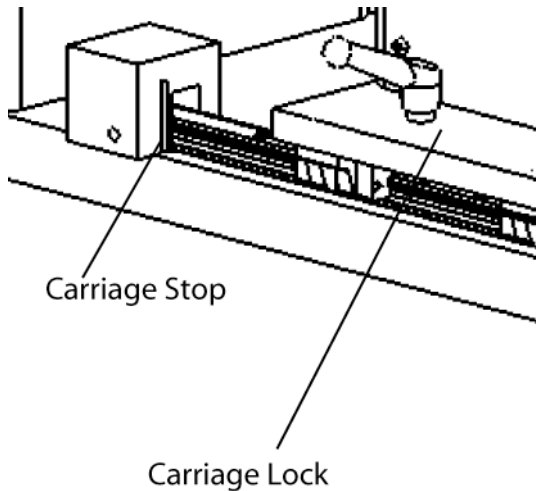
3.6 Adjusting Torque and Angle

Use the two hand wheels for coarse and fine adjustments. Turn the wheels *clockwise* for *positive* torque and angle readings, and *counterclockwise* for *negative* torque and angle readings.

3.6.1 Coarse Adjust

1. Initialize torque and angle units as described in Section 3.3.
2. Disengage the Fine Adjust by turning the Fine Adjust Rod, located behind the Fine Adjust Wheel *counterclockwise to the left*.
3. Rotate the Coarse Adjust Handle, located on the right-hand side of the tester, to apply a 1:1 ratio for coarse movements. One turn of the hand wheel equals one revolution on the chuck mounting plate.

3.6.2 Fine Adjust

1. Engage the Fine Adjust by turning the Fine Adjust Rod, located behind the Fine Adjust Wheel, *clockwise to the right*. Rotate the Fine Adjust Hand Wheel, located on the front of the tester, to apply a 40:1 ratio (80:1 for micro adjustments). In other words, you will need to turn the Hand Wheel 40 times for the chuck mounting plate to make a single revolution in the TST 200 and 80 times on the TST 1300.

Reaction Plate
Fine Adjust Handwheel
Rotational Lock
Fine Adjust Rod (engaged)
Coarse Adjust Handwheel
Stop Plates
Tooling Quick Change Rod for chuck assembly
Carriage Stop
Carriage Lock
Rotation Stops
Stop Pin
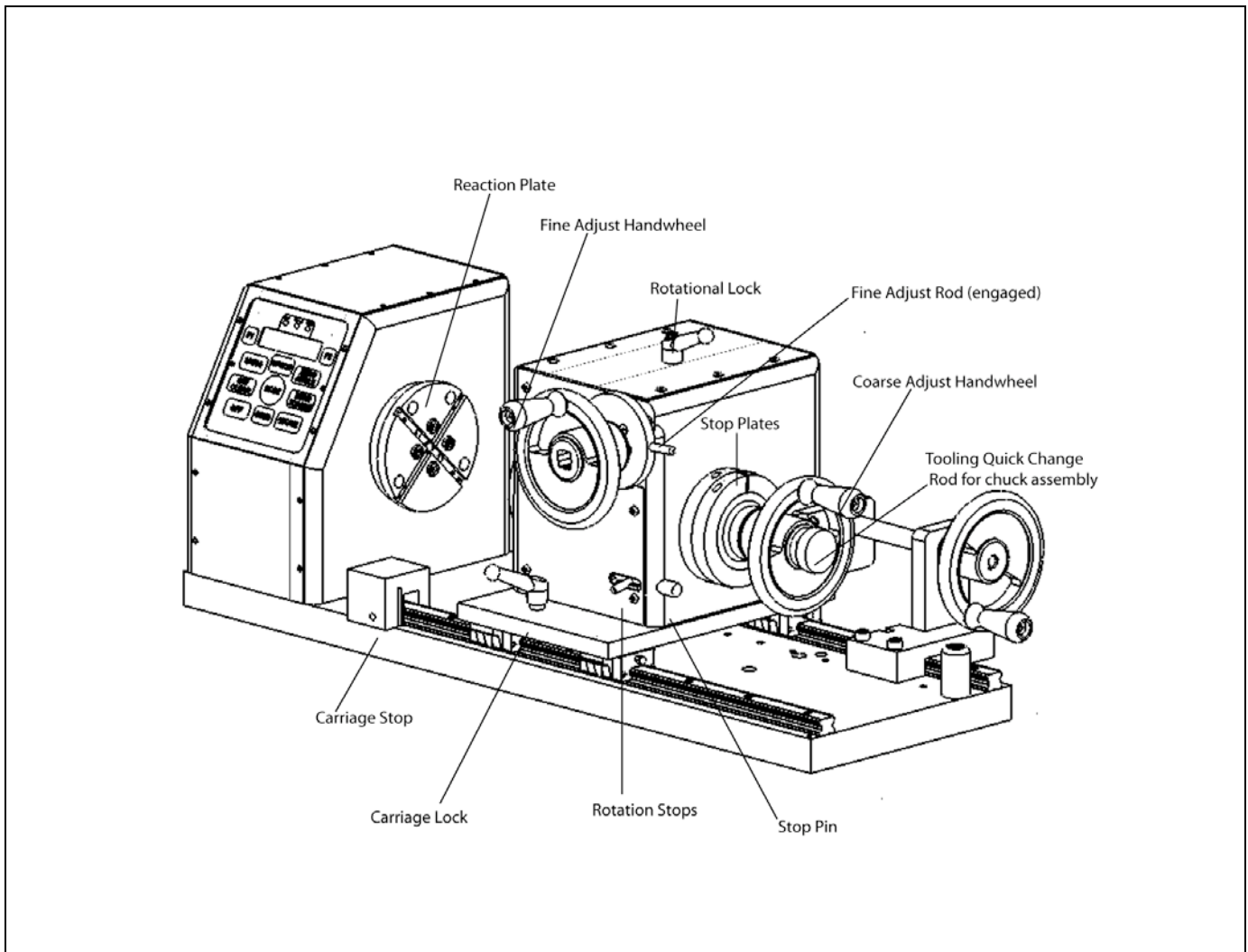
3.7 Setting Rotational Stops

For repetitive applications that require multiple test points on a given spring, three mechanical stops can be set.
1. Turn the Fine Adjust Hand Wheel, located on the front of the tester, to the desired angle reading (this could be the zero reference point).
2. Engage the Stop Pin, located below the hand wheel on the front of the tester, by sliding it to the right.
3. Loosen the set screws on the Stop Plates with a 3/16-inch allen wrench so the Stop Plates rotate freely.
4. Position the left-hand Stop Plate against the Stop Pin. Tighten the set screw. Disengage the Stop Pin by moving it to the left.
5. To set another Rotational Stop, rotate the Hand Wheel and repeat the above procedure, using the right-hand Stop Plate.
6. Repeat these procedures until all the desired stops are set.

Be sure the rotational stops are positioned as close to the tailstock housing as possible, or they will not contact the top pin correctly.

3.8 Changing Torque Cartridges

The Torsion Spring Tester covers a complete array of torque ranges, from 0.3. in-lb to 1,300 in-lb, thanks to an assortment of interchangeable torque cartridges. Lower capacity torque cartridges have an overload-prevention lock mechanism. Be sure the cells are in a locked position when changing cartridges, installing custom or universal tooling in the tester, or mounting springs for a test

1. Turn off power.

2. Unscrew the Tooling Quick Change Rod on the left side of the tester to remove the Reaction Plate. Do not apply excessive force, especially on light torque cartridges. Be sure they are in "lock mode."

Reaction Plate   **Chuck fixture**

Interchangeable Torque Cartridge
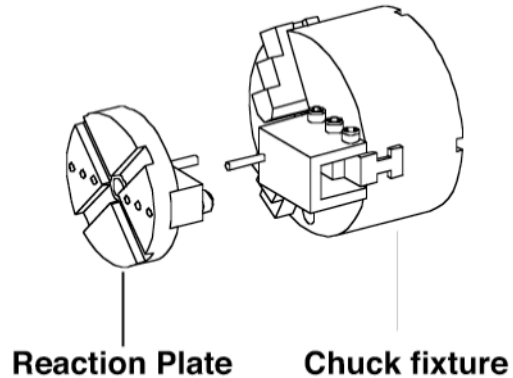
3. Unscrew the four, #8-32 x .5 socket head screws and slide the cartridge out of the flange receiver.
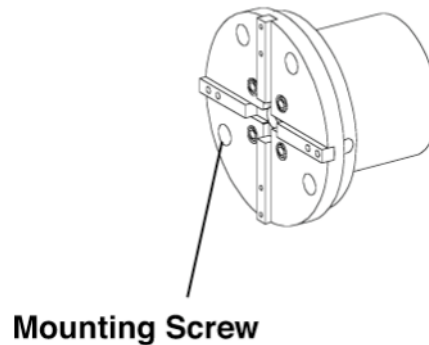
Mounting Screw

4. Insert the new torque cartridge, making sure the connector on the cartridge lines up with the connector in the flange receiver.
5. Insert and tighten the four mounting screws.
6. Replace Reaction Plate.

3.9 Mounting a Spring for Testing with Universal Tooling

1. Insert the chuck fixture on the right-hand side of the machine, centering it on the Quick Change Tooling Rod and matching up the grooves on the chuck with the bars on the Chuck Mounting Plate.

2. Insert a mandrel, appropriately sized to fit the spring you want to test, into the chuck. Tighten the chuck with the chuck key.

Lug Spring Stop   Clamp Spring Stop

3. Slide a U-shaped clamp spring stop over one of the stepped jaws on the chuck. Tighten the screws.

4. Mount a Tooling Block on the Reaction Plate on the left-hand side of the tester, making sure it is centered on the Quick Change Tooling Rod and that the bars on the Reaction Plate match up with the grooves on the Tooling Block. If your torque cell has a locking feature, make sure to lock the torque cell down! This will prevent damage to lighter cells.
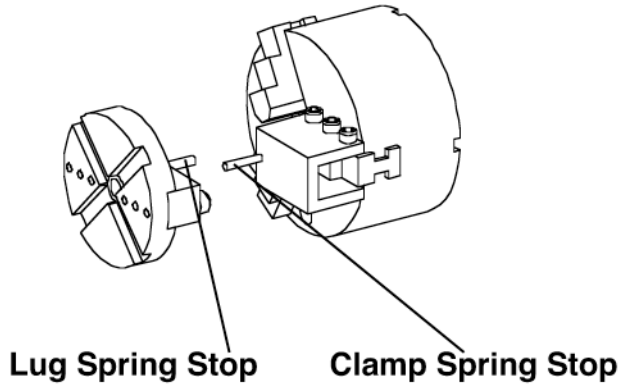
5. Slide a rectangular stop block into the slot on the Tooling Block. You may need to loosen the three screws above the slot.

6. Mount the spring on the mandrel and position the carriage so the spring just rests on the pin on the stop block.

6. Tighten the three screws on the stop block.

7. Move the Carriage Stop into position and lock it. Lock the Carriage and turn the Rotation lock to lock.

8. Begin testing, following the procedures outlined in Section 4.

3.10 Storing Test Data

Each time you press the <Store> button, Angle, Torque, Time and Date or the last Two Point with Rate test are stored in memory. You can continue testing and download the test data at a later time to a printer, computer or data logger.

When you press <Store>, you will see this message:

Storing Test
Number: xxxx

The TST will save up to 1,800 test results for the Manual and Peak modes and up to 500 for the Two Point with Rate mode.

3.11 Sending Data Via the RS 232 Port

Before you send data to a computer, printer or data logger, you must first connect the RS 232 port on the TST to the output device.
1. Connect the tester to a printer via a printer cable or a computer/data logger via a computer cable.
2. Set the company name and city to be printed in the report heading. See Section 6.5.
3. Choose Data Format or Report Format. See User Setup, Section 6.1.

3.12 Sending Current Test Data

Send the data that's displayed on the tester to a printer, computer or data logger.

Press the <Send> button. The data is downloaded to the RS232 port. You will see the message:

> **Sending**
> **Please wait...**

If the printer is not connected, or is busy, you'll see this message:

When you press F2, you'll get an error message and hear a long beep.

> **Option**
> **Store   EndPrint**

If the printer is connected and you want to send additional data, press <Send> again.

Press <Option> to end the test cycle and print a summary of the data.
Press F2. A summary of previous data, which includes Mean, Standard Deviation, Maximum, Minimum and Range, is transmitted to the printer via the RS232.

Note: The Print Summary Option must be enabled (default enabled). See Section 6.1, p. 29.

3.13 Sending Stored Test Data

Send previously stored test data via the RS232 port. You'll have the option of keeping or clearing the data from memory.

Press the <Send> button. You'll see this message:

> **Send Stored xxxx**
> **Stored   Present**

Press <F1> to send stored data. If the print summary option is enabled, (Section 6.1), a summary will be created when the stored data is sent. If no data is in memory, only current data will be sent.

If stored data is sent, you'll see this message:

> **Keep Data?**
> **Clear   Keep**

Press <F1> to clear the test data, or <F2> to keep the test data.

4 TESTING EXAMPLES

The Torsion Spring Tester tests in positive, negative, peak torque and in two-point with rate and two-point with angle modes. Following are examples of testing procedures.

4.1 Example 1: Measuring a Right-Hand Torsion Spring

Test a torsion spring in a positive (clockwise) direction to a given torque or angle and display the result. You can also print a statistical summary.

Press <On/Clear> to turn the TST on.

Manual Mode is the default testing mode. Press <Mode> until you see this display:

> **Manual Mode**

Mount the spring to be tested on a mandrel, allowing the ends to rest on the Clamp Spring Stop and the Lug Spring Stop.

Lug Spring Stop   **Clamp Spring Stop**
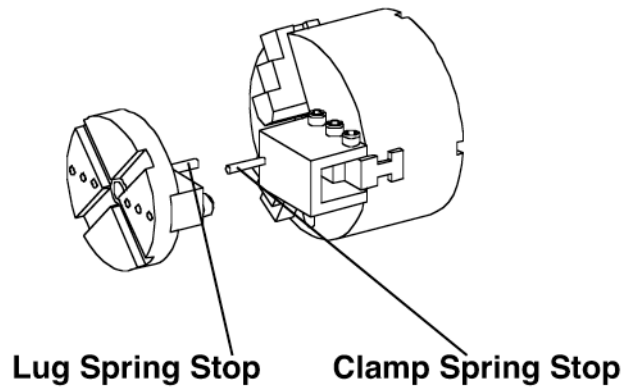
Press <Zero Torque> and <Zero Angle> to initialize the tester.
Torque the spring to the first load or angle by turning the hand crank in a clockwise direction. The display shows a positive angle and torque.

Note: The effect of hysteresis—a lag in spring response—should be factored into the test result.

```
A      n/a   deg
T   0.0000  in lb
```

```
A      0.0   deg
T   0.0000  in lb
```

```
A     180.0    deg
T     5.4320   in lb
```

Press <Send> to print, or <Store> to save.
After printing, press <Option>, then <F2> to print a statistical summary.

4.2 Example 2: Measuring Spring Rate with the Torsion Spring Tester

Test a torsion spring in a positive direction (clockwise) to a given torque or angle at two test points. After capturing the results, a spring rate is displayed. You may print or store the results.

To Display Only

Press <On/Clear> to turn on the tester.

Mount a spring on a mandrel, allowing the ends to rest on the Clamp Spring Stop and Lug Spring Stop. Press <Zero Torque> and <Zero Angle> to initialize the machine.

Press the <Mode> key until you reach the Two Point with Rate display.

Torque spring to first load or angle, then press <F1> to capture test point 1.

Torque spring to second load or length. Press <F1> to capture test point 2.

Press <F1> to view points, <Send> to print, <Store> to save, or <Clear> to reset. To print a statistical summary, press <Option>, <F2>.

To Print or Store Directly

Press <On/Clear> to turn on the tester.

Mount a spring on a mandrel, allowing the ends to rest on the Clamp Spring Stop and Lug Spring Stop. Press <Zero Torque> and <Zero Angle> to initialize the machine.

Press the <Mode> key until you reach the Two Point with Rate display.

Torque spring to first load or angle, then press <Send> or <Store> to capture test point 1.

Torque spring to second load or length. Press <Send> or <Store> to capture test point 2. Rate is not displayed, but is stored.

Press <Option>, then <F2> to print a statistical summary.

A	0.0	deg
T	0.0000	in lb

Two Point With
Rate Mode

A	90.0	Tp1
T	5.6360	in lb

A	120.0	dg	Tp2
T	10.3210		in lb

Rate   in lb
0.1562   /deg

4.3 Example 3: Measuring a Left-Hand Torsion Spring with Torque Limit Option

Test a torsion spring in a negative direction (counterclockwise) to a given angle with specified torque limits. A corresponding LED light indicates the test result. In this example, the low limit is -2 in lb; the upper limit is -5 in lb and the specified angle is -5 degrees.

Press <On/Clear> to turn tester on. Press <Option> until the display shows:
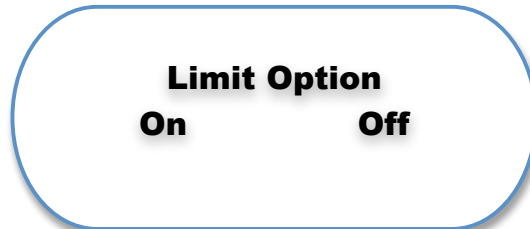
Limit Option
On   Off

Press <F1> to turn on the limit option.

Limit Option
Torque   Angle
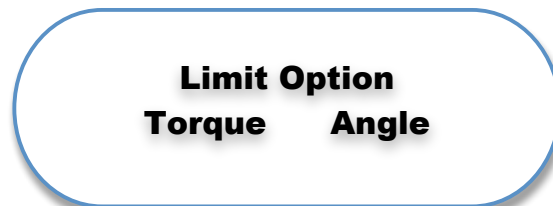
Press <F1> to select Low Torque limit display.

Press <F2> to select a Negative torque value. Press <F1> to scroll from left to right through the digits. Press <F2> to change the digit to the number you want.

Man. Low   in lb
Nxt   -   2.0000   +
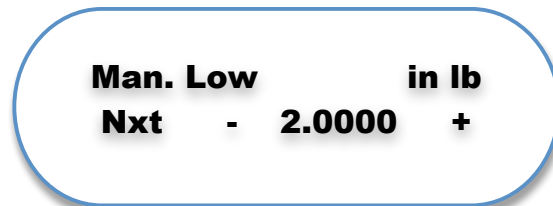
Press <Option> to select High Torque limit display. Press <F2> to select a Negative torque value. Press <F2> to change the digit to the number you want.

Man. High   in lb
Nxt   -   5.0000   +

Press <On/Clear>. The * in front of "in lb" indicates the Torque Limit selected.

A   0.0   deg
T   0.0000   * in lb
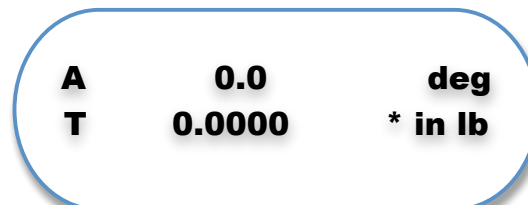
Mount your test spring on a mandrel, allowing the ends to rest on the Clamp Spring Stop and Lug Spring Stop. Press <Zero Torque> and <Zero Angle> to initialize the tester.

Turn the hand crank in a counterclockwise movement until you reach the negative angle you specified. If the torque value is within limits, the middle "Good" LED light will light. If torque is above the upper limit, the "High" light will glow. If torque is below your chosen lower limit, the "Low" light will be lit.

Note: You should factor hysteresis—the length of time it takes a spring to return it its original state—into your test results.
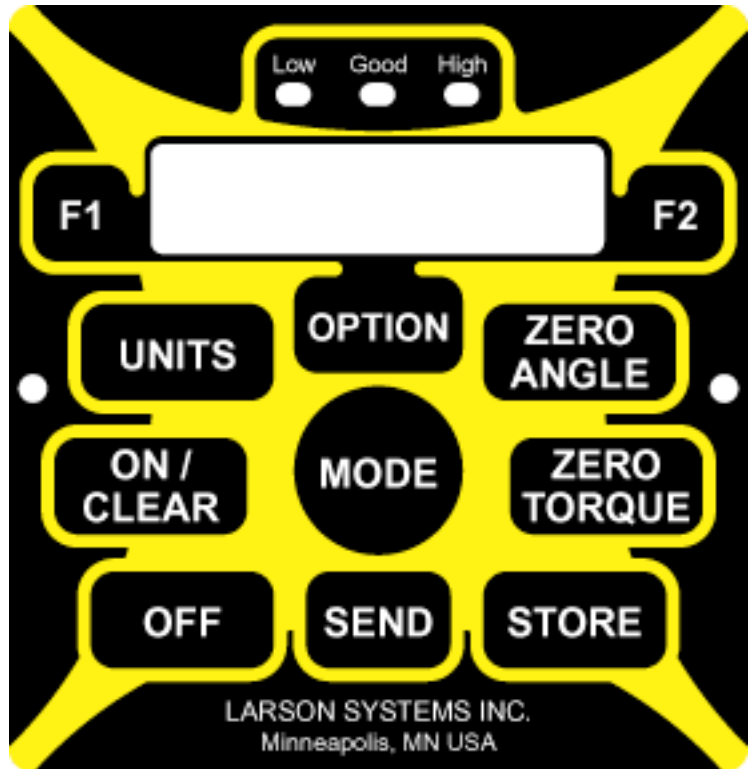
5 USING THE OPTION MENU AND F1 AND F2 KEYS

The Option menu helps you access commonly-used tester functions: Limit Option menu (if ordered); Power off; Torque cell calibration check; User setup menu; and Calibration menu. Press <Option> to advance through the displays. Press <F1> or <F2> to select various functions. Press any key to exit the Option menu.

5.1 User Options
The Option menu gives you rapid access to tester functions and other menus.

Option	Limit Option	Option
Store EndPrint	On Off	Offset Power
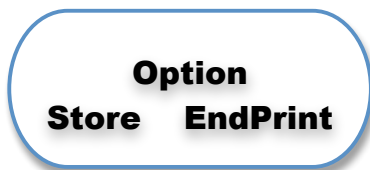
```
┌─────────────────┐   ┌─────────────────┐   ┌─────────────────┐
│     Option      │   │     Option      │   │     Option      │
│    Cal Check    │   │   User Setup    │   │   Diagnostic    │
└─────────────────┘   └─────────────────┘   └─────────────────┘

┌─────────────────┐   ┌─────────────────┐
│     Option      │   │     Option      │
│   Calib Menus   │   │  Factory Setup  │
└─────────────────┘   └─────────────────┘
```

5.2 Option--Printing a Summary at the End of Testing (EndPrint)

The *EndPrint* option allows to you print summary data such as the mean, standard deviation, maxium, minimum and range at the end of testing. Press <F2> to select EndPrint.

```
┌──────────────────────────────┐
│           Option             │
│   Store         EndPrint     │
└──────────────────────────────┘
```

If there was no printout, the display will show:

```
┌──────────────────────────────┐
│      Print-out Not in        │
│         progress             │
└──────────────────────────────┘
```

If a printout has started, the printer will print the statistical summary and the display will show:

```
┌──────────────────────────────┐
│       Print-out Done         │
│       Please wait...         │
└──────────────────────────────┘
```

5.3 Option--Clearing Stored Data (Store)

The Clear option lets you see how many points are saved, clear the last test point entered, or clear all test points. Press <F1> to select.

```
┌──────────────────────────────┐
│           Option             │
│   Store         EndPrint     │
└──────────────────────────────┘
```

If no tests are stored, the display will show:

Press <On/Clear> to continue.

> No information stored

If data is stored, the display will show each test result. You can scroll through the results by pressing <F1>.

If there is a test you don't want to keep, press <Option>. The tester displays a screen to Clear Memory Now. Choose <F1> to clear that entry.

> Clear Mem   2
> Now

Clear all the data by pressing <Option>. Press <F1> to Clear All Memory Now. The tester will display the "No information stored" screen.

Press <On/Clear> to perform another operation.

> Clear All Memory Now

5.4 Option--Load/Angle Limits Option

The Limit option allows you to enable or disable the Load/Angle Limits option. The option is enabled and calibrated for the current mode selection (manual, peak or two point with rate mode).

> Limit Option
> On   Off

Press <F1> to enable the limits; <F2> to turn them off.

Press <F1> to set limits for Torque; <F2> for Angle.

> Limit Option
> Torque   Angle

Press <F1> to set the Low limit. Press <F2> to select a negative or positive value. Press <F1> again to move the cursor to the next digit to the right. Press <F2> to change the digit to the next higher number.

```
Man.      Low        in lb
Nxt       0.0000        +
```
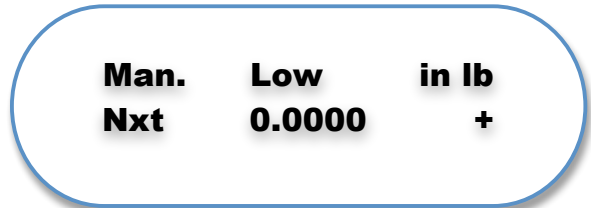
Press <Option> to set the High limit. Press <F1> to move the cursor to the next digit on the right. Press <F2> to change the digit to the next higher number.

```
Man.      High   in lb
Nxt       0.0000     +
```
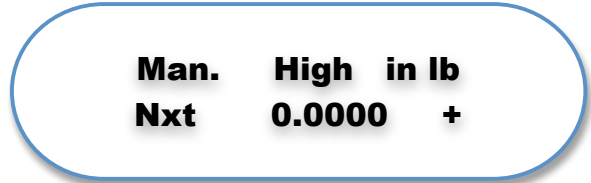
When finished, press <On/Clear> to return to normal testing modes.

When testing, observe the LED lights, which indicate the status of the spring:
- Low—below the lower limit
- Good—within the lower and upper limits
- High—above the upper limit

5.5 Option--Power off (Power)

To turn the tester off immediately without waiting for the display to time out, press <Option> until the display shows the Offset/Power screen. Press <F2> to select the Power off menu. If you press <F1>, the power will stay on. If you press <F2>, the tester will shut down. You can also turn off the power by pressing the <Off> button.

```
         Option
   Offset      Power
```

5.6 Option--Angle and Torque Offset (Offset)

The Angle and Force Offset option allows you to add or subtract a number to the angle or torque on a display. This helps you set a common zero point and maintain repeatability in testing.

Press <F1> to select Offset.

```
         Option
   Offset      Power
```

Press <F1> to move the cursor to the right.
Press <Units> to move the cursor to the left.
Press <F2> to increase a digit.

Press <Option> to go to the Torque Offset screen. Press <F1> to move the cursor to the right. Press <Units> to move the cursor to the left. Press <F2> to increase a digit.

When you have adjusted the offsets, press <On/Clear> to return to normal testing modes.

> Tor. Off.   (kg M)
> Nxt   8.1521   +

5.7 Option--Calibration Check (Cal Chk)

The Calibration Check allows you to view a shunt value and a torque value to verify that the tester is still within torque tolerance. The Load Cell shunt value is derived at calibration and is recorded in the tester's memory. The displayed torque value should equal the shunt value within the accuracy tolerance listed in Section 1.6. To test springs accurately, the zero reading should display 0.0000.

Press <Option> until you reach the Calibration Check screen. Press <F1> to select Select Shunt.

> Option
> Cal Check

Press <F1> to select Load Cell. (Panel Shunt is not used with the torsion tester.)

> Select Shunt
> Load Cell   Panel
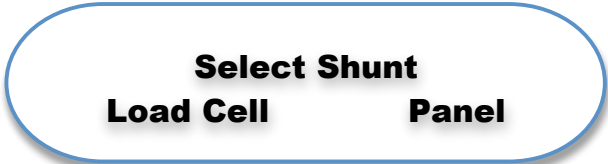
The tester will enter the Cal Chk mode.

> Cal Chk Mode

5.8 Option—Diagnostics

Check out various parts of your Torsion tester to determine if they're working correctly.

Scroll through the User Setup menu until you reach the Diagnostic screen. Press <F1> to enter the Diagnostic menu. Press <Option> to move forward one screen; press <Mode> to move backward one screen.

> **Option**
> **Diagnostic**

View and verify battery voltage. Press <Option> to move to the next screen.

> **View Batt Volts**
> **-   No +**

Check out the keypad. Press <F1> to go to the "Press Any Key" screen. Press any keys on the keyboard. If you press Option, the screen should read Option; if you press Mode, the screen should read Mode. Press <Clear> to go to the next Diagnostic screen.

> **Perf Keypad Chck**
> **Now**

Press <F1> to check the screen. The cursor will automatically move around the screen and check each "cell" twice. To halt the checking process, press <Clear> and you will return to the Perf Screen Chck screen. Press <Clear>, then <Option> to move to the next screen.

> **Perf Screen Chck**
> **Now**

Some testers require external inputs. This screen allows you to verify if these inputs are closed or open (C or O).

Press <Option> to go to the next screen.

> **External Inputs**
> **COO**

Press <F1> to move to the next test. Press <F2> to toggle Off or On. Press <Option> to go to the next screen.

> **Output Diag Test**
> **Nxt   1 Off   tgl**

This screen shows you the printing protocols you may have chosen—baud rate and delays.

> **RS232 Protocols
> 4800, Delay .01**

This screen shows that you have chosen to print a report with a heading. Press <Option> to bring up the next screen.

> **RS232—Report On
> Heading**

Press <F1> to perform this check. The RS232 will send data to the data port and report the results.

> **Perf RS232 Chck
> Now**

This screen tells you the size of the microprocessor and the amount of Random-Access Memory (RAM) contained in the tester.

> **16 MHz processor
> with 64 Kb RAM**

LSI testers can be equipped with up to 16 different smart load cells. This screen lists the cells one by one with their serial number and capacity. If you see a reading that says SMC 2, for example, it means that smart cell 2 is currently loaded into the tester.

> **SM 1   100.0 lb
> -   SN 100   +**

Press <F1> to move back one number. Press <F2> to move to the next higher number. Press <Option> to go to the next screen.

Print information about the smart cells. Press <F1> to print information for a single cell.

> **Print Cell Info**
> **One   All**
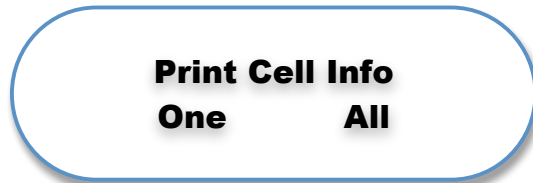
The following screen asks which cell number you want to print. Press <F1> to move the cursor from left to right. To the next cell number, press <F2. Press <Option>, then <F1> to print information about the chosen cell immediately.

> **Cell to Print**
> **Nxt   08   +**
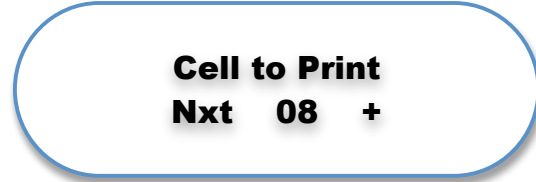
To print information about the E2 non-volatile memory (factory settings, calibration, user settings), press <Option> to go to the next screen. Press <F1> to print.

Press <On/Clear> to return to normal testing mode.

> **Print E2 Mem**
> **Now**

5.8 Option—Calibration Menus

There are no user-selectable options in this area. Only authorized calibration personnel who have a pass code can perform calibration. Any calibration modifications done by unauthorized personnel will void the warranty.

5.9 Option—Factory Setup

There are no user-selectable options in this area. Only authorized LSI personnel who have a password may work in this area. Any factory setup modifications done by unauthorized personnel will void the warranty.

6 User Setup

The User Setup menu allows you to change user functions, setup parameters and tester configuration to meet your needs. You need to enter a pass code to change these settings. Once you've entered your password, Press <F1> to select the User Setup menu.

Option
User Setup

User Setup
RS232   Power

User Setup
Dampening   Date

User Setup
Company   City

User Setup
Backlight   Units

User Setup
1st Peak Filter

User Setup
+/- Rule

User Setup
I/O Polarity

User Setup
Cal Info

6.1 User Setup—RS232 and Choosing Data/Print Format

The first screen you will see in the User Setup option is the RS232 Power screen.
While you are in this setup menu, you can press <Mode> to return to a previous screen.

> **User Setup**
> **RS232**   **Power**

To choose your output format, Press <F1> to select RS232. The display will read:
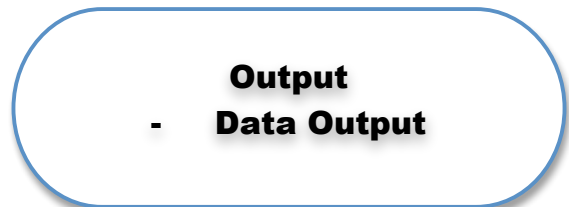
Press <F1> to choose Data Format, or <F2> to choose Report Format.

> **Output**
> **-**   **Data Output**

If you chose <F2>, the display will look like this:
Push either <F1> or <F2> to choose Yes or No.
Press <Option> to move to the next screen.

> **Print Report:**
> **-**   **Yes**   **+**

The following screen asks if you want to print out all the test statistics or use a standard format. Press <F1> or <F2> to toggle between Full Stats and Standard. Press <Option> to move to the next screen.

> **Print Out Format**
> **-**   **Full Stats**   **+**

The next screen asks if you want to print a heading on your report. Press <F1> or <F2>
(- or +) to choose Print Heading or No Heading.

Press <Option> to move to the next screen.

> **Printer Format :**
> **- Print Heading +**

This screen asks if you want to print a summary of your data. Press <F1> or <F2> to choose Print Summary or No Summary.

Press <Option> to go to the next screen.

> **Printer Format:**
> **- Print summary +**

This screen shows the default printer settings, which are set for an 80-character line length. By pressing <F1> or <F2> (- or +), you can change the space between lines from double to single. Go to the next screen by pressing <Option>.

Printer ch, width
- 80, Double +

This option allows you to choose the communications method between the tester and an output device, usually a computer. Selections include hardware, and software delays of .01 and .025 seconds. Hardware is the default setting, especially if you purchased your printer from LSI. To choose other settings, use <F1> or <F2> to toggle between None, Delay .01 or Delay .025. Press <Option> to go to the next screen.

Printer Protocol
- Hardware +

This screen allows you to set the Printer Baud Rate. The default is 9600 baud, but you may select 1200, 19200, 2400, and 4800 baud as well, simply by pressing <F1> or <F2> until you reached the desired transmission speed.

Press <Option> to move to the next screen.

Printer BaudRate
- 9600 +

Use this screen to select the type of paper you want to use. Press <F1> or <F2> to select Plain Paper or Roll Feed.

Press <Option> for the next screen.

Paper Type
- Plain Paper +

This Option lets you set the number of lines per sheet of paper. The default setting is 66 lines per page for an 8.5" x 11" sheet of paper; however, you may wish to set more or fewer lines, depending on paper size. Press <F1> to move the cursor to the next space to the right. Press <F2> to increase the digit by one.

Press <Option> to move to the next screen.

Lines per Page
Next 66 +

This screen allows you to select your printer. You have three choices, an Okidata, an Epson, or other. Press <F1> or <F2> to make your choice.

```
   Dbl Wdth On/Off
  -   Oki-  1F/1E   +
```

6.2 User Setup—Setting the Power Timeout

The power timeout feature conserves battery life.

At the RS232 Power screen, press <F2> to choose Power. This Option allow you to change the length of time the tester stays on if it is idle for a period of time. If the tester remains idle for too long, it automatically shuts off to conserve battery life.

```
      User Setup
  RS232      Power
```

Press <F1> to select Next, which moves the cursor right to the next digit. Press <Option> to move back to the beginning of the string of numbers. Press <F2> to increase the digit to the next higher number. To decrease a digit, press <Zero Angle>. Note: The default time-out is 20 minutes. Press <On/Clear> to return to normal testing mode.

```
   Power Time-out
   Next   20:00  +
```

6.3 User Setup—Adjusting the Torque Dampening

Dampening eliminates noise in the display caused by vibration. It also slows the measurement process. Set the dampening to the minimum level necessary to achieve a stable, readable display.

Reach Dampening mode by pressing <Option> under the User Setup screen until you see this display:

```
      User Setup
   Dampening    Date
```

Press <F1> to choose Dampening.

Press <F1> or <F2> (- or +) to choose Low, Medium, High or None. When finished, press <On/Clear> to return to normal testing mode.

Peak Dampening
-   Low +
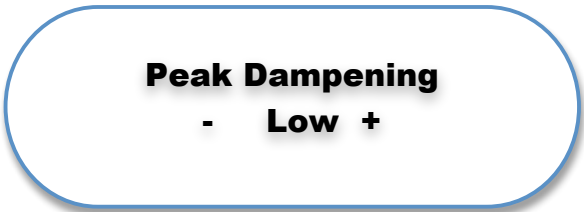
6.4 User Setup—Setting Today's Date and Time

Set the Date and Time, which are transmitted via the RS232 port and added to printed reports.

> **User Setup**
> Dampening   Date

Scroll through the User Setup menu until you reach this display. Press <F2> to select Date.

The default setting is MM/DD/YY, but you may choose DD/MM/YY or YY/MM/DD by pressing <F1>. Once you have decided on the format, press <Option> to enter dates.
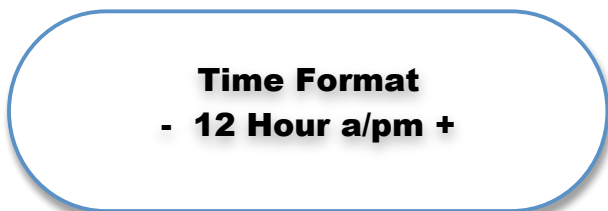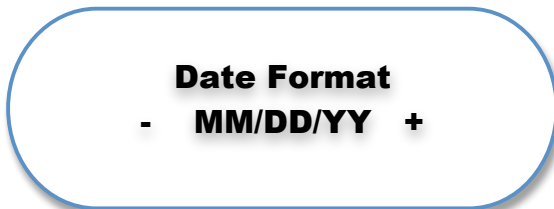
> **Date Format**
> -   MM/DD/YY   +

> **DD:MM:YY**
> Next   05 03 00 +

> **Time Format**
> - 12 Hour a/pm +

Press <F1> to move the cursor to the right. Press <Units> to move the cursor to the left. Press <F2> to increase the digit. Press <Zero Angle> to decrease the digit. Press <Option> to go to the next screen.

You may choose between a 12-hour and a 24-hour clock. Press either <F1> or <F2> to make your choice, then push <Option> to set the time.

> **HH:MM a/pm**
> Next   06:11   a   +

This is the time-setting screen. Press <F1> to advance the cursor to the right. Press <Units> to move the cursor to the left. Press <F2> to increase the digit. Press <Zero Angle> to decrease the digit. When you have set the time, press <On/Clear> to return to normal testing mode.

6.5 User Setup—Entering Your Company Name and City

Entering your company name and city into the tester gives your reports a more finished appearance and acts as a theft deterrent as well.

When you enter your company name, it will automatically appear as the second line in your reports. Press <F1> to select Company.

> **User Setup**
> **Company   City**

You may enter a company name as long as 32 characters, typing in 8 characters per line. There are 4 lines available for entering your company name.

> **Company Name   1 / 4**
> **Next   your com   +**

The character set includes:

ABCDEFGHIJKLMNOPQRSTUVWXYZ
Abcdefghijklmnopqrstuvwxuyz
& ' () *+,-./
0123456789

An empty space exists between each set of characters. Place this space between words, such as Larson Systems.

Press <F1> to move the cursor to the right. Press <Units> to jump the cursor to the end of the line or move one space to the left. Press <F2> to advance to the next letter in the alphabet. Press <Zero Angle> to back up one letter. When you complete a line, press <Option> to move to the next line. There are four screens in all. When you are finished entering your company name, place a space at the end of the line. Then press <On/Clear> to return to normal testing mode.

Follow the same procedure for entering the name of your City. Press <F2> to select City. When you have entered your city, place a space at the end of the line, then press <On/Clear> to return to normal testing mode.

> **City Name   1 / 4**
> **Next   Anytown,   +**
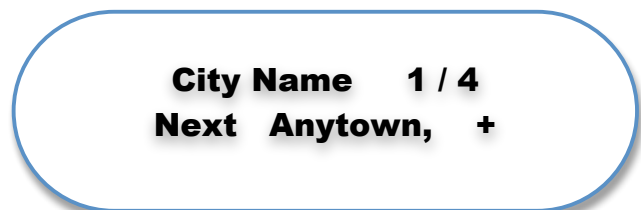
6.6 User Setup—Setting the Backlight Timeout and Units of Measurement

Scroll through the User Setup Menu until you find this screen:

> **User Setup**
> **Backlight   Units**

The display backlight is set to turn off after the tester sits idle for a period of time. This conserves battery life. The default setting is 20 minutes; however, you can set it to your own preferences.

> **Light Time-out**
> **Next   20:00   +**
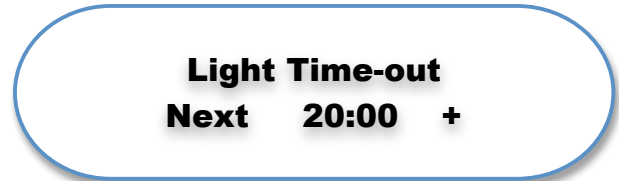
Press <F1> to select the Time-out function for the tester's backlit screen.

Press <F1> to advance the cursor one space to the right. Press <Units> to advance it to the left. Press <F2> to change a number to the next higher number. Press <Zero Angle> to change the number to a lower number. Press <On/Clear> to return to normal testing mode.

To change the units of measurement, press <F2> when you see this screen.

> **User Setup**
> **Backlight   Units**

Press <Option> to view the measurement units available:

In lb used
N mm used
Gm mm used
Kg mm used

In oz used
Ft lb used
N M used
Kg M used
Kg cm used
Deg used

Rev used
DMS used

> **Units Used**
> **-   in lb used +**

Press <F1> or <F2> to select the units you want to use. If you do not select N mm, for example, that unit of measurement will not be available to you in the Units menu.

```
 ╭─────────────────────────╮
 │       Units Used        │
 │   -   No in lb used  +  │
 ╰─────────────────────────╯
```
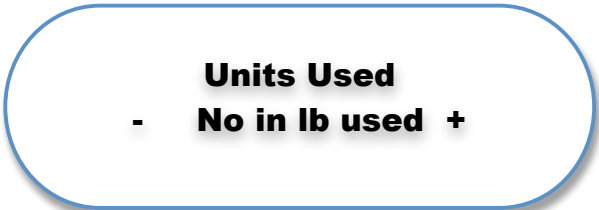
6.7 User Setup—(1st Peak/Filter)

6.7.1 1st Peak

This setting is not used in torsion spring testing.

6.1.2   Filter

Filtering is the first submenu under Filter [F2]. Using [F1] or [F2] choose between None, Low, Medium, High, User #1, User #2, User #3, and User #4. Once the desired selection is displayed, press [OPTION]. Toggle between Yes and No using [F1] or [F2] to display filter. Press [OPTION] to select. The next four submenus are accessed using the [OPTION] key after each. The directions follow on the next page along with filtering information.

```
 ╭─────────────────────────╮
 │       Filtering         │
 │   -     None    +       │
 ╰─────────────────────────╯
```

Dampening (Kd)	Enter % value using [F1] and [F2]
Dampen Min (M)	Enter % value using [F1] and [F2]
Decay Rate (C)	Enter % value using [F1] and [F2]
Recovery (R)	Enter value using [F1] and [F2]

To review entries made under Filtering press [OPTION]. Press [SEND] to save and return to the previous menu. Press [OPTION] to continue to next User Setup menu item.

During normal operation the display shows some number of discrete force values every second. These values can be thought of as the value being displayed and the next value to be displayed. When the two values are subtracted from each other, the result is an error. Filtering works by multiplying this error by a percentage and then adding that partial error to the displayed value and displaying that as the new value. The percentage that the error is multiplied by is Kd. Kd changes over time. While the force is stable, Kd decreases from the Kd entered in the User Setup menu to the Dampen Min (M) value at a rate defined by the Decay Rate (C). The Recovery (R) value is used to increase Kd when the force starts to change based on duration and amount of change. The Kd value will be shown as it changes over time when Display Filter is chosen.

```
 ╭─────────────────────────╮
 │     Display Filter      │
 │   -      Yes   +        │
 ╰─────────────────────────╯
```

6.8 User Setup--+/- Rule

+ / - Rule
Choose +/- Rule using [F1]. Go to +/- Torque Rule using [OPTION]. (Angle Rule not active on this model.) Select CW Positive or CCW Positive using [F1] or [F2]. CW = Clockwise, CCW = Counterclockwise. This corresponds to

the direction the tool is being tested on the unit and displays the readings taken in the direction selected as positive numbers. <u>This setting may need to be changed frequently</u>.

When performing tests to result in a Calibration Certificate for signature, it is important that the readings are positive numbers. If performing the test in Clockwise direction, choose CW Positive - Counterclockwise, CCW positive. If negative readings are recorded, the Calibration Certificate will always produce a FAIL test for the torque tool. When done, press [SEND] to return to the previous menu. Press [SEND] again to return to the User Setup main menu.

> **User Setup**
> **+/- Rule**

> **+/- Torque Rule**
> **- CCW Positive +**

> **+/- Angle Rule**
> **- CW Positive +**

6.9 User Setup—I/O Polarity

I / O Polarity
The I / O Polarity menu accesses a setup feature for users who need to use the external inputs and outputs on the tester with certain auxiliary equipment. To select, press [F1] and the second display example shown above appears.

> **User Setup**
> **I/O Polarity**

Press [F1] to advance through the "H" fields underlined. Press [F2] to change any "H" to "L". These 4 fields represent polarities of 2, 3, 4 and 5, respectively, from left to right and define the active voltage level for those polarities as high or low.

> **Input   2 Pol.**
> **>HHHHXXXXXX+**

Press [OPTION] to advance to the third display example shown here. This screen operates the same: Press [F1] to advance through the "H" fields underlined and press [F2] to change any "H" to "L". These eight fields represent polarities of 6, 7, 8, 9, 10, 11, 12 and 13 from left to right.

> **Output   6 Pol.**
> **>XXXXHHHHHH+**

This menu feature is not commonly used. Contact LSI for further instruction.

**User Setup
Cal Info**

6.10 User Setup—Calibration Information

There are no user-selectable options in this area. Only authorized LSI personnel who have a password may work in this area. **Any modifications in this area performed by unauthorized personnel will void the warranty.**

7 CALIBRATION AND FACTORY SETTINGS

Tester calibration is set at Larson Systems. Only trained personnel should adjust calibration. **Adjustment by unauthorized personnel voids the warranty.**

There are no user functions in the factory settings. **Adjustment by unauthorized personnel voids the warranty.**

8 USER SETUP PASSWORD

You may need a password to get into User Setup to change dates, locations, or time on your tester. When you see the screen, "Authorized Personnel Only," type in the following code:
| Units | | Send | | F1 |. You are now in the User Setup menu.

9 TORSION TESTER ERROR CODES

4: Error 4
Past Full Scale!
Torque cell is torqued beyond full-scale force.

39: Error 39
Printer Error
External device time-out. The tester tried to send data to the printer through the printer port, but it took too long.

40: Error 40
Send PC Error
External device time-out. The tester tried to send data through the PC port, but it took too long.

56: Error 56
No contact results to send
The Store key was pressed but a test has not been taken.

60: Error 60
Storage Maxed
Operator pressed <Store>, but the maximum number of tests is already in memory.

62: Error 62
Manual Only Send to end set
Operator pressed <Store>, but the tester was not in Manual mode, even though the first test stored was a Manual mode test. You can store tests of one mode only.

63: Error 63
Peak Only Send to end set
Operator pressed <Store>, but the tester was not in Peak mode, even though the first test stored was a Peak mode test. You can store tests of one mode only.

65: Error 65
Manual Only
Optn/F2 end form
Operator pressed <Send> while not in Manual mode, even though the first test was a Manual mode test. You can send tests of one mode only. Choose Option, then EndPrint, and proceed.

66: Error 66
Peak Only
Optn/F2 end form
Operator pressed <Send> while not in Peak mode, even though the first test was a Peak mode test. You can send tests of one mode only. Choose <Option>, then <EndPrint>, and proceed.

70: Error 70
key n/a
Operator pressed a key that is not operable in the current mode.

86: Error 86
Must use (lb) (in)
Operator changed units of measurement during the testing cycle, then pressed <Send>. Operator must complete test cycle using the same unit of measure.

87: Error 87
Computer asked for stored result data, but none is stored.

89: Error 89
Must be at least 1 Min.
Operator tried to enter a display sleep time of less than 1 minute.

92: Error 92
Call LSI
Initialize?   No
A power-up check indicates that the E2 prom memory has a fault. Press <F2>, then call LSI.

95: Error 95
Call LSI
RAM Error
A power-up check indicates a fault in the RAM memory on chip 1. Call LSI to find out what is wrong. Press any key to continue. This error will also produce a 2-second beep just after the initial power-on beep.

98: Error 98
Low Battery
Please charge
The battery is getting low and requires a re-charge. The tester can be operated with the charger plugged in.

99: Error 99
Battery Too Low!
Must Charge
The battery level is too low and must be re-charged. The tester will not work without recharging the battery or plugging it into an electrical outlet.

10 TESTER DEFAULTS

The Torsion Spring Tester comes equipped with factory-set default settings. You may wish to refer to the following:

RS-232 Menu:

<u>Output format</u>: Data   <u>Output format</u>: Report

	Print report: No
Send results: Yes	Print format: Print heading
Data transfer: No heading	Print summary
Send count	Printer ch width: 80, double
Send date	Printer protocol: Hardware
Send time	Printer baud rate: 9600
No tab char	Paper type: Plain paper
Send angle	Lines per page: 66
Send torque	

Communication protocol: Hardware

Communication baud rate: 9600

Item	Default setting
Measurement units	in lb
Angle offset	0.0 (deg)
Manual dampening	2
Peak dampening	None
Light time-out	00:05:00
Power time-out	00:20:00
Company	Your Company Name
City	Anytime, USA

Calibration	Default Setting
Coarse Gain	3413
Fine Gain	1.0000
Coarse Offset	2048
Fine Offset	0

11 TESTER MAINTENANCE

Routine maintenance is limited to periodic cleaning. Keep linear bearings clean and grease in six-month intervals to maintain smooth motion. **The tester should be calibrated annually. Contact LSI at (763) 780-2131 for service.**

WARRANTY

Larson Systems Inc. warrants the Torsion Spring Tester to be free from defects in material and workmanship for a period of twelve months from the date of purchase. This warranty covers all parts. It applies only to testers and accessories which have been installed and operated in accordance with instructions in our operating manual, have not been tampered with in any way, misused, suffered damage through accident, neglect, or conditions beyond our control and have been serviced only by authorized personnel.

Larson Systems Inc. is not responsible for loss in operating performance due to environmental conditions, such as humidity, dust, corrosive chemicals, deposition of oil or other foreign matter, spillage, or other conditions beyond our control. There are no other warranties expressed or implied, and Larson Systems Inc. shall not be liable under any circumstances for incidental or consequential damage.

PROCEDURE FOR WARRANTY SERVICE

1. Request an RMA number from Larson Systems Inc.
2. Ship the tester freight prepaid to:

> LARSON SYSTEMS INC.
> 10073 Baltimore St.
> MINNEAPOLIS, MN 55449
> PHONE: (763) 780-2131
> FAX: (763) 780-2182

Note!   Any shipment sent freight collect will be rejected.
3. Warranty determination will be made at the factory. Warranty service will be processed promptly.
4. The tester will be returned freight collect per LSI's current shipping procedures.
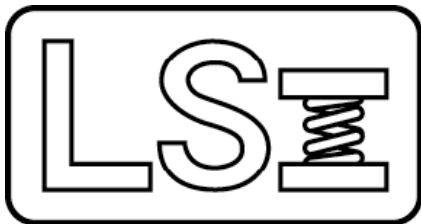
Larson Systems Inc.
10073 Baltimore Street NE
Minneapolis, MN 55449-4425

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