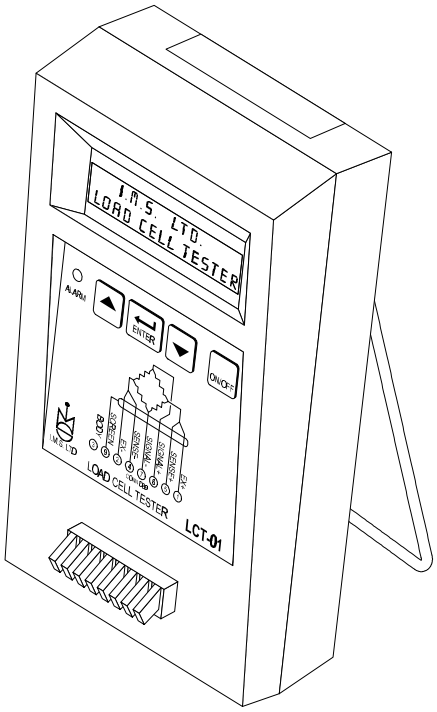
Load-Cell Tester

Model LCT-01



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The information in this manual is considered accurate as of the time of publication. I.M.S. reserves the right to modify features of the LCT-01 at any time.

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The Strain Gauge Load Cell

Strain gauge weighing is based on the measurement of the deformation of metal as a result of compression, tension, flexion, shearing or torsion. Weight placed on a strain gauge load cell deforms its component metal spring elements, and the deformation of these thin metal filaments is measured by sensor elements, or strain gauges. The strain gauges, usually four or a multiple of four, are connected into a Wheatstone bridge configuration (Figure 1) in order to convert the very small change in resistance into a usable electrical signal. In addition, passive components such as resistors and temperature dependent wires are used to compensate and calibrate the bridge output signal.

Consider the example of an axial type load cell, which usually consists of a hollow or solid cylindrical shaft and four strain gauges mounted around the circumference. The strain gauges are mounted and connected to form a Wheatstone bridge circuit. The basic relation of Stress = Load/Area ($\sigma = P/A$) and Strain = Stress/Young's module ($\varepsilon = \sigma/E$) can be used to determine the strain under different loads.

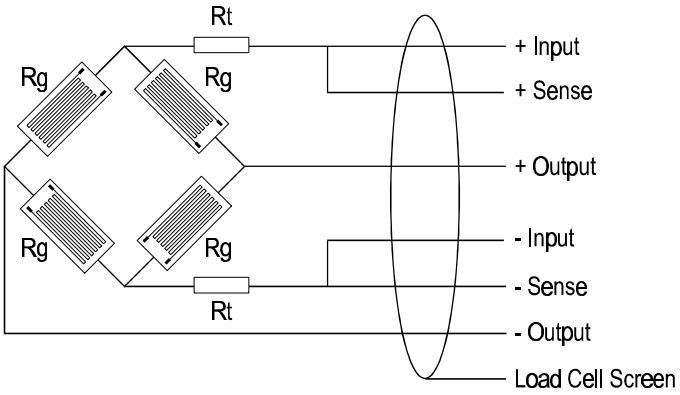


Figure 1: Typical Full-Bridge Electrical Circuit for a Six-Wire Load Cell

Rg	Strain Gauge
Rt	Temperature Compensation Resistor

The relation between the applied load and the output signal may be found by calibration: applying known loads and measuring the resultant output voltage. The resulting curve in most load cells is almost linear, and this calibration allows for the conversion of the output signal to its source: the applied load.

Consider the example of a load cell with a rated output of 2 mV/V, and a maximal load of 10 kg. If the output signal with no load is 0, feeding the load cell with 10 V excitation voltage will result in an output signal of 20 mV when the applied load is 10 kg. Since the output signal is linearly proportional to the load applied, a 5 kg load would give an output signal of 10 mV.

In every load cell the rated output, the available excitation voltage, and the maximal load are defined in the manufacturer's specification.

Functions of the LCT-01

The LCT-01 is a hand-held, easy-to-use device which requires no special training or expertise to operate. The LCT tests either four-wire or six-wire load cells, covering the whole range of load cell output.

The LCT-01 supplies a quick initial evaluation for all types of strain gauge load cells. Due to its portability and design, the LCT-01 is useful not only in laboratories, but also on-site in hard-to-access locations. The load cell can be tested without being removed from the installation.

LCT-01 Tests Performed

1. Resistance between the Exc+ (INPUT+) and Exc- (INPUT-) lines
2. Resistance between the Sig+ (OUTPUT+) and Sig- (OUTPUT-) lines
3. Resistance between the cable shield and all other lines
4. Resistance between the load cell body to all lines
5. Dynamic test of the load cell, including
   - Voltage feeding in load cell input
   - Measuring load cell output voltage
   - The output voltage represented as a percentage of the voltage that the tested load cell should produce at maximal load
6. Resistance between the Exc+ (INPUT+) and Sense+ lines (six-wire load cells only)
7. Resistance between the Exc- (INPUT-) and Sense- lines (six-wire load cells only)

Approximated Linearity Test

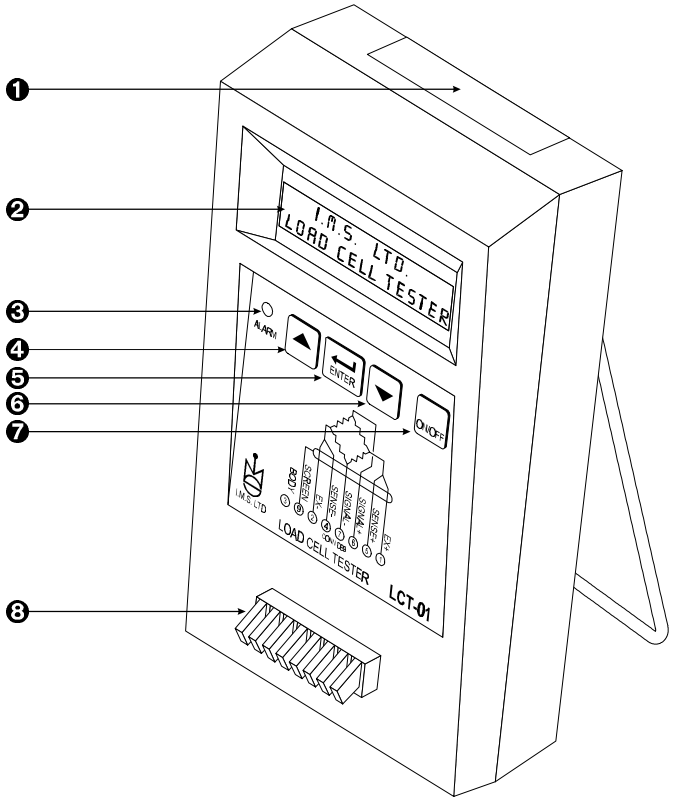
The LCT-01's dynamic test reports the current load as a percentage of the maximal load. Using this figure you may perform an approximated linearity test of the load cell by testing the load cell with various loads and comparing the ratio between the reported percentages with the ratio of the loads.

For example, if the current output signal displayed by the LCT-01 is 26% for a 10 kg load cell, increasing the current load by 1 kg (10% of the 10 kg maximal load) should add 10% to the displayed output signal. If the load cell is functioning correctly, the expected output signal for a 1 kg load should therefore be 36%.

Weighing Platform Balancing

When a load must be homogeneously distributed among several load cells, the LCT may be easily used for balancing the scale.

LCT-01 Parts Identification



1	Battery Compartment	5	Enter Button
2	LCD Display	6	Scroll Down Button
3	Alarm Light	7	On/Off Button
4	Scroll Up Button	8	Wire Connectors

Battery Installation

The LCT-01 is powered by four standard AA batteries. Because power is supplied to the load cell only during the dynamic test (for one second) the batteries should last for over 500 hours of testing.

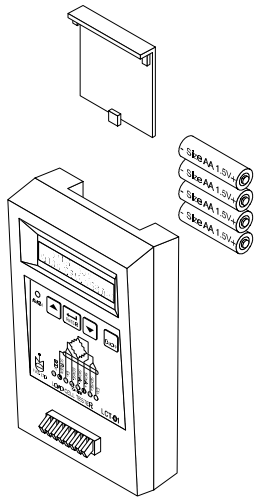
If the LCT-01 is idle for five minutes it will automatically shut down. Previously entered load cell characteristics, as well as the last test results, are maintained in memory until the unit shuts down.

Note: To reuse the previous load cell characteristics press the Scroll Down button periodically in order to restart the five-minute countdown.

When the batteries need replacing you will see the following message on the LCD Display:

```
    LOW BATTERY
REPLACE BATTERY!
```

To replace or install batteries follow the procedure below:



1. Remove battery cover
2. Insert batteries
3. Replace cover

Note: Maintain proper polarity when inserting batteries.

LCT-01 Test Procedure

Follow the procedure below to test your load cell. You will find it useful to have the load cell specification sheet available.

When several load cells are connected in parallel, such as in a weighing platform, the LCT-01 will test the entire installation by connecting it directly to the summing box. To check the functioning of each load cell, the test should be performed on each load cell individually.

Attach Load Cell Wires

Attach load cell wires according to the wiring code provided by the manufacturer (refer to page 16 for the color wiring guide). When the wires are connected, press the ON/OFF button.

You will see the following screen as the LCT-01 performs its self-test.

```
   I.M.S.  LTD
LOAD CELL TESTER
```

Note: If the screen is blank or if you see a low battery warning replace batteries (page 9).

Load Cell Type

Next you will be prompted for the load cell characteristics.

```
LOAD CELL TYPE?
4or6 wires 4   Õ ↵
```

The LCT-01 will ask if you are testing a four-wire or six-wire load cell. Six-wire load cells include Sense+ and Sense- (used to detect the voltage drop along the wire) which run in parallel to the Input+ and Input- wires.

Press the Scroll Up key to change the default answer. When the display is correct, press the Enter key.

Load Cell Output Rate

Load cell output ranges between 1 mV/V and 5 mV/V (most common being 2 mV/V and 3 mV/V), depending on the model and type of load cell. The output rate scales the voltage transmitted by the load cell in the Signal lines which is used in the Output Signal result.

The default Load Cell Output is 2.0 mV/V. Adjust the rated output according to the load cell specification sheet by pressing the Scroll Up or Scroll Down key. The value will change in increments of 0.1 mV. Press the Enter key to accept the displayed output.

```
L/C RATED OUTPUT
 (2.0mV/V) Õ Ô ↵
```

Start Test

The LCT-01 will now ask you to make sure that the wires are connected. Press the Enter key to begin the test.

```
WIRES CONNECTED?
PRESS ↵ TO START
```

Dynamic Test

After pressing the Enter key, the LCT-01 will perform the dynamic test.

```
TEST IN PROGRESS
PLEASE WAIT...
```

When the test is over you will see the following screen:

```
* END OF TEST   *
................
```

After approximately one second this screen is replaced by the screen below.

```
PressÕ to SCROLL
Press↵ to START
```

Press the Scroll Up key to view the test results, or press Enter to run another test.

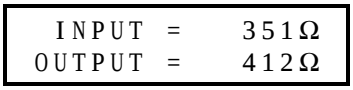
Note: The load cell characteristics you set in the first test stay in memory until the LCT-01 is turned off or powers down after five minutes of inactivity.

LCT-01 Test Results

If the LCT-01 finds results that definitely indicate faulty load cell function, the Alarm LED will flash, a short beep will sound, and the atypical result will blink in the relevant results screen.

Note: Absence of an alarm does not indicate that the load cell is functioning properly. Always compare the LCT-01 results with the data sheet of your load cell.

Input / Output Test



Input

Measured Value	Resistance between the Exc+ and Exc- lines
Tested Function	Input bridge resistance (up to a maximum of 8KΩ)
Result	Should match the load cell manufacturer's input specification. If testing several load cells in parallel, the optimal value is the manufacturer's specification divided by the number of load cells connected in parallel in the installation.
Minimum / Maximum value	1 Ω / 8KΩ
Blinking Display	Resistance less than 50Ω or more than 8KΩ

Output

Measured Value	Resistance between the Sig+ and Sig- lines
Tested Function	Output bridge resistance (up to a maximum of 8KΩ)
Result	Should match the load cell manufacturer's output specification. If testing several load cells in parallel, the optimal value is the manufacturer's specification divided by the number of load cells connected in parallel in the installation.
Minimum / Maximum value	1 Ω / 8KΩ
Blinking Display	Resistance less than 50Ω or more

	than 8KΩ

Shield / Ground Test

```
SHIELD > 10MΩ
GROUND > 10MΩ
```

Shield

Measured Value	Resistance between cable shield and all lines
Tested Function	The sum of load cell and cable resistance
Result *	A result above 10 MΩ usually indicates normal function. For most load cells the value is 5000 MΩ
Minimum / Maximum value	0.01 MΩ / 10 MΩ
Blinking Display	Resistance less than 10 MΩ

Ground

Measured Value	Resistance between load cell body and all lines
Tested Function	The sum of load cell and cable resistance
Result *	A result above 10 MΩ usually indicates normal function.
Minimum / Maximum value	0.01 MΩ / 10 MΩ
Blinking Display	Resistance less than 10 MΩ

* Note: If the reason for testing the load-cell was a non stable, or drifting, result, it is recommended to check the resistance between the shield and lines with a device suitable for checking up to 1000 MΩ.

Sense Pos. / Sense Neg. Test (6-wire load cells only)

```
SENSE Pos.    <1Ω
SENSE Neg.    <1Ω
```

Sense Pos.

Measured Value	Resistance between Exc+ and Sense+ lines
Tested Function	Feedback of positive input voltage
Result	Low resistance (depending on cable length) is normal
Minimum / Maximum value	0.1 Ω / 99 Ω
Blinking Display	Resistance higher than 10 Ω

Sense Neg.

Measured Value	Resistance between Exc- and Sense- lines
Tested Function	Feedback of negative input voltage
Result	Low resistance (depending on cable length) is normal
Minimum / Maximum value	0.1 Ω / 99 Ω
Blinking Display	Resistance higher than 10 Ω

Signal Output Test

```
SIGNAL  OUTPUT
EQUIVALENT   +9%
```

Signal Output

Measured Value	Voltage between Sig+ and Sig- lines
Tested Function	Voltage of load cell output
Result	The measured voltage is represented as a percentage of the full scale based on the load cell output rate (in mV/V) specified by the user when defining load cell characteristics (see page 10)
Blinking Display	a Beyond ±100% b As a result of a failure in previous tests. The LCT-01 will display "CAN NOT MEASURE."

Example

If a load cell's maximum load is 100 kg, applying a 10 kg load during a test should give a 10% change in the result.

Load Cell Color Wiring Guide

Manufacturer	+Excitation	-Excitation	+Signal	-Signal	+Sense	-Sense	Screen
Artech	Red	Black	Green	White			Bare
A&D Engineering	Red	White	Green	Blue			Yellow
Allegang	Green	Black	White	Red			Bare
Alphatron	Red	Black	Green	White			Bare
Bongshin	Red	White	Green	Blue			Yellow
Beowulf	Green	Black	White	Red			Bare
BLH	Green	Black	White	Red			Yellow
Cardinal	Green	Black	White	Red			Bare
Celtron	Red	Black	Green	White			Bare
Digi	Red	White	Green	Yellow			Silver
Electroscale	Red	Black	Green	White			Bare
Evergreen	Green	Black	White	Red			Bare
Flintab	Green	Black	White	Red			Yellow
General Sensor	Red	Black	Green	White			Bare
Genisco	Red	Black	Green	White			Bare
GSE	Red	Black	White	Green			Bare
HBM	Green	Black	White	Red			Yellow
HBM (PLC, SBE)	Red	Black	Green	White			Yellow
Huntlleigh	Green	Black	Red	White	Blue	Brown	Bare
Interface	Red	Black	Green	White			Bare
Kubota	Red	White	Green	Blue			Yellow
LeBow	Red	Black	Green	White			Bare
National	Green	Black	White	Red			Yellow
NCI	Red	Black	White	Green	Yellow	Blue	Bare
Nikkel	Red	Black	Green	White			Bare
Ormond	Red	Black	Green	White			Bare
PT	Red	Black	Green	White	Brown	Blue	Bare
Phillips	Red	Blue	Green	Gray			Bare
Revere	Green	Black	White	Red			Orange
Rice Lake	Red	Black	Green	White			Bare
Scaime (AG)	Brown	Green	Yellow	White	Gray	Pink	Bare
Sensortronics	Red	Black	Green	White			Bare
Sensortronics (60007)	Green	Black	White	Red			Yellow
Sensotec	Red	Black	White	Green			Bare
Strainsert	Red	Black	Green	White			Bare
T-Hydronics	Red	Black	Green	White			Bare
Tedea	Green	Black	Red	White	Blue	Brown	Bare
Thames Side	Red	Blue	Green	Yellow			Bare
Toledo	Green	Black	White	Red			Yellow
Totalcomp	Red	Black	Green	White			Bare
Transducers	Red	Black	Green	White			Orange
Transducers Sys.	Red	Green	Yellow	Blue			Bare

Notes

Notes

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