



## Using the *LCT100* for Load Cell Troubleshooting

### In General

The load cell sensor used to sense weight and force under a wide range of adverse conditions and various environment like; vibrations, high moisture etc.

Load cell might be damaged because of overloading, chemical or moisture ingress, lightning strikes, mishandling (dropping or side hitting), vibrations, cable and connector problems or internal components malfunction. As a result, the system might provide unstable/unreliable readings, zero drifting or even stop from functioning.

The portable load cell tester model LCT100 allows to perform a complete and professional test in 1 minute and saving the need for the following equipment:

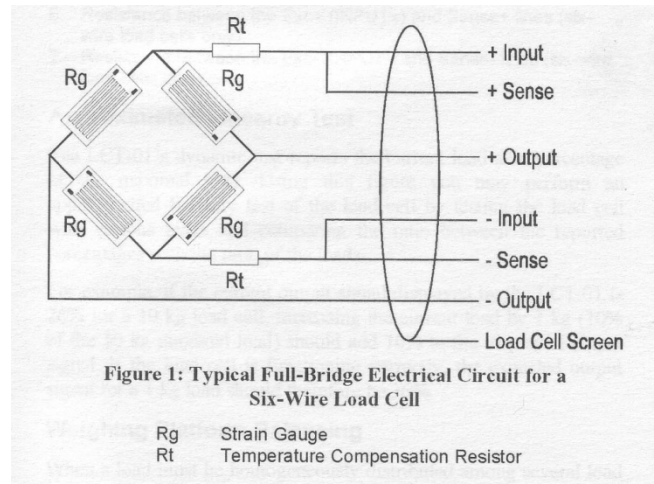
- High quality digital volt meter with high measuring accuracy to measure the zero balance, bridge integrity and signal output
- A Mega-Ohmmeter (Megger) capable of reading up to 5000 Mega-Ohm to measure the insulation resistance
- A stable power supply
- A calculator to do all required calculations to check scale / load cell linearity

### Doing the troubleshooting

Carefully do a visual inspection to check the system integrity for the followings:

- Damage, corrosion on the load cell body
- Cable integrity and connections inside the junction/summing box
- Water or chemical ingress inside the summing box
- Force shunts due to dirt or mechanical misalignment

Note: The load cells are produced according to specifications which generally described in the product data sheet. In most cases you get detailed information on the calibration certificate that comes with each load cell. It will mention the exact values for the input/output resistance, insulation resistance, zero balance rated output and the wiring code.



**Figure 1 A typical scheme of 6 wires load cell**

## Testing the Zero Balance

The zero Balance is defined as the load cell output when it's not loaded. The LCT100 will show the output in percentage from the full scale. For example: Testing a load cell with a load capacity of 100kg when it's not loaded, we expect to get a result around 0% while if we apply 40kg on the cell, we expect to see around 40%.

Changes in Zero balance occur if the load cell has been permanently deformed by overloading or excessive shock or metal fatigue. Also, moisture ingress will change the strain gages resistance and will affect the zero balance.



**Figure 2 Zero output when load cell is loaded**

Note: In most calibration certificates, the manufacture will show the zero balance that was measured while testing the cell. It doesn't have to be exactly 0% and it can vary around zero. By going back to the example above, if the zero balance is 0.32% so, after applying 2kg we expect to see 2.32%.

## Bridge Integrity

The bridge integrity is verified by measuring the input (excitation voltage) and Output (Signal) resistance. Results must be the same as in the original calibration certificate or the data sheet specifications.

Changes in the bridge resistance are most often caused by a broken or burned wire, electrical component failure or short circuit. This might have happened due to vibrations, excessive temperature or from lightning or welding.



**Figure 3 Typical bridge input/output results**

Note: In most load cells the manufacturer will add internal compensation resistors to compensate temperature changes (figure 1). Therefore the input and output resistance of the bridge are not identical.

## Insulation Resistance

The insulation resistance is measured between the load cell circuit and the cable shield and the load cell body.

The LCT100 will measure the resistance between the bridge and the cable shield, between the bridge and the load cell body and between the load cell body and cable shield.

The insulation resistance of the 3 measurements should be higher than 3000 MΩ when typically it will be 5000 MΩ or more. A lower value indicates electrical leakage caused by moisture ingress within the load cell body or, the cable. It results in unstable reading and stability changes with temperature.



Figure 4 showing the insulation resistance results. The right one is an example of bad result and led turns red

Note: To get accurate insulation reading, it is **important** to perform a quick calibration on the LCT100 before conducting the test otherwise, the insulation resistance results will be wrong. First make sure to connect only the 4 / 6 wires to the tester and leave the cable screen and body not connected (those are the 2 left pins on the connector). Turn on the device and simultaneously press the 2 right buttons (marked for calib) . The display will show that the unit is being calibrated and in few second it is ready for the test. Now connect the screen and shield and perform the test. There is no need to run the calibration procedure in case of not measuring the insulation resistance.

### Shock Resistance and repeatability

This test can be done by choosing the “gain” test from the menu. In gain mode, the LCT100 performs as an indicator - continuously showing the load cell output in percentage from the full scale. Lightly rap on the cell to shock it and watch the readings during the test. Those should not become erratic and return to original zero when stop rapping. Erratic readings may indicate a failed electrical connection or damaged glue layer between strain gage elements.



Figure 5 Typical reading when load cell is not loaded

## Testing Linearity

This test is conducted by choosing the “gain” test from the menu. By applying a known weight on the scale / load cell you should see a percentage change which must be equivalent to the applied weight in percentage from the full capacity of the load cell. For example; 10kg weight on a 50kg scale will show 20% change, while 50kg will show 100% change. Results that show a non linear load cell, may indicate force shunts that might be caused by dirt, mechanical misalignment or accompanying components. It is recommended to do this test with few weights to check the full range of the load cell / scale.



**Figure 6 performing a linearity test with 3 weights**

Note: The linearity test can be done on a single load cell or on a complete scale by connecting the LCT100 to the junction box that summing all the load cells. The test can be done even when you don't know exactly the load cell gain (mv/V) - by watching the percentage change on known weight. For example if 10kg shows 8.5% change adding another 10kg must show 17% etc.

## Distinguishing Between Four- and Six-Wire Load Cells

Both four- and six-wire cells have +/- Input (excitation) and +/- signal lines, while six-wire cells have + and - sense lines, connected in parallel to the input lines. (Figure 1).

The sense lines used to actually measure the excitation voltage at the load cell and feed this back to the indicator that modifies its amplifier or its output voltage to compensate for resistance fluctuations (caused by temperature changes ) on the cable.

A 4 wire cell is calibrated and temperature compensated with a certain length of cable and must perform within a specific temperature range. Never cut or extend the length of a 4 wire cable.

Unlike four-wire load cells, six-wire cables do not contain a temperature compensating system and the sense wires are critical for best performances especially with long cables.

The resistance between sense+ and Input+ and Sense- and Input- must remain in the range of few ohms. High resistance means a cable problem or broken wires inside the cell.



**Figure 7 Typical reading when sense lines are OK**

Note: Make sure to choose 6 wires load cell to perform this test. If 4 wires were chosen, the LCT100 will skip the sense test,