Load Cell Troubleshooting Guide

Reliable Scale Corporation
6 – 1480 28 Street NE
Calgary, AB, T2A 7W6
Canada
Tel:1-800-419-1189
(403) 272-8784
Fax: (403) 273-9818
www.reliablescale.com
info@reliablescale.com

1. Contents

2. Revision History

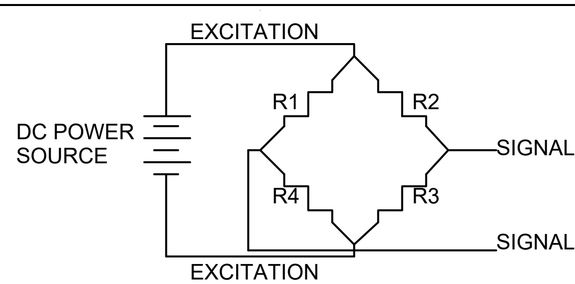
Date	Init.	Revision Detail
Apr 17/01	GEO	Original
Jul 3/20	GPO	Contact information update, added Load cell Worksheet

3. Load Cells - General Description

A load cell is a force sensor which receives a voltage (excitation) from a regulated power source (usually a digital indicator or signal conditioner) and sends back a low voltage signal (signal) when force is applied. The load cell signal is converted to a visual or numeric value by a "digital indicator". When there is no load on the cell the two signal lines are at equal voltage. As a load is applied to the cell, the voltage on one signal line increases very slightly and the voltage on the other signal line decreases very slightly. The difference in voltage between the two signals is read by the indicator.

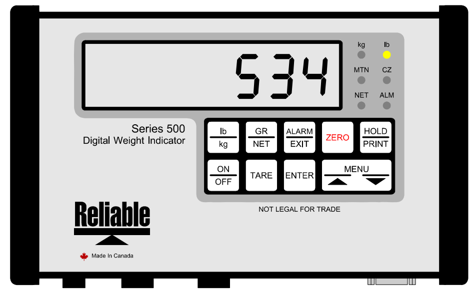
The load cell core is usually made of good quality steel or aluminum. The circuit consists of precision foil resistors called strain gages connected in a configuration called a Wheatstone bridge. The gages are bonded very securely to the metal where they sense very small deflections in the metal caused by the load being applied to the cell. Because the signal levels are very small, the circuit must be protected from all outside influences such as moisture, physical damage or electrical interference.

A **Wheatstone Bridge** schematic is shown on the right. The 4 strain gages are shown as R1, R2, R3 & R4. The DC voltage source is supplied by the digital indicator. The signal lines are also connected to the digital indicator.

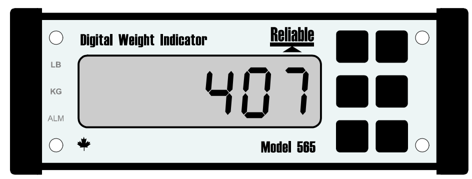


WHEATSTONE BRIDGE

4. Digital Indicators - General Description



Digital weight indicators are instruments which convert electronic signals into a visual display. These indicators may have some data storage capability and may be used to control external devices such as gates or lights.



Some of our digital indicators built for general purpose use while others are designed for a specific application or industry.

Most digital indicators supply a DC voltage (excitation) to the load cell. Excitation voltages are well regulated and are normally between 5 and 15VDC, depending on the indicator manufacturer. Load cell response is normally 3.0(or lower) mV/V of excitation; i.e., the load cell milli-volt signal will be 3.0 X the excitation voltage when loaded to full capacity.

For example; A 3.0mV/V load cell will have 24 mV signal when loaded to capacity while connected to an 8VDC excitation supplied by a digital indicator.

5. System Faults & Failures

Do not hesitate to contact your supplier for assistance and advice. He has the resources and experience to help you diagnose most problems over the phone.

5.1 Reading does not return to "0" when load is removed.

There are several possible causes:

5.1.1 Binding at the Load Sensor

External equipment rubbing against the load cell or weighing platform can have a significant effect on the readings. It is most easily noticed at the "0" return point.

5.1.2 Dirt, Ice or Mud at the Load Sensor

Materials such as ice or mud which can harden and freeze the platform to the foundation can introduce serious errors to the readings. Normally, cleaning around the load cell area or platform will correct the problem. Be careful not to cut a load cell wire during the cleaning process.

5.1.3 Over stressed Load Cell

If the metal core of the load cell has been loaded beyond its elastic limit, the readings will not return to "0" properly. This occurs most often if a load cell has been subjected to a heavy shock load.

5.2 Unstable Reading Possible Causes:

5.2.1 Poor power supply.

1. Check supply voltage. Voltage levels below 11.5 VDC can be expected to cause fluctuations in the readings.
2. Check current capacity of supply system. Reliable Scale indicators can be expected to draw 200 to 400mA at 12 VDC depending on the application.

5.2.2 Poor load cell connection.

1. Check physical condition of connectors, pins & sockets.
2. Check the cable carefully for its entire length. Watch particularly for cuts in the jacket, twists or pinches. Flex the cable thoroughly to detect any internal breaks. Watch the display for sudden reactions while flexing the cable.

5.2.3 Indicator Fault

1. Digital indicator may have damage to one of its circuits
2. Digital indicator may be severely out of calibration.
3. Digital indicator/load cell combination may require coarse zero adjustment.

Do not hesitate to contact your dealer or the manufacturer.

5.3 Readings drift slowly up or down

1. Check for moisture (ground loop) in the load cell. See section 6.2 on page 8.
2. Check effect of sudden temperature change on the load cell and indicator.

5.4 Indicator flashes “Over” or ‘Under”

1. Check load cell connection & cable as described in section 5.2.2 on page 5.
2. Check cell for possible over stress. See section 6.3 on page 10.
3. Check for proper calibration of digital indicator.

6. Load Cell Tests

The load cell should be checked while disconnected from the indicator.

6.1 Bridge resistances

Use a digital multi-meter set to ohms (Ω).

Check the resistance readings between all of the pairs of wires on the load cell cable (or pins on the connector). The example below uses Reliable Scale Corporation standard colour code and a 350 Ω bridge.

Red (+) excitation	Black (-) excitation	Orange - Shield
Green (+) signal	White (-) signal	

Example: Normal Load Cell

red/black	428 Ω - can be 350 or more, usually 390 or more
red/green	302Ω - above 262.5, usually 282.5 or more
red/white	302Ω - <u>must</u> be same as red/green
black/green	301Ω - above 262.5, usually 282.5 or more
black/white	301Ω - <u>must</u> be same as black/green
green/white	350Ω - should be exactly 350, but may vary by (+ -) 2Ω because of errors in the meter being used.
shield/any colour	should show "open" circuit i.e.,: no connection

Recommendation: If you don't see the pattern shown in the example:

1. Double check your readings
2. Call the load cell manufacturer for assistance. Most have a 1-800 number to call.

6.2 Checking for moisture (Ground fault / Insulation resistance)

Moisture in the load cell will allow a small voltage "leak" between the strain gage circuit and the metal "body" of the cell. If this occurs, the readings on the indicator will be very unstable or impossible to read. This "leak" is called a ground loop and can be detected using a meter capable of measuring very high resistances.

You will need a multi-meter with a resistance range of 2000 Megohms or more. Most multi-meters are seldom used for measuring such high resistances, so manufacturers do not include the high range required for ground loop testing. We use a Wavetek model 15XL for this test. It is not an expensive multi-meter but it does have the range required and it works well.

1. Set the meter range to 2000Megohms.
2. We include this step to demonstrate the sensitivity of the multi-meter. Hold the probes, one in each hand, making sure that you have good skin contact on the tip of each probe. The multi-meter will begin fluctuating, giving a reading somewhat above 010. This reading is the electrical resistance of your body.
3. Hold the load cell wires (one or more) and one meter probe between your left thumb and forefinger. Make sure the probe and the wire are making good contact.
4. Take the other probe in your right hand. Make sure that your hand is <u>not</u> in contact with the metal of the probe. The meter can sense the electrical resistance of your body if you touch the two probes at the same time. There is no danger in this but it will invalidate the test.
5. Momentarily touch the two leads to the steel (or aluminum) of the load cell. This creates a momentary short and ensures good contact with the

steel. The meter reading should drop to 010 megohms.

6. While the reading on the multi-meter is climbing, touch the probe in your right hand to the metal case of the cell. Be sure that dirt or corrosion do not prevent the probe from contacting the metal. We recommend scratching the probe against the load cell until you can see freshly exposed metal.
7. If the multi-meter reading continues to climb past 1999 megohms there is probably no moisture in the cell. If the reading goes back to 010, there is either a short or severe moisture in the cell. If the reading fluctuates but does not go all the way up (1999) or down (010), there is likely some small amount of moisture seeping into the cell.

If the reading does not go past 1999 megohms, the cell must be replaced. A qualified load cell repair shop can likely return the cell to good operating condition.

6.3 Over Stressed Load Cells

Load cells which have been severely overloaded will "take a set" and will not operate properly. Over stressing is not common, but it does happen on occasion if shock loads have been applied. It is sometimes difficult to diagnose an over stressed cell, but there are some symptoms to watch for.

Symptoms:

1. The digital indicator may show an "over" condition. If the indicator "coarse zero" is able to clear the "over" error, the indicator may not return to zero properly after loading and unloading the cell. Be careful not to confuse this behaviour with mechanical interference from an outside source. In other words, be sure that nothing is rubbing against the cell or loading mechanism, causing erroneous readings.
2. The digital indicator may show an unreasonably high reading and operate sluggishly. In this case too, be sure there is nothing rubbing against the cell.
3. There is visual deformation of the cell body.

If you suspect over stressing of a load cell, have it checked out by a qualified repair shop. Over stressed load cells cannot normally be repaired.

7. Checking the Indicator/Load Cell as a System

After the load cell has been checked for resistances and ground loops, it should be checked while connected to a digital indicator. Some indicators operate on 115vAC power while others use 12VDC. Always check the indicator power requirements before connecting it to the power source. If battery power is being used be sure the battery is properly charged. A low battery will result in unstable or incorrect readings.

7.1 Checkout Procedure

1. Connect the load cell to the indicator. If the indicator has screw terminals be sure the screws are tight and that good contact is made with the load cell wires. Good contacts throughout the system are critical. If crimp-on connectors are used on the load cell wires, they should be soldered as well as crimped. Crimp-on connectors are a common cause of unstable readings. If connectors are used they should be clean and in good condition. Corroded, wet, or poorly assembled connectors frequently cause problems.
2. Turn the indicator ON and wait a few seconds for readings to stabilize. The reading is not necessarily at “0”. It should be stable and respond to load being applied to the cell.
3. Press the ZERO key. The reading should go to “0” and stay there.
4. Set your multi-meter to the 20 or 30VDC range.
5. Read the voltages between the four load cell connections. The shield connection is not connected to any part of the load cell circuit, so there is no need to check it. The example below shows typical voltage readings.

   Example: An indicator supplying 8VDC to the load cell (same cell as p 3).

Red/black 8.000VDC

Red/green 4.000 VDC

Red/white 4.000 VDC

Green/white 0.000 VDC (at no load)

6. Set the meter to the mv range. There may be a small signal between green & white wires; in this case the maximum reading would be 24.00 mV when the load cell is loaded to full capacity; (8.000VDC X 3.0mV/V = 24.00mV) .

8. Glossary of Terms

Binding: Something external to the weighing system is preventing the load cell or weigh platform from moving freely. Symptoms include poor return to "0" and sluggish response to changes in weight.

Bridge : Wheatstone Bridge; A type of electronic circuit used extensively in load cells (transducers). It must have at least four resistive devices (gages) to form a bridge, one in each of the four legs of the circuit.

Capacity: The amount of load (weight) a load cell is rated to handle.

Deadload: The amount of load (fixed force) on a scale system prior to actual loading, i.e., weight of platform, cage, cattle squeeze, etc.

Load Cell Calibration: The output voltage signal (mV/V) produced by the load cell; Example: 2.000 mV/V ±1% @ rated load

Output: The voltage signal the load cell is producing at a specific load (weight). This signal is written as millivolt per volt at a specified capacity; written mV/V. Example : 2.000 mV/V@ 15,000 lb.

System Calibration: Adjusting displayed value on an indictor to match a known load (weight) being applied to the weighing system. The indicator correlates a weight (lb) to a load cell signal (mV/V @ _lb).

System Capacity : The amount of load a load cell, or combination of cells and mechanisms designed to support.

9. For Your Notes:

10. Load Cell Evaluation Form

Job No. / Location	
Manufacturer	
Model	
Capacity	
mV Output	
Colour Code / Pinout	+Ex ____ -Ex ____ +Sig ____ -Sig ____ Shld ____

S/N			S/N		
Identifier			Identifier		
Cable Condition			Cable Condition		
Connector Cond.			Connector Cond.		
+Ex to -Ex			+Ex to -Ex		
+Sig to -Sig			+Sig to -Sig		
+Ex to +/- Sig			+Ex to +/- Sig		
-Ex to +/-Sig			-Ex to +/-Sig		
Ground Fault			Ground Fault		

S/N			S/N		
Identifier			Identifier		
Cable Condition			Cable Condition		
Connector Cond.			Connector Cond.		
+Ex to -Ex			+Ex to -Ex		
+Sig to -Sig			+Sig to -Sig		
+Ex to +/- Sig			+Ex to +/- Sig		
-Ex to +/-Sig			-Ex to +/-Sig		
Ground Fault			Ground Fault		