LOAD CELL TROUBLESHOOTING

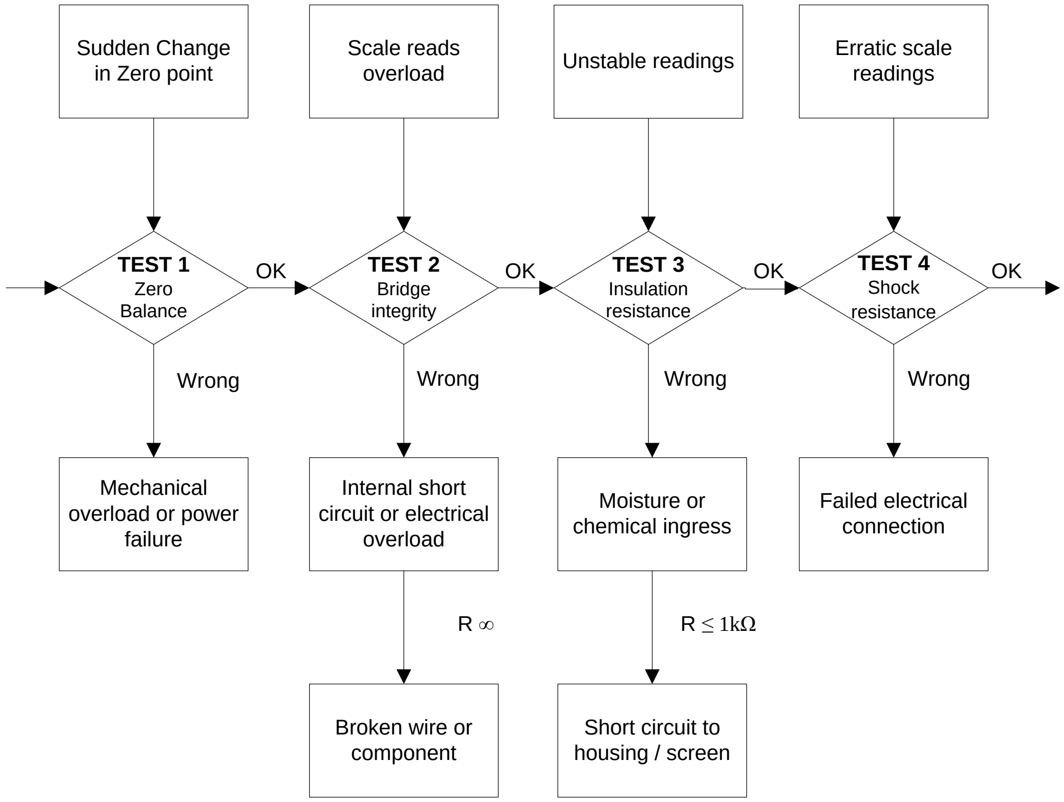
The objective of this Technical Note is to perform a simple check to identify troubleshooting of a load cell on the field, by using simple instrumentation as a digital multimeter and a test load.

Visual Inspection

The first step is to make a visual inspection of the load cell to detect a defect or a change in respect a new one. Check the following:

- Inspect the general appearance of the load cell: It must be clean without dirt or corrosion.
- Inspect the sealing: It must isolate internal circuits from moisture or other contaminants.
- Silicone or metallic covers must remain intact, without cuts, impacts, corrosion or holes.
- Inspect the cable: It must keep the original length, without damages as cuts or twisting.
- Inspect the cable's gland: It must not be manipulated.

Test procedure

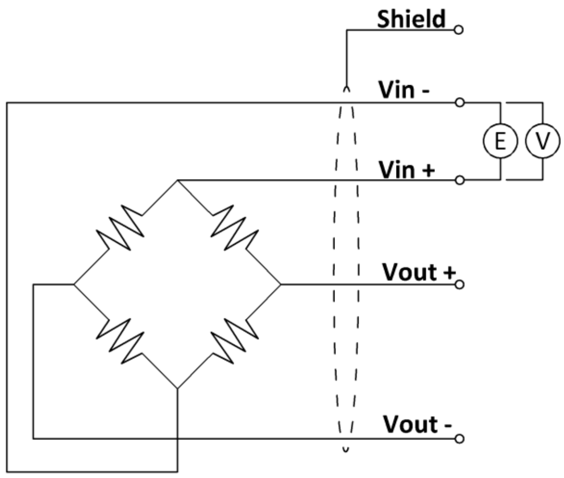


<u>TEST 1. Zero balance</u>

The objective is to verify if output signals delivered by the load cell are coherent. Connect load cell's excitation wires V_{IN+} (green) and V_{IN}- (black) to the power supply of the electronic indicator used on the scale, and disconnect signal wires V_{OUT+} (red) and V_{OUT-} (white). Then take note of the following measures:

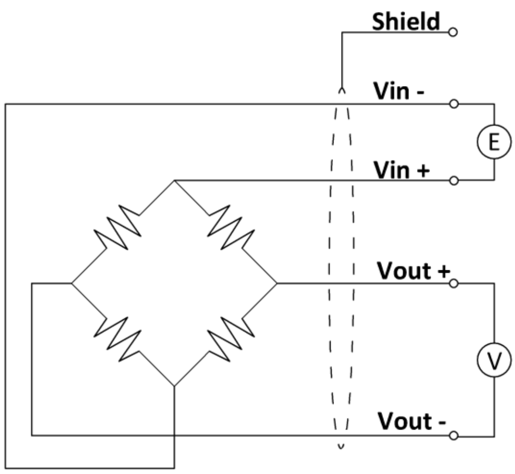
Power supply voltage (V)

Verify that correct supply voltage is delivered to the load cell, measuring voltage across load cell's wires V_{IN+} (green) and V_{IN-} (black).



Output signal without load (mV)

Put the load cell in working position without any dead load on it, and read the mV output signal across output wires V_{OUT+} (red) and V_{OUT-} (white). The output signal must be stable and must have a value within manufacture tolerances: ±2% of 2mV/V = ±0,04 mV/V; if power supply is 10V then it will be within ±0,4 mV. The load cells can normally work with zero shifts of around 10%, so the scale can normally be recalibrated when the zero shift of the load cell remain within ± 0,2 mV/V; if power supply is 10V then it could be within ± 2 mV.



Output signal with load (mV)

Put the load cell in working position and apply a test load while reading the output signal in mV across wires V_{OUT+} (red) and V_{OUT-} (white). Do the following checks:

- **Signal growing in correct sense.** Apply a force (even manually with the hand) to see if the signal moves to the prearranged sense.

- **Signal stability:** Put or hang a static load, without any vibrations, and see signal stability, it has to be better than ±0,002 mV (± 2 microV/V).

Analysis:

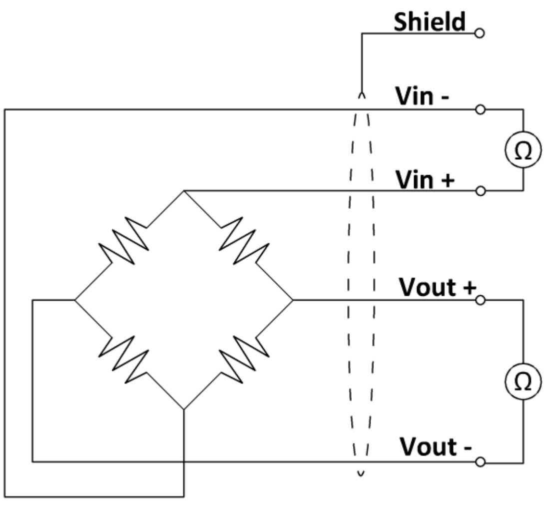
- If power supply is not constant and sufficient to feed the load cell, it is necessary to verify if there is an irregularity in the power supply and check wiring connections between the load cell and the power supply.
- Changes in zero balance occur if the load cell has been permanently deformed due to mechanical overloads or shocks.
- Load cells that experience progressive zero output changes per time period can be affected by moisture, insulation fails or changes in bridge integrity.
- In case that output signal doesn't grow in the prearranged applied load sense, it's necessary to verify wiring connections.

TEST 2. Bridge integrity

The objective is to verify if the internal load cell's electrical circuit keeps its original value. When any component fails, normally, there is a change in its electrical properties, and thus their electrical resistance also change. On this procedure, the value of resistance and insulation will be read with all the load cell's wires in open circuit (disconnected).

Input resistance
Read electrical resistance in Ohms across excitation wires V_{IN+} (green) and V_{IN-} (black).
The obtained value must be within tolerances specified in the data sheet. We have different standards, depending on load cell model, but in general are 400± 30 Ω or 800 ± 30 Ω.

Output resistance
Read electrical resistance in Ohms across signal output wires V_{OUT+} (red) and V_{OUT-} (white).
The obtained value must be within tolerances specified in the data sheet. We have different standards, depending on load cell model, but in general are 350± 5 Ω or 700 ± 5 Ω.



Analysis
Changes in bridge resistance are more often caused by a broken wire, an electrical component failure or internal short circuit. This might result from over-voltage (lightning or welding), physical damage from shock, vibration or excessive temperature.

TEST 3 Insulation resistance

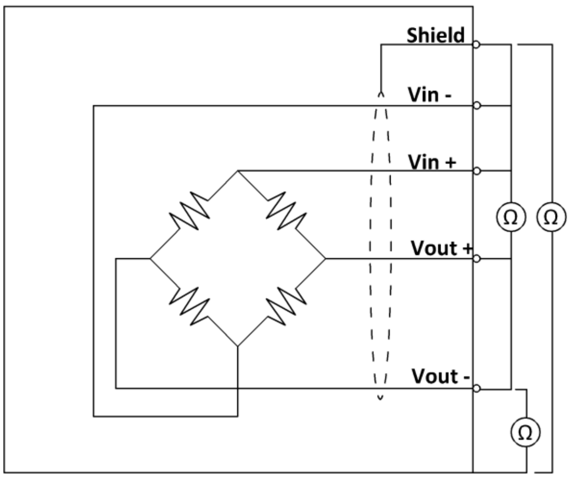
The objective is to verify that the load cell's electrical circuit keeps its original values without drifts. It's necessary to read the values of insulation resistances with all the wires disconnected.

Check if the following insulation resistances are good:

a) Insulation circuit to metal body: The resistance across a load cell wire (anyone of the "colour" wires) and the load cell's metal body.
b) Insulation circuit to shield: The resistance across a load cell wire (anyone of the "colour" wires) and the cable's shield.
c) Insulation metal body to shield: The resistance across the metal body and the shield. By default almost all load cells are not connected to the metal body, but there are particular cases that can be connected.

The results must to be open circuit, without contact, without drift.
If it's possible to use a mega ohmmeter, the insulation resistance should be 500 MΩ or higher. In case of not having a mega ohmmeter available, it is important to make the same measure with a standard ohmmeter on the maximum scale (20 MΩ range) to tray to detect insulation problems.

Pay attention not to use a mega ohmmeter that supplies voltages over 50 Volts to prevent load cell damage.



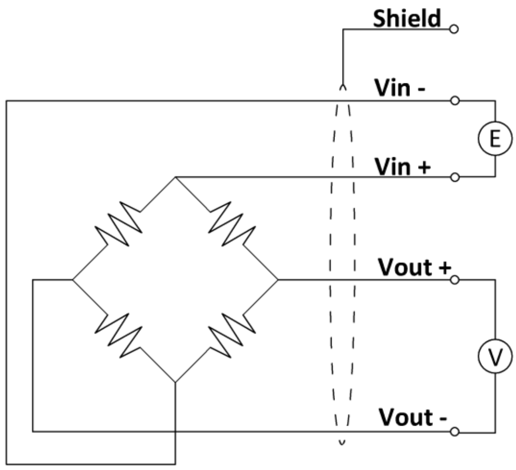
Analysis
The load cell's circuit must be insulated from the metal body and the shield. The shield must be insulated from the metal body (except particular cases). Insulation problems are normally caused by mechanical stress on load cell cable or wires (internal or external) or by water or corrosive products and can cause reading instability.
Extremely low values (< 1 kΩ) can be caused by short circuit.

TEST 4. Shock resistance

Connect directly the load cell to a power supply or preferable a weighing indicator. Disconnect all the rest of load cells in case of a multi load cell system.

Connect the multimeter across V_{OUT+} (red) and V_{OUT-} (white) wires and apply soft impacts to the load cell, you can use a small hammer or screw driver for example.

Be careful not to overload or harm the load cell (especially if it's a low capacity load cell).



Analysis:
Read the multimeter before and after the test. After several impacts output readings must remain stables, returning to original values. Erratic readings could indicate an electrical connection failure or damage in a component or in the glue layer between strain gauge and load cell body as a result of an electrical transient.

Note 1: Tests and information above are done with the intention of helping in troubleshooting for a load cell in an installation. They are simplified tests, using simple tools and they are not determinant for detect all types of fails on load cells and neither to evaluate load cell's specifications. To obtain better results it's necessary an accurate analysis issued by experts.

Note 2: In case of being necessary, it will be helpful for your technical support to have annotated in a table all the measures, readings and observations according to the previous explanations supplied with the load cell model, nominal capacity and serial number.

LOAD CELL VERIFICATION FORM

Load cell Data:

Model: _______________
Nominal Capacity: __________ kg, t
Serial Number: _____________

Description of the installation, scale type and environment:

____

____

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Description of the Fail:

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Visual Inspection:

Label:	□ OK	□ Unreadable	□ Lost	
Aspect:	□ Like New	□ Used		
	□ Clean	□ Dirty	□ Rusted	
Mechanical Damages:	□ Dents	□ Hits	□ Deformations	□ Broken Weldings
Cable:	Length:_____m	□ Good	□ Cuts	□ Crushes
Comments:				

Electrical Inspection:

Excitation Voltage:		Volts (V)		
Zero signal- No Load Output:		Milivolts (mV)	□ Stable	□ Unstable
Input Resistance:		Ohms (Ω)		
Output Resistance:		Ohms (Ω)		
Insulation:				
Circuit – Body		MΩ		
Circuit – Shield		MΩ		
Shield – Body		MΩ		
Stability to Small Impacts:	□ Stable	□ Unstable		

Conclusions: □ Good □ Failed □ Not possible to evaluate

Probable Fail Causes:

□ Mechanical overload □ Electrical overload □ Water ingress
□ Break on internal component or wire □ External Cable in bad conditions
□ Others:____

Customer Data for Contact: **Date: ___ /___ /_____**

Company Name:

____

Contact Person: ______________________________________
Telephone: _______________; _______________ Fax: _______________; Email: _______________
To the attention of:

____

Telephone: _______________; _______________ Fax: _______________; Email: _______________