_ STRAIN GAUGE LOAD CELLS

USER MANUAL
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Notes on the use of product

For safe and efficient use of the product, please read carefully the following instructions before starting any operation.

Any use of the product other than the one described in this manual shall be considered the user’s full responsibility.
The same applies for any unauthorized modifications.
In addition to the hereby listed standards, the user must comply with the provisions of the current legislation regarding personal safety and health together with all other persons in the workplace.
SISGEO is not responsible for any accident, breakdown or other problems due to lack of knowledge and / or non-compliance with the requirements contained in this manual.
Check that the product has not been damaged during the transport.
Verify that the package includes all items as well as any requested optional accessories; if anything is missing, please promptly contact the manufacturer.
The user must strictly follow all the operations described in this manual.
Maintenance or repair of the device is permitted only by authorized operators.
These operators must be physically and intellectually suitable.
For information about instruments or to order spare parts, always specify the product information which can be found on the identification label.
When replacing parts, always use ORIGINAL SPARE PARTS.
The manufacturer reserves the right to make either technical and / or commercial changes, without prior notice.
It is our policy to keep manuals continuously updated.

Symbols

Below are the symbols used to catch reader’s attention on the manual:

Pay particular attention to the following instruction.

Identification

Instruments can be identified
• From a production lot number (written on the Compliance Certificate)
• From a serial number (s/n) engraved indelibly on the instrument
• From a label on the instrument
• From a label on the cable
INTRODUCTION

This manual covers two types of strain gauges load cells:

- Cylinder load cell
- Steel lining load cell

Cylinder load cells are used to monitor loads in pile testing, struts, tiebacks and arch support whilst Steel Lining load cells are designed for tunnels steel lining and pile testing applications.

DESCRIPTION

Cylinder load cells

Cylinder load cells consists of:
1. A cylindrical solid steel body, with electrical resistance strain-gauges connected in a Wheatstone Bridge circuit. Their number and position makes the load cell insensitive to eccentric loads.
2. An electric cable for the connection to the readout.

The load applied to the load cell produces a deformation of the strain-gauge and consequently a proportional variation of the electrical output.

The output is ratiometric (mV/V), so proportional to voltage supply (max. 10V).

For example, for a load cell with sensitivity of 2mV/V full scale the output will be:
- 2mV with 1V power voltage
- 20mV with 10V power voltage

The cable has six conductors, two of which are used to compensate the voltage drop due to cable length (sensing).
Steel lining load cells

Steel lining load cells consist of:
1. A strong stainless steel body with an internal pressure room filled with deairated oil;
2. An electric pressure transducer with 4-20 mA output signal (current loop);
3. An electric cable for the connection to readout;
4. 2 bearing plates with spherical surface (optional) allows a more uniform distribution of the load on the cell.

As the load applied on the load cell increases, the oil exerts a pressure on the diaphragm of the pressure transducer.

PRELIMINARY CHECKS

Before installation it is recommended that a “no load” reading is taken with a readout so as to be sure that no damage has occurred during transportation from factory to site (see Taking measurements).

The difference between the “no load” reading and the zero load reading on the Calibration Report supplied with the instrument, must not exceed 1% of full scale.

Except for the normal tools required to install the instrument, no other special tools are required.
Load cells should be installed with care. Please take special care and check that the surface of the pile head is smooth, flat and solid. This will ensure that the load will be transmitted correctly to the load cell. The special construction of the load cells reduces their sensitivity to eccentric loads.

Example of load cells installation in piles

Some tips:

- Level pile’s head;
- Anchor, on the head, a steel plate of at least 3cm thickness, paying attention to the levelling;
- The plate surface must be smooth and flat;
- The outer dimension must be slightly less than pile’s diameter;
- Weld 3-4 rings on the steel plate in order to avoid the cell from moving around on the bearing plate;
- Arrange a similar plate for the cell upper face;
- Connect the load cell to the readout and check that everything is working correctly;
- If necessary protect the cable from mechanical damage and avoid moisture or water seepage from the end.

Installation during load test

The cell shall be installed between suitably designed load distribution plates centered between the pile, the ballast and the jack which will apply the load.
Suggestions for installation on steel tunnel linings

- Clean and level the support surface until it is flat and solid and if required build up a supporting surface with high strength concrete;
- Manufacture a steel plate larger than the cell diameter and place it on the flat surface;
- Weld on to the base plate 3 or 4 steel supports in order to avoid cell movement (at the end of the steel lining placement they must be removed);
- Manufacture and weld on to the steel lining a distribution plate of 2-3 cm. thickness and dimensions similar or larger than the steel lining;
- Place the cell on the base plate, centering it between the steel supports;
- Weld the base plate and the distribution plate, with the cell between them, using the steel supports;
- Place the steel lining;
- Remove the steel supports to load the cell;
- If necessary protect the cable from mechanical damage and avoid moisture or water seepage at the end.

Example of positioning of the steel supports to center the cell

Transducer dimension is slightly less than the cell thickness, so, if the twin plate with spherical surface is not utilised (highly improve the quality of measurement), pay attention that the transducer is not directly in contact with the plates so to avoid unstable measurements and / or damages.

To work properly, the cell shall be installed between two steel plates that must be stiffer than the cell.
TAKING MEASUREMENTS

Manual readings are taken by connecting the conductors to a manual readout according to the following scheme:

<table>
<thead>
<tr>
<th>4-20 mA current loop</th>
<th>Red</th>
<th>+ Loop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Black</td>
<td>- Loop</td>
</tr>
<tr>
<td></td>
<td>Shield</td>
<td>Shield</td>
</tr>
<tr>
<td>Ratiometric signal mV/V</td>
<td>Red</td>
<td>+ Vcc</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>GND</td>
</tr>
<tr>
<td></td>
<td>Blue</td>
<td>+ Sensing</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>- Sensing</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>+ Out</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>- Out</td>
</tr>
<tr>
<td></td>
<td>Shield</td>
<td>Shield</td>
</tr>
</tbody>
</table>

To obtain reliable measurements, with mA instruments, we recommend a warm up time not less than 5-10 seconds. For automatic measurements, connect the instrument to a datalogger.

DATA MANAGEMENT

The following formulas allow to convert the electrical measurements into engineering units:

Linear factor \( L_{\text{eng}} = \frac{L_{\text{ele}}}{S} [\text{kPa}] \)

Polynomial factors
\[
L_{\text{eng}} = (L_{\text{ele}}^2 \times A) + (L_{\text{ele}} \times B) + C [\text{kPa}]
\]

\( S \) = sensitivity factor
\( A, B, C \) = polynomial conversion factors

\( S, A, B, C \) factors are stated on Calibration Report

The exercise readings refer to the initial reading (zero reading).

\[
\Delta_{[\text{kN}]} = L_i - L_0
\]

\( L_0 \) = Zero reading [kN]
\( L_i \) = Exercise reading [kN]

Zero reading shall be taken carefully once the installation is performed and the instrument is in operating conditions.

Example

Measure Range 3000kN (readings mA)
\( S = 0.005292 \text{mA/kN} \)
\( A = 5.9678 \times 10^3, B = 1.736e+02, C = 70991e+02 \)
\( L_0 = 4.004 \text{mA}, L_i = 16.9 \text{mA} \)

Using:

Linear factor \( (L_i - L_0)/S = (16.9 - 4.004)/0.005292 = 242.6 \text{kN} \)

Polynomial factors \((L_i^2 \times A) + (L_i \times B) + C = (L_0^2 \times A) + (L_0 \times B) + C = 2395.7 \)

\( \Delta_{[\text{kN}]} \) = 2400.1kN
STRAIN GAUGE LOAD CELLS

TROUBLESHOOTING

Cells with 4-20 mA output signal

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero measure [mA]</td>
<td>Wiring not correct</td>
<td>Correct the wiring</td>
</tr>
<tr>
<td></td>
<td>Lack of power</td>
<td>Check readout excitation</td>
</tr>
<tr>
<td>Measures not proportional to the applied load</td>
<td>Eccentric load</td>
<td>Center the load</td>
</tr>
<tr>
<td></td>
<td>Unsuitable plates</td>
<td>Change the plates</td>
</tr>
</tbody>
</table>

Cells with mV/V ratiometric signal

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No measurement / Unstable or overrange measurements</td>
<td>Wiring not correct</td>
<td>Correct the wiring</td>
</tr>
<tr>
<td></td>
<td>Lack of power</td>
<td>Check readout excitation</td>
</tr>
<tr>
<td></td>
<td>Cable cut or damaged, Measure the resistance between Red&amp;Black, Blue&amp;Green, Yellow&amp;White conductors : it must be approximately 1400Ω. Consider cable length. The single conductor resistance for 0WE106000000, is ca. 84Ω/km</td>
<td>Repair the cable. Cable splicing kit available from SISGEO.</td>
</tr>
<tr>
<td>Measurements not proportional to the applied load</td>
<td>Eccentric load</td>
<td>Center the load</td>
</tr>
<tr>
<td></td>
<td>Unsuitable plates</td>
<td>Change the plates</td>
</tr>
</tbody>
</table>

MAINTENANCE

After-sales assistance for calibrations, maintenance and repairs, is performed by SISGEO’s service department.

The authorization for shipment shall be activated by RMA “Return Manufacturer Authorization” Fill in the RMA module clicking on:


Send back the instrument/equipment with the complete accessories, using suitable packaging, or, even better, the original ones.

The shipping costs shall be covered by the sender.

Please return to the following address with correct delivery documentation:

SISGEO S.r.l.
Via F.Serpero, 4/F1
20060 MASATE (MI)

On the delivery document it is mandatory to indicate the RMA code received.

Technical assistance e-mail: assistance@sisgeo.com