H-LEVEL

MONITORING SYSTEM

USER MANUAL

INDEX

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 SISGEO.
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 instrument 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

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

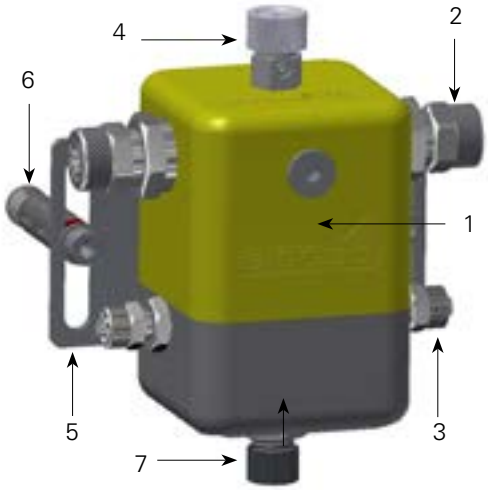
INTRODUCTION

H-level settlement gauges are used to monitor subsidences and/or settlements in buildings and structures.
An H-level system is composed by a reference tank, placed out of the area that has to be monitored, and by one or more settlement gauge based on pressure transducer.
The settlement gauges are placed in the points of interest and are connected through two flexible tubes.
One tube contains the liquid, the other is necessary for the barometric compensation, which is common to all the settlement gauges .
During the plant design phase, we suggest to install a settlement gauge near the tank (in a stable zone not subject to settlements) in order to have some measurements to compare to the other settlement gauges.
The vertical movement of a settlement gauge modifies the level of the head between the tank and the settlement gauge, creating a pressure variation.

It is possible, on request and for particular applications, to ask for the horizontal installation of the settlement gauge.

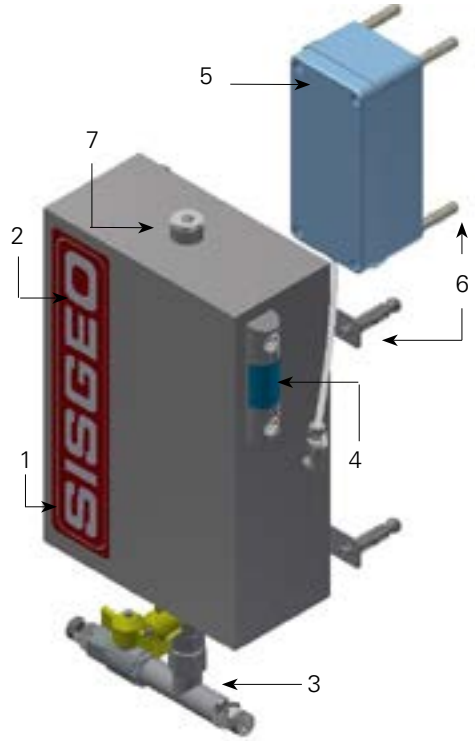
DESCRIPTION

The **H-LEVEL settlement gauge** consists of:



1. Settlement gauge;
2. hydraulic tube connectors Ø 10/12 mm;
3. barometric compensation tube connectors Ø 6/8 mm;
4. drain valve;
5. fixing plate;
6. plugs (hole Ø 12mm);
7. connector.

The **tank** consists in:



1. Measure tank (lower part);
2. autofilling tank (upper part);
3. hydraulic tube connector Ø10/12mm;
4. water level control;
5. air filtering and drying system on tubes for barometric compensation;
6. plugs;
7. cap.

In the packaging there are also circuit closure caps (to be installed in the last settlement gauge of the circuit).

Usually the liquid used is a water-glycerine mix (50% water, 50% glycerine).
This mix has been chosen for its high temperature range without substantial changings in physical features, to its low gas tension and for the lack of seaweeds and mould formation.
In addition, it is also chemically inert to the materials composing the system and environmentally non-dangerous.
The medium density is 1.1555 g/cm3 .

The **saturator** is an optional accessory used to fill the circuit.
It consists in:

1. A stainless steel container of Ø250mm and about 20l. capacity;
2. a valve for Ø 6/8 tube;
3. a valve for Ø 10/12 tube;
4. manometer;
5. compressor connection;

It is combined with a portable compressor with rechargeable battery.

PRELIMINARY CHECKS

Useful tools:

- Spanner n° 12 e 18
- Screwdriver
- Allen key n° 5,10
- Drill and tips of Ø 9 and 12mm suited for the material to be drilled
- Cutter
- Bucket
- Rags
- Funnels
- Raceways with plugs for fixing tubes and cable

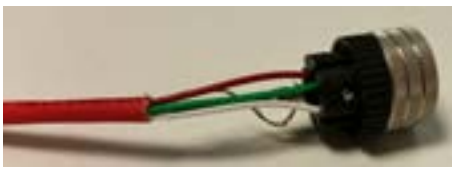
INSTALLATION

Connectors wiring

The electrical cable to be connected to the instrument generally has already a connector on one side.
On request, it is possible to supply a cable reel from which it is possible to cut the single parts.
In this case, it is necessary to wire the connectors as follows:

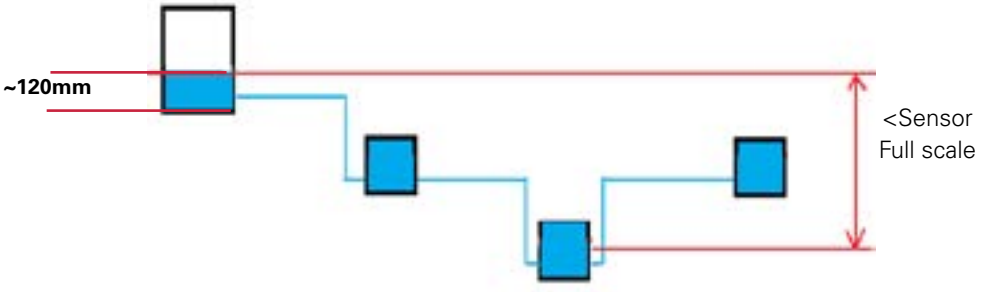
PINS	FUNCTION
N° 1	+Loop
N° 2	Thermistor
N° 3	Thermistor
N° 4	- Loop
N° 5	Shield






Precautions and suggestions

Verify the correct functioning of every sensors before starting the installation.
The value you read without pressure is around 4mA.
If installed outside, provide a roofing in order to supply some repair from the bad weather conditions.
The settlement gauges have to be installed at the same height and below the level of the tank without exceeding the range of the settlement gauge.
Consider also the expected settlements.



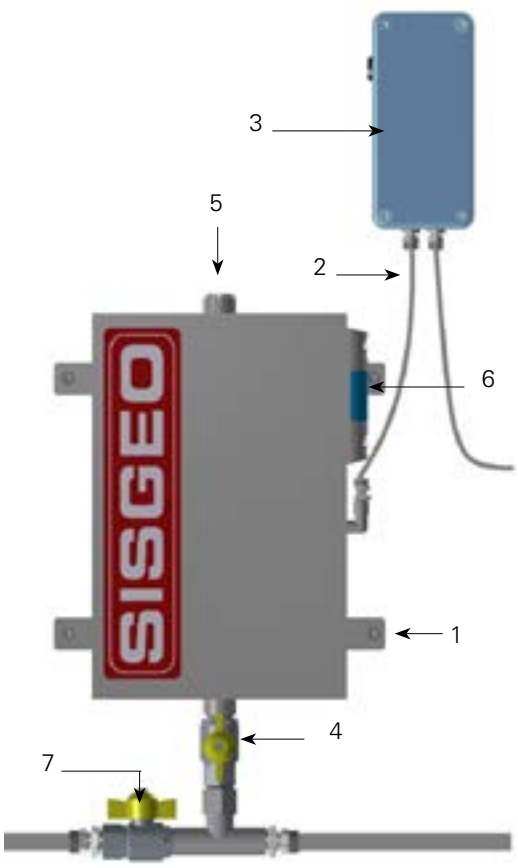
If insulation is used, it is necessary to cover the whole circuit, also near the settlement gauge. Use suitable insulation foams.

Settlement gauge installation

- Fix the instrument with the supplied plugs (1). Hole Ø12 mm;
- fit the 4 tubes on their connectors and screw the sleeves (2);
- to help the drain, we suggest to fix the tubes (3) on the wall in order to keep them below the connector (see picture below);

- ensure that the drain valve is closed (4);
- arrange a container to receive the liquid that drains from the last settlement gauge.

Tank installation



- Fix the tank with the 4 plugs supplied (1). (Hole Ø12mm);
- connect the filter system (3) to the tank using the 6/8 tube that is ca. 20cm long (2) and fix it to the wall higher than the tank. (Hole Ø9mm);
- close the valve (4);
- remove the cap (5) and fill in the tank using a funnel and cheking the water level control (6). (the volume is approximately 7l.);
- close the cap (5);
- keep the valve closed (4).

Filling of the circuit

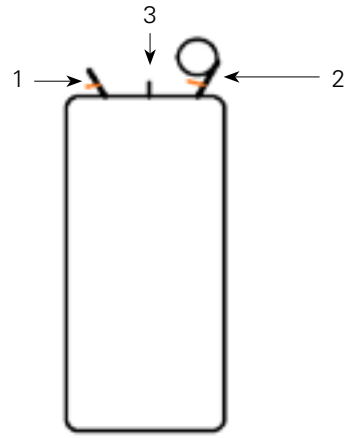
It's possible to fill in the circuit in two ways:
- using gravity (for short circuits of 15/20m)
- using the saturator.

Note: Approximately, you need about 8 l. x 100 m.

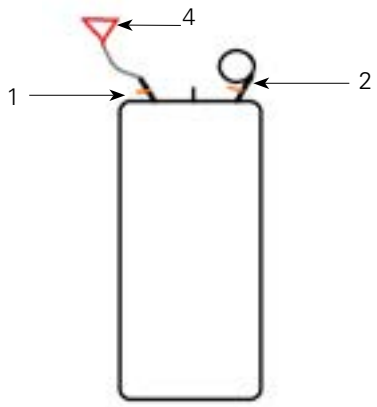
Using gravity

- Close the valve (7);
- use a suitable container and connect it to the valve (7);
- put the container at a level that allows to fill in the circuit. Do not exceed 10m. head;
- open the valve (7);
- drain the liquid from the last settlement gauge;
- when the whole circuit is filled, and there are no air bubbles, close the connector with the cap supplied (see next paragraph);
- close the valve (7) and disconnect the container;
- drain the settlement gauge as explained next.

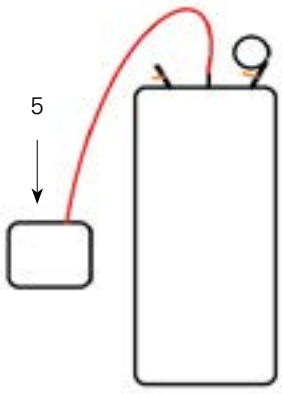
Using the saturator



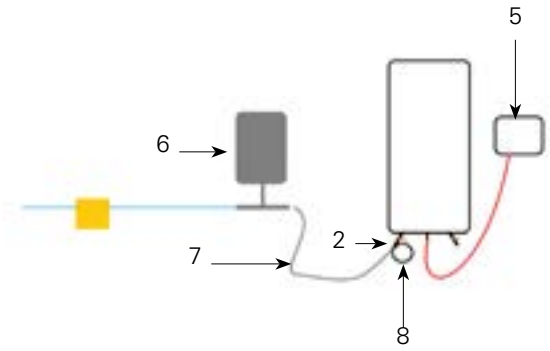
Open both valves (1-2).
Remove the plastic cap (3).



Fill the tank using a funnel (4) with the mix necessary to fill the whole circuit.
It is important to fill the circuit in a single time.
Close the valves (1-2) and connect the compressor.



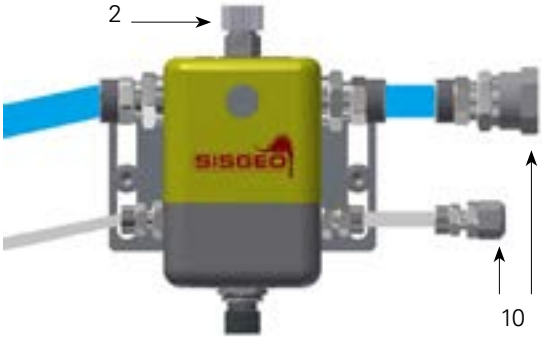
Turn on the compressor (5) and reach a pressure of about 4 bar.
Do not disconnect the compressor.



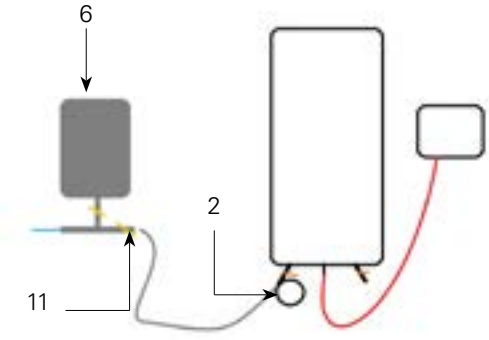
Put the saturator with the valves upside down.
Connect the saturator to the tank (6) using the 10/12 tube (7).

Open carefully the valve (2).
Do not exceed 1 bar of output pressure (8).
Attention: a pressure too high could irremediably damage the settlement gauges.

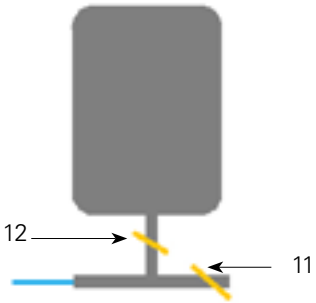
Let the liquid drain from the last settlement gauge (9) to eliminate any air bubbles within the circuit.



Put the supplied cap on the last settlement gauge (10) and close the valve (2) of the saturator.



During the closure of the last settlement gauge, close the tank valve (11).
Disconnect the saturator from the tank (6).

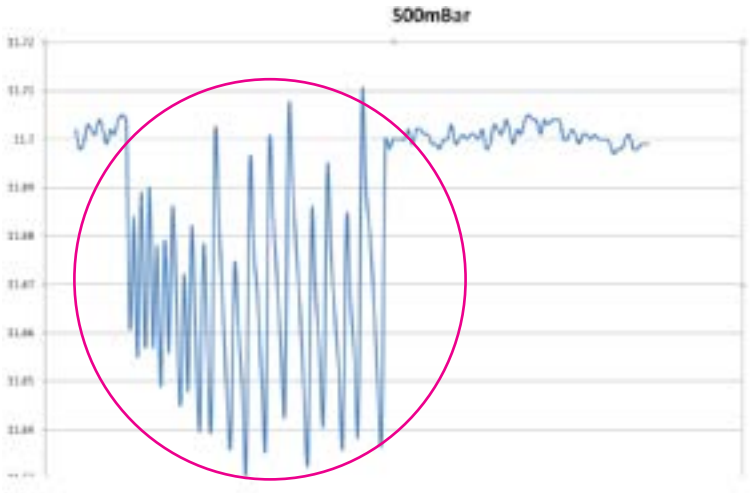


Open the tank valve (12) and let the tank liquid touch the settlement gauges.
Open for 2 second the valve (11) to drain air.
Pay attention to the liquid spill.

Open the drain valve (13) for 2/3 second and close it immediately.
Repeat this operation for every settlement gauge.
Read each settlement gauge and verify that they are in the required value.
If necessary, move them up or down.

Tank auto-filling

The tank has an auto-filling system, that allows the liquid level to remain stable also in case of little leaks in the circuit.
This example shows how to notice the spills analyzing the data.
This behaviour will be registered on all settlement gauges and will be necessary to find and fix the leak on the circuit.



TAKING MEASUREMENTS

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

	COLOUR	FUNCTION	PINS
Sensors with 4-20 mA signal current loop	Red	+Loop	1
	Black	- Loop	4
	White	Thermistor	2
	Green	Thermistor	3
	Shield	Shield	5

To obtain reliable measures we recommend a warm up time not less than 10 seconds.

DATA MANAGEMENT

The following formulas allow to convert the electric measurements into engineering values:

Linear factor $L_{eng} = L_{ele}/S$ [mm H_2O]

Polynomial factor $L_{eng} = (L_{ele}^2 \times A) + (L_{ele} \times B) + C$ [mm H_2O]

L_{eng} = Engineering unit
L_{ele} = Electric unit
S = linear sensitivity factor
A, B, C = polynomial conversion factors

S, A, B, C are stated on Calibration Report.

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

$$\Delta_{mm}\ H_2O = L_i - L_0$$

L_0 = Zero reading [mm H_2O]
L_i = Excercise reading [mm H_2O]

Zero reading shall be taken carefully once the installation is performed and the instrument is in operating conditions.
For many applications is necessary to wait several days to obtain a reliable zero reading. We suggest to take the readings in a short lapse of time to verify if the system is stable.

Note: in case the liquid used is a mix of 50% water and glycerine, the obtained values in mm must be divided for 1,1555.

Please consider what is written in the introduction paragraph on the way to connect data.

Temperature measure

With a Sisgeo readout, the temperature is taken directly in °C.
If you measure thermistore resistance value, you have to convert it using the formula or the table in Appendix 1.

Data analysis note

Generally speaking, but especially when there are complex circuits, it is necessary to use a statistical approach to analyze the data and cancel any temperature effect on the measures.

TROUBLESHOOTING

Problem	Possible cause	Solution
Unstable measure	Shield not connected	Connect the shield
	Electro-magnetic fields nearby (engines, generators, radio antennas, welders, high voltage lines...)	Identify and remove the cause.
	Data acquisition system grounding not well done.	Provide efficient grounding
OmA measure	Open circuit	Make a correct connection
	Wrong connection	Make a correct connection
Overrange measure	High absorption	Fix critical point
	Short circuit	Fix critical point

MAINTENANCE

Check periodically the hygroscopic salts status in the air filter system and change them when 50% is shown.

Check for leaks in the tubes.
In case of cuts, we recommend to use joints connectors (see photo below)

MAINTENANCE SERVICE

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". Create your account and then fill in the RMA module clicking on:

http://www.sisgeo.com/repairs.html

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***

APPENDIX 1

THERMISTOR TEMPERATURE CONVERSION

Resistance to temperature equation:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3} = 273.2$$

Where:
T= temperature in °C
LnR= natural Log of the thermistor resistance
A= 1.4051x10-3 (coefficents calculated over the -50 to +70°C span)
B= 2.369x10-4
C=1.019x10-7

Ohms	*Temp*	*Ohms*	*Temp*	*Ohms*	*Temp*	*Ohms*	*Temp*
16.60K	-10	5971	10	2417	30	1081	50
15.72K	-9	5692	11	2317	31	1040	51
14.90K	-8	5427	12	2221	32	1002	52
14.12K	-7	5177	13	2130	33	965.0	53
13.39K	-6	4939	14	2042	34	929.6	54
12.70K	-5	4714	15	1959	35	895.8	55
12.05K	-4	4500	16	1880	36	863.3	56
11.44K	-3	4297	17	1805	37	832.2	57
10.86K	-2	4105	18	1733	38	802.3	58
10.31K	-1	3922	19	1664	39	773.7	59
9796	0	3784	20	1598	40	746.3	60
9310	-1	3583	21	1535	41	719.9	61
8851	2	3426	22	1475	42	694.7	62
8417	3	3277	23	1418	43	670.4	63
8006	4	3135	24	1363	44	647.1	64
7618	5	3000	25	1310	45	624.7	65
7252	6	2872	26	1260	46	603.3	66
6905	7	2750	27	1212	47	582.6	67
6576	8	2633	28	1167	48	562.8	68
6265	9	2523	29	1123	49	543.7	69
						525.4	70