Multy Rod Extensometer

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STRUMENTI E MISURE GEOTECNICHE
E STRUTTURALI

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WARNINGS

For Fiber Glass Model: Extreme Caution in opening fiber glass rolls:

- Fiber glass is in tension, opened reacts like a spring
- Ends of the fiber glass are connected with metal parts that must be kept firm when cable ties are cut;
- Do not open without holding the ends of the fiber glass firmly;

Do not let the instrument fall into the hole quickly;

Do not put the instrument in flammable liquids or potentially explosive gases;
Do not connect the instrument to the readout unit with wet hands.

Do not use the instrument in water where an electric dissipation is in progress;
If installation direction is upward be sure that anchorages, top part of the instrument, rods, transducer and protective caps are perfectly anchored.

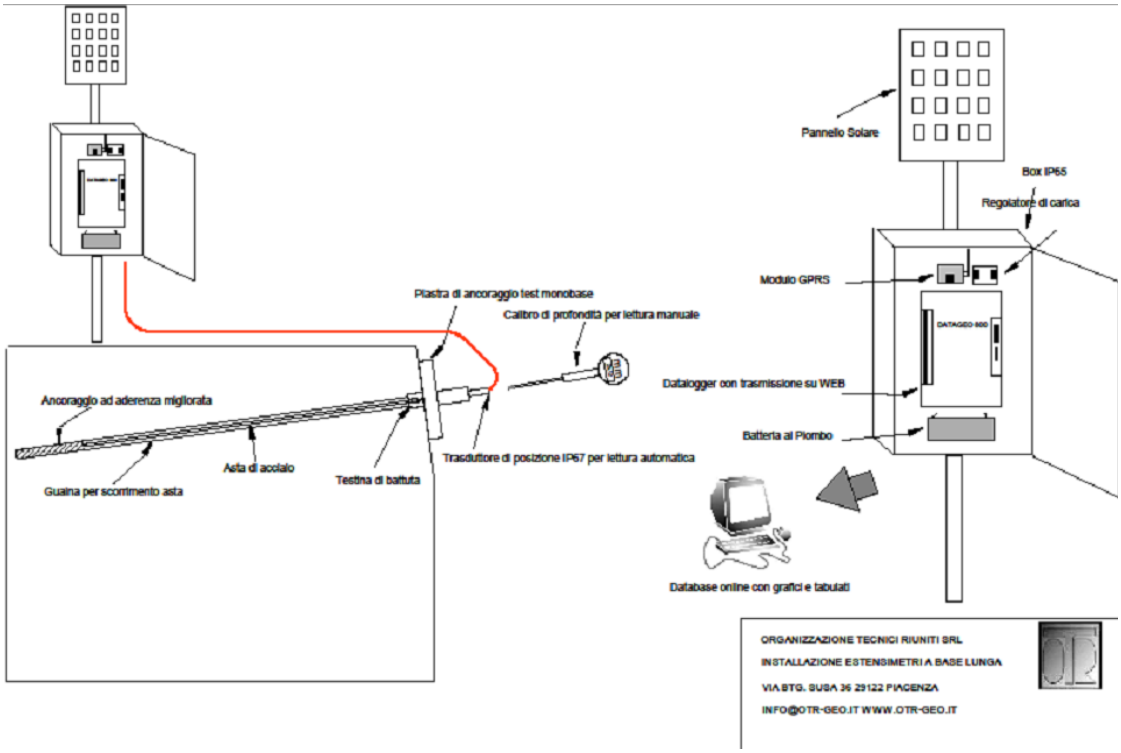
Use protective gloves.

Furthermore

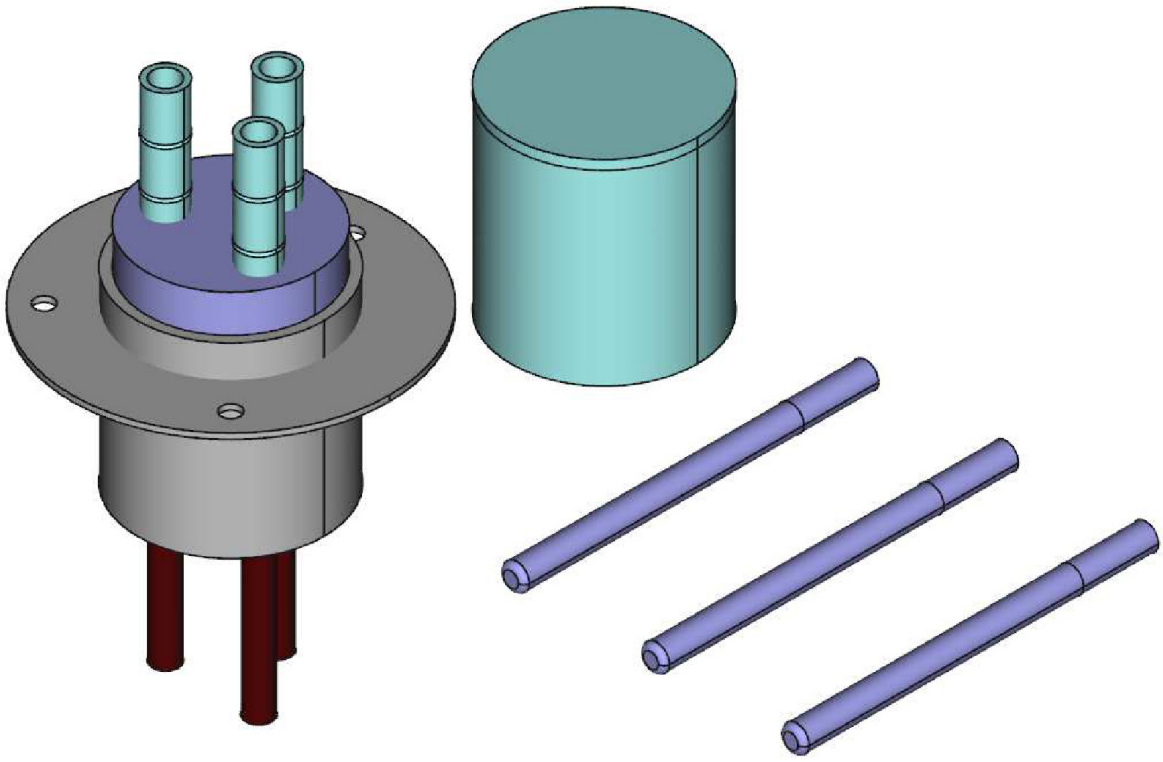
- Use surge arresters for installations with unprotected cables longer than 30 meters.
- During the installation phase, disconnect the instrument from measuring devices or from any device connected to the AC power supply;
- Clean the instrument and its cable with alcohol or water, do not use acetone or aggressive liquids for plastics or labels;

Application

Singlepoint and multipoint extensometers (up to 6 measuring bases) are used to monitor movements of soil, rocks, rock masses, foundations, or concrete walls.
This instrument is installed inside a borehole and it consists of anchor points connected to the surface by invar or steel rods protected by an external, anti-friction sleeve. The measuring bases are free to move along their protective sleeve and they transfer the movement from the lower anchoring point to the head of the instrument. The measurement of the movement variation is taken by a centesimal depth gauge or by an electrical displacement transducer.



Description



Extensometers consist of one (singlepoint extensometer) or more (multipoint extensometer) measuring bases (up to 6) in invar or stainless steel, with external diameters of 8 and 10 mm respectively. Invar is to be preferred over steel where large temperature variations can be expected, as its thermal expansion coefficient is about ten times inferior to that of steel.
The bottom end of every measuring base is connected to an improved adhesion zinc plated rebar. The whole length of the measuring bases is protected by an anti-friction, flexible HDPE tube.

The top terminal consists of an aluminum tube attached to the extensometer head by means of a mechanical coupling which is also the housing of the displacement measuring instruments.
The measuring head is provided with a flange with a collar pipe for the borehole, which makes installation easier. The flange has two lateral openings from which the grout injection tubes protrude. The head is covered by a plastic and aluminum protective cap.
The injection tubes have different lengths: one is as long as the longest rod, and the other one is 1 m long.

Identification

Every estensomteter is identified by:

- Batch number;
- Model type;

Technical Features

Body Material	Stainless steel , Aluminium
Rod Material	Stainless steel ,Invar, Fiber glass
Full scale	±50 mm

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Installation

In order to install a three-point extensometer it is necessary to have a borehole with stabilized walls with a standard working diameter of 101 mm.
Here follows the installation procedure:

INOX/INVAR models (Fiber Glass model is pre-assembled):

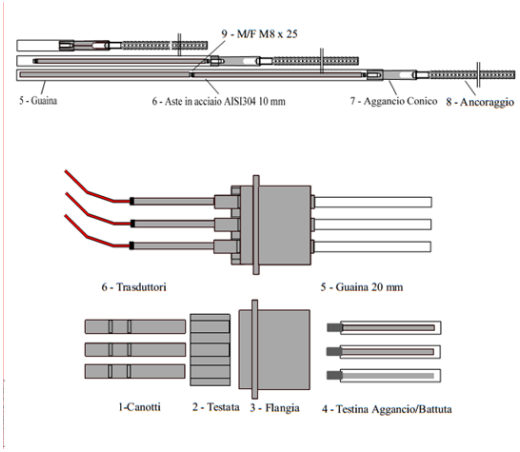
- For each measuring base, screw the first measuring rod onto the coupling on the lower anchor block (which is already pre-assembled);:
- Screw all the rods in place until the project length has been reached. If the length is superior, shorten the last rod by cutting it with a hacksaw, then glue the measuring base terminal (in Fig.1) to the head of the rod which has been cut.
- Using the hacksaw, cut a length of antifriction sheath equal to the length of each measuring base;
- For each base, insert the previously assembled rods into the antifriction sheath until the coupling on the lower anchor block is reached, and join the two by pushing, then seal using tape;
- Cut the top part of the antifriction sheath, and leave about 50 mm of the rod terminal unsheathed;
- Fit the top terminal onto the measuring base, making sure the sheath is fully inserted in its place;
- Fit the anchor units into the measuring head and tighten the grub screws on the groove in the top terminal;

For Fiber Glass models:

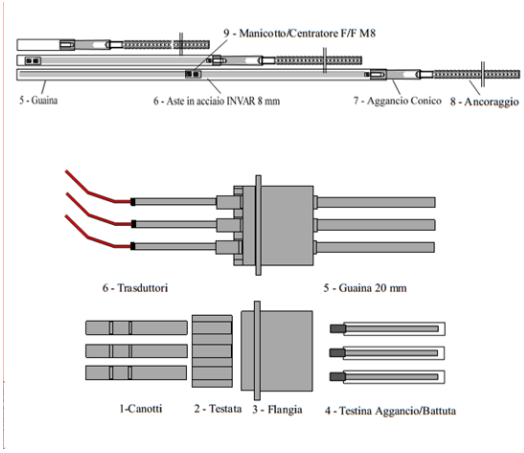
- A M6 screw is installed inside the instrument to keep the length of the rod in position during installation;

All models:
- Uncoil the injection tube for the whole length of the longer base and cut that length using the hacksaw;
- Prepare a 1 m long section of injection tube;
- Assemble all the bases and the injection tubes, wrapping the instrument in tape every 2 meters, so as to make it easier to insert it in the borehole;
- Insert the assembled extensometer in the borehole, for Fiber Glass model: handle/insert the instrument using the external sheath;
- Secure the extensometer's measuring head to the wall using anchor bolts;
- Inject grout through the injection tube (see the next chapter).

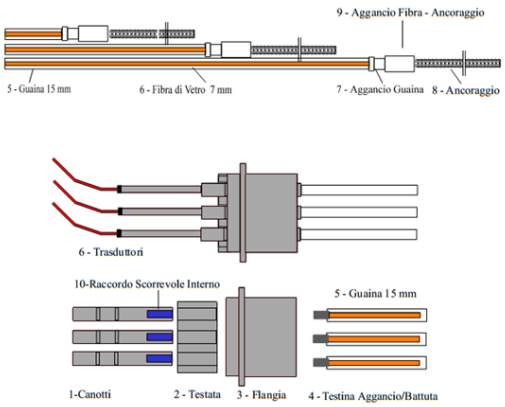
Assembly Drowings



Stainless Steel Model Parts



INVAR Steel Model Parts



Fiber Glass Model Parts

Grouting Procedure

It is possible to choose between two different grouting procedures, depending on the type of borehole:

- Downward and sub-vertical borehole
- Upward and sub-horizontal borehole

In downward, sub-vertical boreholes, proceed as follows:

- Connect the cement injection pump to the longer injection tube;
- Inject the grouting mix (cement and water) at moderate pressure;
- When the grouting mix starts flowing out of the shorter injection tube, stop the injection;
- Eventually seal the two injection tubes so as to prevent cement spillage.

In upward and sub-horizontal boreholes, proceed as follows:

- Connect the cement injection pump to the shorter injection tube;
- Inject the grouting mix (cement and water) at moderate pressure;
- When the grouting mix starts flowing out of the longer injection tube, stop the injection;
- Eventually seal the shorter injection tube as to prevent cement spillage;

For further safety, fill up the borehole using the longer tube, then seal it permanently.

Installation of electrical displacement transducers

- For each measuring base, take the displacement transducer to be installed and set the rod to the starting point, so that the blocking pin is locked in place (this will prevent the transducer from rotating while it is being installed on the measuring base);
- Insert the transducer in the top terminal and screw it onto the measuring base terminal until the end position is reached, making sure to constantly apply pressure to it;
- Connect the instrument to the readout unit and adjust the position of the instrument, pulling it out of the top terminal, until about half of the measuring range is reached;
- Secure the transducer to the top terminal by using a M6 grub screw (with an Allen wrench);
- Run the transducer cables through the opening at the base of the protective cap;
- Install a junction box (optional);
- Run the transducer cables through the gland nut of the junction box (optional);
- Connect the transducer cables to the terminals in the junction box, connecting each cable to its corresponding terminal (optional);
- Connect the cables with connectors to their corresponding terminals (optional).

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Readouts

Per effettuare le misure si possono utilizzare due sistemi di misura:

- Comparatore centesimale digitale di profondità;
- Trasduttore elettrico di spostamento di tipo potenziometrico e/o a corda vibrante e unità di lettura.

Il comparatore centesimale digitale di profondità è uno strumento manuale removibile adatto alla misura di lunghezze.
Lo strumento permette la misura della posizione relativa del terminale della base di misura rispetto alla parte superiore dell'ancoraggio superiore, posto sulla testa di misura (fig.1).

Utilizzando un trasduttore elettrico di spostamento sono disponibili diversi sistemi di lettura, sia manuali che automatici. L'unità di lettura Geotester 2 evidenzia sul display un valore in unità elettrica o fisica, se configurata. Per il loro utilizzo consultare i manuali del modello usato

Taking Measurements

In order to take measurements, it is necessary to connect the instrument cable to the readout unit, following the instruction manual of the readout unit being used:

The instrument's signals may differ depending on the type of sensor, potentiometer, vibrating wire or converter (mV or mA) being used.

Displacement transducer with output signal expressed in mV:

Blu Cable	= V reference*
Brown Cable	= GND*
Black Cable	= Output*
Shield	= Earth of datalogger

Refer always to calibration sheet of sensor

Displacement transducer with output signal expressed in 4-20 mA:

Red Cable	= + 15 volt
Black Cable	= Loop
Shield	= Earth of datalogger

Displacement transducer with output signal expressed in Hz (vibrating wire instrument):

Red Cable	= + signal
Black Cable	= - signal
Green Cable	= Temp
Withe Cable	= Temp
Shield	= Earth of datalogger

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Data processing

As previously mentioned, it is possible to use two measuring instruments when taking measurements:

Digital depth gauge;
- Electric displacement transducer and readout unit.

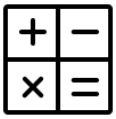
The measurements obtained with the digital centesimal depth gauge are expressed in metric units (mm), while the electric displacement transducer and readout unit produce an electric signal which is converted into engineering units [mm] using the conversion factor in the calibration sheet.
The format of the readings depends on the readout unit which is being used.

The displacement measurement is given by the tension reading (mV) or by the output current reading (mA) or by the frequency reading (Hz) taken by the electrical displacement transducer.

Calculations & Formulas

For greater precision, use the polynomial factors in the transducer's calibration report.

L = Reading expressed in engineering units [mm]
E = Electrical reading (mV, mA, or Hz)
K = Sensitivity factor (shown on the calibration sheet)



$$L\ (mm) = E \times K$$