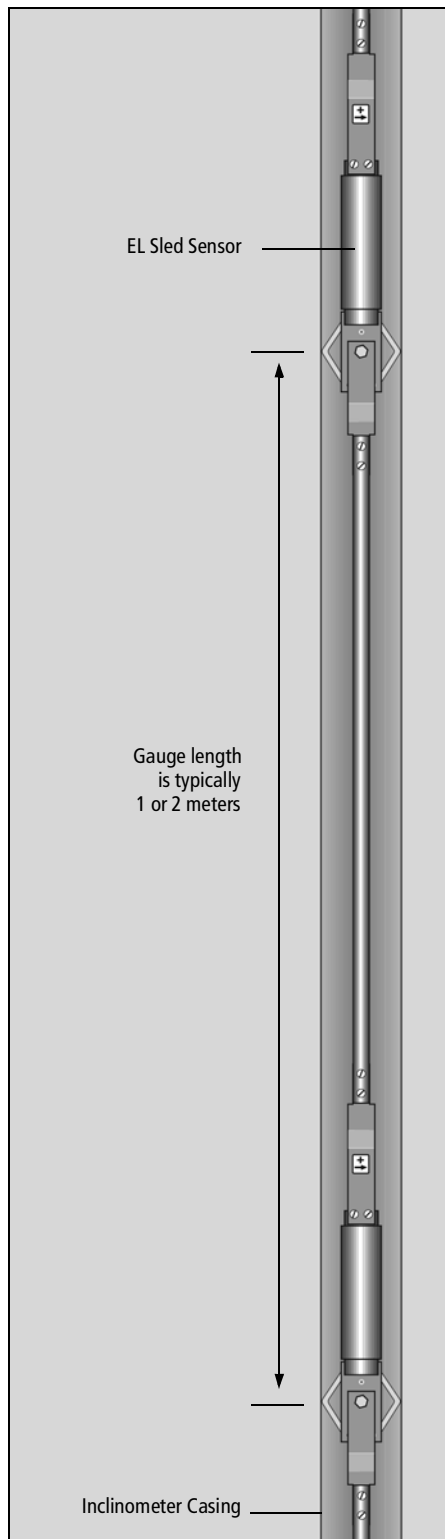


EL Sled Sensors



Applications

The EL sled sensor is an economical tilt sensor for in-place inclinometer applications, such as:

- Monitoring deformation of diaphragm walls supporting deep excavations.
- Monitoring deformations of embankments and retaining walls.
- Monitoring landslide areas above dams, highways, and railroads to provide early warning of slope failure.
- Monitoring stabilization measures such as compensation grouting (horizontal version).

Operation

An in-place inclinometer system consists of inclinometer casing and a string of tilt sensors, such as the EL sled sensor. The inclinometer casing is installed in a vertical borehole that passes through a suspected zone of movement. The sensors, each connected to the next at a pivot point, are positioned inside the casing to span the zone of movement. When ground movement occurs, the casing is displaced, causing a change in the tilt of the sensors inside.

The sensors measure tilt, the angle of inclination from vertical. The tilt measurement is converted to lateral deviation using the formula $L \sin \theta$, where L is the gauge length of the sensor and θ is the tilt.

Displacement, the lateral distance the casing has moved, is calculated by finding the difference between the current and initial deviations.

In most applications, sensors are connected to a data acquisition system that continuously monitors movements and can trigger an alarm when it detects a change, or a rate of change, that exceeds a preset value.

Advantages

Real Time Monitoring: The EL sled sensor is ideal for continuous, unattended monitoring and can deliver readings in near-real time.

Rigid Gauge Tubing: Reliable detection of movement and related displacement calculations require straight-line sensor gauge lengths. Rigid gauge tubing satisfies this requirement.

Complete Solution: Slope Indicator offers complete monitoring solutions that include data loggers and software such as Argus, which can make profile plots and trend plots of inclinometer data available on the web just minutes after the readings are obtained.

EL Sled Sensors vs EL IPI Sensors

EL sled sensors differ from EL in-place inclinometer sensors in several ways:

- EL sled sensors are intended for one-time installation. IPI sensors have wheels that allow easy retrieval and reuse.
- EL sled sensors are uniaxial and measure tilt in one plane only. EL IPI sensors can be supplied in either uniaxial and biaxial versions.
- EL sled sensors are typically supplied with less sensitive electrolytic vials. EL IPI sensors are supplied with higher performance, but higher cost electrolytic vials.
- IPI sensors can be supplied with built-in multiplexing, which simplifies installation and wiring when many sensors must be used in one inclinometer casing.

SYSTEM CONFIGURATION

A complete EL sled sensor IPI system includes inclinometer casing, sensors, sleds, gauge tubing, signal cable, termination hardware, data logger, and software.

Inclinometer Casing: Choose 85 mm or 70 mm (3.34" or 2.75) diameter casing. See casing data sheet for details.

Sensors: Choose a horizontal or vertical sensor. Sensor does not include sled, gauge tubing, or signal cable.

Sleds: Choose a sled to match the diameter of your casing. One sled is required for each sensor.

Gauge Tubing: Gauge tubing is sized to make exact gauge lengths of 1, 2, or 3 meters. Order gauge tubing for each sensor.

Signal Cable: Specify a cable length for each sensor. Cable runs from the location of the sensor to the location of the data logger.

Termination: Choose a top clamp or a top sled to terminate the sensor string or the gauge length of a single sensor. The top clamp holds the sensors string at the top of the inclinometer casing. The top sled allows the sensor string to be pushed deeper into the casing. A steel cable and cable suspension kit are used to secure the string or retrieve it, if necessary.

Top Clamp: Choose the top clamp that matches the size of your casing. Not used with top sled.

Top Sled: Choose the top sled that matches the diameter of your casing. Not used with top clamp.

Cable Suspension Kit: Used with top sled. Includes cable clamps and other fittings. Requires cable below.

Retrieval Cable: Retrieval cable is used to relieve installation-induced stresses in the sensor string. Cable spans distance between top sled and cable suspension kit.

Data Loggers: Slope Indicator supplies Campbell Scientific CR10X data loggers. See separate data sheet. Wiring instructions and sample program can be found in the technotes section at www.slopeindicator.com.

Software: Communication software is required to retrieve data from the data logger. Data reduction software is required to process and plot the data. Slope Indicator Argus monitoring software for processing and distributing the data in near real time.

SLED SENSORS

Sled Sensor, Vertical. 56804410

Sled Sensor, Horizontal 56804420

Sled for 85mm Casing 56804485

Sled for 70 mm Casing 56804470

Tubing for 1 m Gauge Length 16804441

Tubing for 2 m Gauge Length 16804442

Tubing for 3 m Gauge Length 16804443

Signal Cable 50613527

Order sled and gauge tubing for each sensor.

Choose wheels to fit 85 or 70 mm casing. Tubing is sized to make 1, 2, or 3 meter gauge lengths.

Order signal cable for each sensor. Specify length in feet or meters from sensor to readout station. Be sure to allow for both vertical and horizontal distances. Signal cable has seven 22-gauge tinned-copper conductors, shield, and polyurethane jacket.

COMPLETION ACCESSORIES

Top Clamp, for 85 mm Casing . . . 56805255

Top Clamp, for 70 mm Casing . . . 56805252

Top Sled, for 85mm Casing 56804487

Top Sled, for 70 mm Casing 56804472

Cable Suspension Kit 56804460

3/16" Aircraft Cable 56804300

Order one top clamp or top sled for each string of one or more sensors.

Order cable suspension kit with top sled. Order steel aircraft cable for suspending string of sensors. Specify length in feet or meters.

DATA LOGGERS

Campbell Scientific CR10X System

See CR10 data sheet for part numbers and overview of system. Connect up to three sled sensors directly to CR10X data logger. Connect up to 16 sled sensors to one AM16/32 multiplexer.

ARGUS SOFTWARE

See separate data sheet or visit Slope Indicator's website for details.

READOUT

EL Data Recorder 56813500

This readout can be used to check sensors at installation time. It displays and stores tilt readings in volts and temperature readings in degrees C. Includes software for transferring stored readings to a Windows PC.

SLED SENSOR SPECIFICATIONS

Sensor Type: Electrolytic tilt sensor for tilt measurements, thermistor for temperature measurements.

Range: ± 30 degrees. Note that best long-term performance is achieved in casing that is within ± 10 degrees of vertical (or within ± 10 degrees of horizontal with horizontal sensor).

Resolution: 10 arc seconds or 0.05 mm/m using 13 bit readout device such as the CR10 data logger. Increased resolution is possible with a higher resolution readout device.

Repeatability at Null: ± 72 arc seconds or ± 0.35 mm/m.

Calibration: 11 point calibration taken at five temperatures from 4 to 20 °C. Optional extended calibration temperatures from -15 to +40 °C.

Maximum Gauge Length: 3 meters.

Required Casing: Fits 85 or 70 mm (3.34 or 2.75 inch) diameter casing.

Materials: Anodized aluminum housing, tubing, sleds, and hardware.