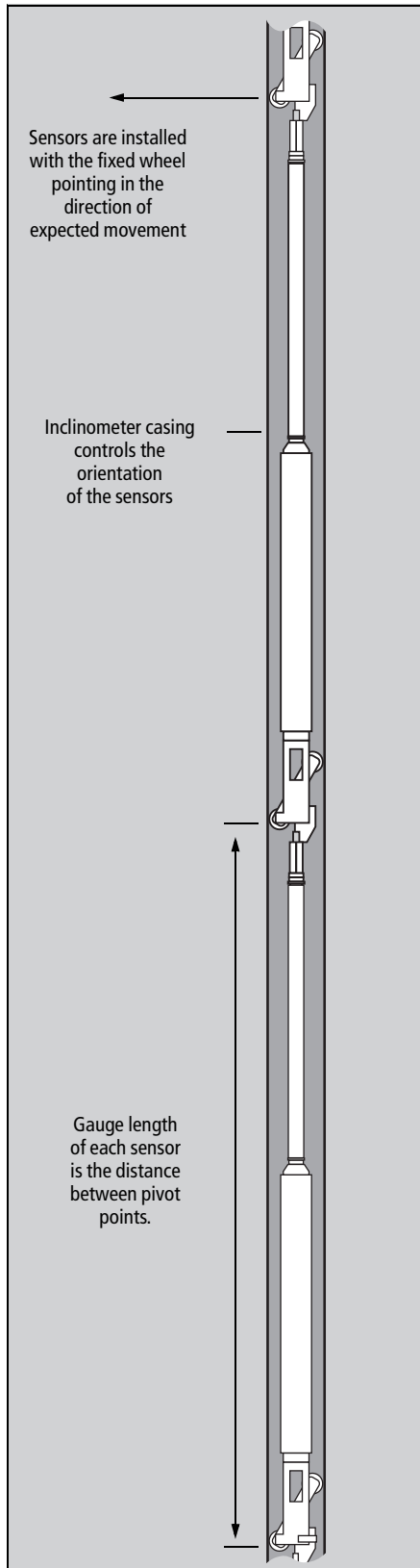


EL In-Place Inclinometer



Applications

The EL in-place inclinometer is ideal for data logging and real-time monitoring. Typical applications include:

- Monitoring deformation of diaphragm walls supporting deep excavations.
- Monitoring ground movements induced by tunnel construction.
- Monitoring deformations of embankments and retaining walls.
- Monitoring landslide areas above dams, highways, and railroads to provide early warning of slope failure.

Operation

The system consists of a number of in-place inclinometer sensors that are installed in inclinometer casing.

The casing provides access for subsurface measurements. Grooves inside the casing control the orientation of the sensors.

The casing is typically installed in a vertical borehole that passes through a suspected zone of movement into stable ground below. One set of grooves is aligned with the expected direction of movement, down hill or towards an excavation, for example.

The sensors are positioned inside the casing to span the zone of movement. When the ground moves, the casing moves with it, changing the inclination of the sensors inside.

Inclination measurements from the sensors are processed to provide the casing profile, the displacement in mm for the gauge length of each sensor, and the cumulative displacement in mm for the entire string of sensors.

In most applications, sensors are connected to a data acquisition system, and data processing is completed by a computer program such as Argus, which can trigger alarms based on a rate of change or other criteria.

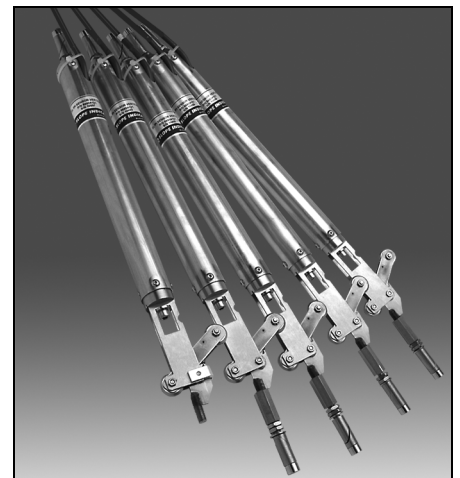
Advantages

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

Removable: Wheeled sensors can be removed to allow verification checks with a traversing probe.

Rigid Gauge Tubing: Accurate displacement calculations require straight-line sensor gauge lengths. Rigid gauge tubing satisfies this requirement. Rigid gauge tubing also provides reliable performance in soft ground, where abrupt changes in profile may occur at a shear zone.

Complete Solutions: Slope Indicator offers complete monitoring solutions that include data loggers and Argus web-based monitoring software, which can present profile plots and trend plots of inclinometer data just minutes after the readings are obtained.



SYSTEM CONFIGURATION

A complete IPI system includes inclinometer casing, IPI sensors, signal cable, suspension kit, suspension cable, data logger, and software.

Inclinometer Casing: Choose 85 mm or 70 mm (3.34" or 2.75) diameter inclinometer casing.

Standard or Multiplexed Sensors: Standard sensors have independent signal cables. This offers the greatest flexibility for placement but limits the number of sensors that can be installed in one casing. Multiplexed sensors share a signal cable, but must be placed within 3 meters of each other.

Uniaxial or Biaxial Sensors: Uniaxial sensors measure tilt in the plane of the wheels. Biaxial sensors have a second sensor that measures tilt in the plane perpendicular to that of the wheels.

Wheels: Order wheels for each sensor. Choose wheels to fit 85 or 70 mm casing.

Tubing for Gauge Lengths: Order gauge tubing for each sensor. Tubing is sized to make exact gauge lengths of 1, 2, or 3 meters. Three meters is the maximum recommended gauge length.

Signal Cable: Order signal cable for each standard sensor. Cable runs from the location of the sensor to the location of the data logger.

For multiplexed systems, order a jumper cable connector and signal cable to run from the top sensor to the location of the data logger.

Suspension Kit: Order one suspension kit for each installation. The kit includes a top wheel assembly, clamps and thimbles, a chain for fine adjustments, and an S hook. Cable not included.

In-Line Suspension Kit: The in-line suspension kit is used when it is necessary to monitor two or more zones in the borehole. It allows sensors at deeper zones to be suspended from sensors above. The kit includes a top wheel assembly for the sensor below, clamps and thimbles, and a hanger that threads onto the sensor above. Cable not included.

Data Loggers: Slope Indicator recommends using Campbell Scientific CR10X data loggers. Two biaxial sensors or three uniaxial sensors can be connected directly to the CR10 or up to 16 uniaxial or biaxial sensors can be connected to an AM 16/32 multiplexer. With multiplexed sensors, up to six string of five sensors each can be connected. No multiplexer is required.

Software: Communication software is required to retrieve data from the data logger. Data reduction software, such as Argus, is used to process and plot the data.

STANDARD IPI SENSORS

Uniaxial IPI Sensor	56804121
Biaxial IPI Sensor	56804122
Wheels for 85mm Casing	56805032
Wheels for 70 mm Casing	56805022
Tubing for 1 m Gauge Length	16804221
Tubing for 2 m Gauge Length	16804222
Tubing for 3 m Gauge Length	16804223
Signal Cable	50613527

MULTIPLEXED IPI SENSORS

Uniaxial IPI Sensor with Mux	56804521
Biaxial IPI Sensor with Mux	56804522
Wheels for 85mm Casing	56805032
Wheels for 70 mm Casing	56805022
Tubing for 1 m gauge length	16804221
Tubing for 2 m gauge length	16804222
Tubing for 3 m gauge length	16804223
Jumper Cable Connector	56804510
Signal Cable	50613527

SUSPENSION KIT

Suspension Kit, 85mm Casing	56804312
Suspension Kit, 70 mm Casing	56804310
3/16" Stainless Steel Cable	56804300

IN-LINE SUSPENSION KIT

In-Line Suspension Kit, 85mm	56804322
In-Line Suspension Kit, 70mm	56804320
3/16" Stainless Steel Cable	56804300

IPI SENSOR SPECIFICATIONS

Sensor Type: Electrolytic tilt sensor for tilt measurements, thermistor for temperature measurements. Built-in signal conditioner accepts power input of 5.5 to 15 Vdc and outputs ± 2.5 volt differential signal. Biaxial version contains two tilt sensors. Multiplexed version operates from a single signal cable.

Calibrated Range: ± 10 degrees.

Resolution: 9 arc seconds or 0.04 mm/m using the CR10 data logger.

Repeatability: ± 22 arc seconds or ± 0.1 mm/m.

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

Max Gauge Length: 3 meters.

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

Housing: Stainless steel. 38mm (1.5") diameter.

Signal Cable: Signal cable, ordered separately, has seven 22-gauge tinned-copper conductors, shield, and polyurethane jacket.

