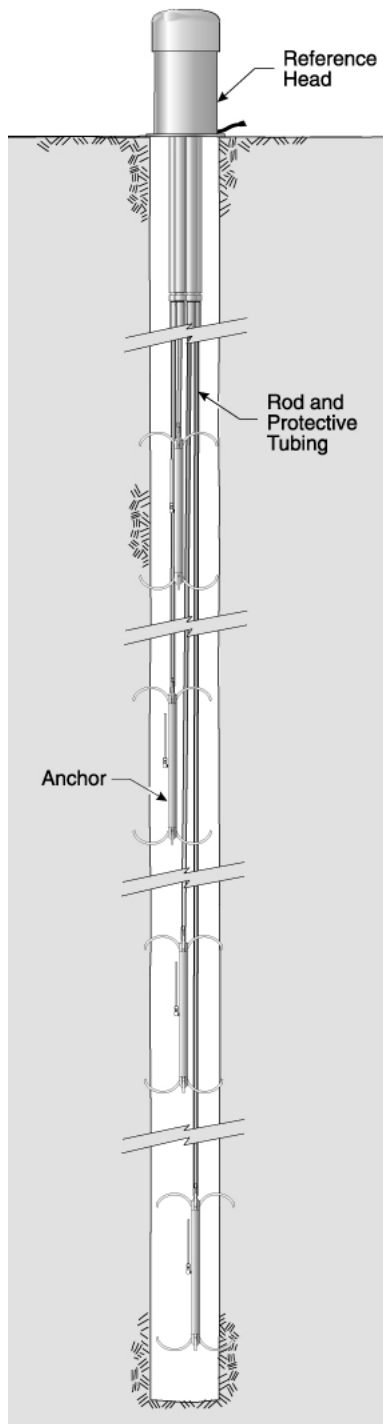


Rod Extensometer



Applications

The rod extensometer is installed in boreholes to monitor settlements in foundations, subsidence above tunnels, displacements of retaining structures, and deformations in underground openings.

Operation

The main components of a rod extensometer are anchors, rods inside protective pipe, and a reference head.

The anchors are installed downhole with rods attached. The rods span the distance from the downhole anchors to the reference head at the surface. The protective plastic pipe prevents bonding between rods and grout backfill.

Readings are obtained at the reference head by measuring the distance between the top (near end) of the rod and a reference surface. A change in this distance indicates that movement has occurred.

Movements are referenced to a stable elevation, typically a downhole anchor. The resulting data can be used to determine the zone, rate, and acceleration of movements, and to calculate strain.

Anchors

Anchors are selected to match field conditions. The groutable anchor is suitable for rock; the hydraulic anchor is suitable for soil.

Rods

Rods are made of fiberglass or stainless steel. Fiberglass rod extensometers are assembled at the factory and shipped to the site, ready to install. The flexibility of these extensometers also makes them easier to install in confined areas, such as tunnels.

Stainless steel rod extensometers must be assembled on site. However, their stiffer rods can be used for deeper anchor depths. A table on the next page presents maximum recommended lengths for fiberglass and steel rods.

Reference Heads

Mechanical reference heads can be used when there is easy access to the extensometer. Measurements are obtained with a depth micrometer.

Electric reference heads are used when access to the reference head is difficult or where continuous monitoring is required. Measurements are obtained with displacement sensors and a read-out or data logger.

Performance Notes

System Accuracy: The main variables in system accuracy are site conditions and the quality of the installation. In general, the best performance is achieved when the borehole is straight and rods are held in tension to keep them straight while the grout backfill cures.

Maximum Recommended Rod Length: In general, rods in tension can be longer than rods in compression, and steel rods can be longer than fiber-



glass rods. In non-vertical installations, friction between rods and the protective pipe becomes a limiting factor. The table below suggests maximum lengths for rods in tension and compression.

Max Rod Lengths: Tension/Compression		
Orientation	Fiberglass	Steel
Vertical Down	20 / 15 m	40 / 30 m
Vertical Up	45 / 30m	60 / 45 m
45° Down	25 / 20 m	40 / 30 m
45° Up	35 / 25 m	55 / 40 m
Horizontal	35 / 20 m	45 / 30 m

Number of Monitored Points: The rod extensometer can monitor up to six points. In practice, the number of monitored points is limited by the size of the borehole, the type of anchor used, the diameter of the protective pipe, and the amount of tubing required for activating anchors and grouting. A 76 mm (3") borehole will accommodate six groutable or hydraulic anchors

Anchors

Groutable Anchor 51815852
Made from rebar, 19 x 365 mm (0.75 x 14.5").

Hydraulic Anchor 5170395

Double-acting hydraulic anchor drives 150 (6") mm prongs into soil. 32 x 620 mm (1.25 x 24.5"). Requires hydraulic tubing & pump.

Fiberglass Rods

Fiberglass Rod 51815855
Protective Tubing 51815860
Rod Completion Kit 51836240

Fiberglass rod has a diameter of 5 mm (3/16") and is supplied in continuous lengths. Protective polyethylene tubing is supplied in continuous lengths. Rod completion kit includes components for top and bottom of rod. Order 1 kit per anchor.

Stainless Steel Rods

Stainless Steel Rod 51704310
Protective Pipe 51704321
Rod Completion Kit 51836210

Stainless steel rod has a diameter of 6.4 mm (0.25") and is supplied in 10' lengths, each threaded and tapped for assembly. Protective pipe is supplied in 10' lengths and includes couplings. Requires PVC solvent cement, which can be obtained locally. Rod completion kit includes components for top and bottom of rod. Order 1 kit per anchor.

Mechanical Reference Head

Single-Point Head 51836110
Multi-Point Head 51836120
Digital Depth Micrometer 51809620

Single-point head works with 1 rod and anchor. Multi-point head works with up to 6 rods and anchors. Readings are obtained with depth micrometer. Digital depth micrometer displays readings in inches and millimeters. 150 mm (6") range, 0.01 mm (0.001") resolution.

Electric Reference Head

Single-Point Head 51836130
Multi-Point Head 5183614
VW Sensor, 60 mm range 52636305
VW Sensor, 100 mm range 52636325
VW Sensor, 200 mm range 42636200
Potentiometer, 60 mm range 51836152
Potentiometer, 100 mm range ... 51836154

Single-point head works with 1 rod and anchor. Multi-point head works with up to 6 rods and anchors. Displacement sensors are supplied with 0.6 m (2') of signal cable.

VW sensor provides resolution of 0.01% FS. Potentiometer provides resolution of 0.1% FS. Repeatability is better than ±0.5% FS.

Special ranges and waterproof ratings can be quoted on request.

VW sensors are read with a VW Data Recorder or a data logger: VW minilogger for single points and V-Logger or Campbell Scientific logger for multiple points.

Potentiometers are read with a Campbell Scientific data logger.

Signal Cable

Signal Cable, 4-Wire 50613824
For one VW sensor.

Signal Cable, 6-Wire 53102900
For one potentiometer.

Signal Cable, Multicore. Contact Factory Universal Terminal Box 57711600

For use with VW Data Recorder. Not required with data logger. Splashproof fiberglass box is 290 wide x 345 high x 135 mm deep (11.5 x 13.5 x 5.25").

Installation Accessories

Pipe Adapter 51835170

Optional adapter for anchoring reference head to 76mm (3") diameter steel pipe installed at collar of borehole.

Flange 51836175

Optional adapter for anchoring reference head to concrete pad at borehole collar. 190 mm (7.5") plastic flange with 152 mm (6") bolt circle.

Grout Tubing 50721008

Used to deliver grout from the grout pump to the borehole. 12.7mm OD (0.5") polyethylene tubing rated for 30 bar (425 psi).

Hydraulic Tubing 51702701

Used to activate hydraulic anchors. 6.35mm (0.25") nylon tubing filled with oil.

Hydraulic Anchor Tools 51704600

Hydraulic pump with gauge, T-connection, oil volume indicator, 1 gallon of oil, and adapter for filling hydraulic tubing.

Spare Nut & Ferrule 5170395

Replacement hardware for connecting hydraulic tubing to anchor.

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