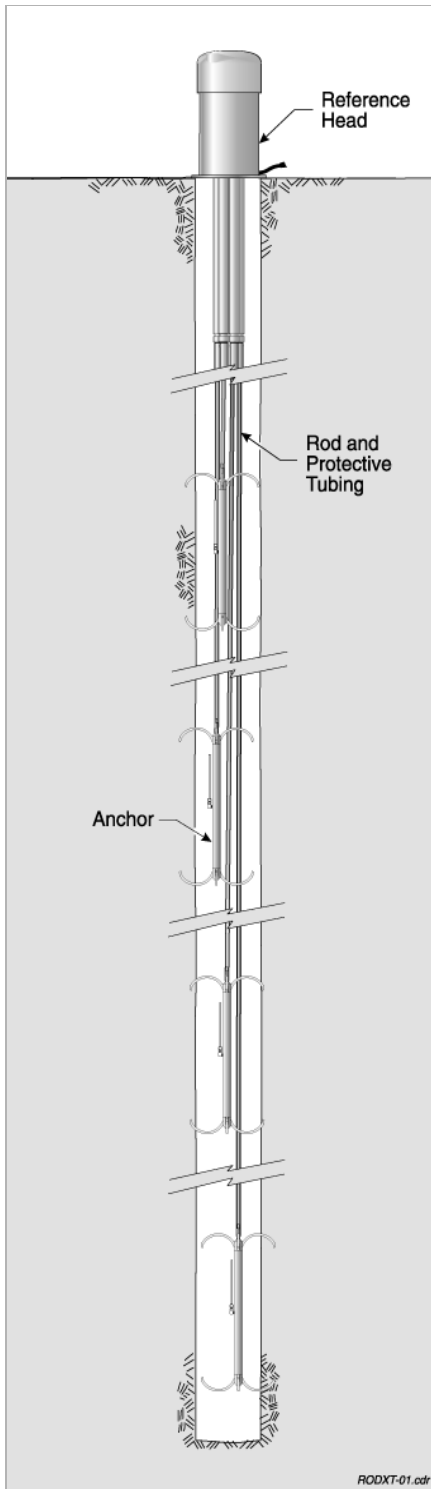


# Rod Extensometer



## 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

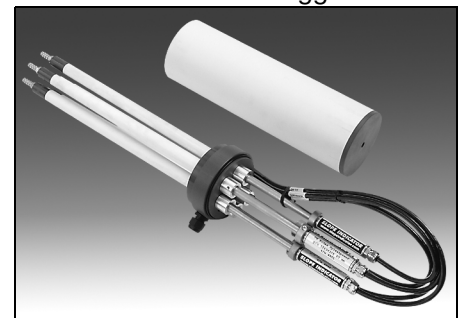
Rods are made of fiberglass or stainless steel. Fiberglass rod extensometers are assembled at the factory and shipped to the site, ready to install. The flexibility of these extensometers also makes them easier to install in confined areas, such as tunnels.

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 readout 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 fiberglass 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 . . . . . 51703952**

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 . . . . . 51836140**

**VW Sensor, 60 mm range . . . . . 52636305**

**VW Sensor, 100 mm range . . . . . 52636325**

**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 . . . . . 51703950**

Replacement hardware for connecting hydraulic tubing to anchor.