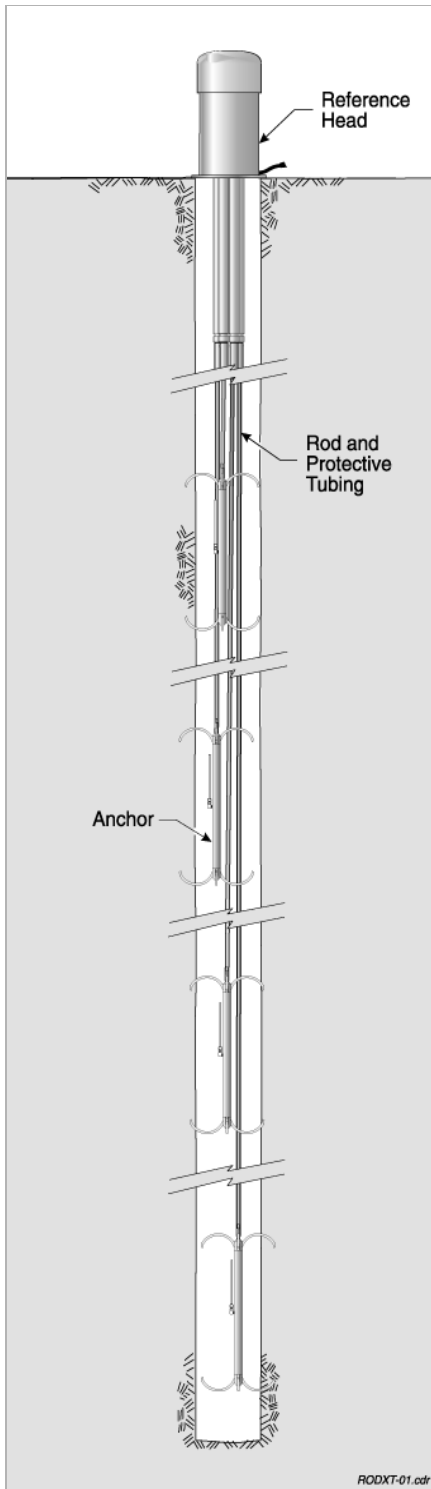


Dual-Read Rod Extensometer



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. The dual-read rod extensometer allows for both electrical and mechanical readings of the extensometer.

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 Head

The dual-read reference head contains both electrical displacement sensors as well as mechanical measurement points that can be read with a depth micrometer.

The mechanical measurement points provide a means of validating the electrical readings without disturbing the reference point.



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 dual-read rod extensometer can monitor up to four 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 normally accommodate up to six groutable or hydraulic anchors

ANCHORS

Groutable Anchor for Stainless . . .51836270
Groutable Anchor for Fiberglass. .51836250
 Made from rebar, 19 x 365 mm (0.75 x 14.5").

FIBERGLASS RODS

Fiberglass Rod 51815855
Protective Tubing. 51815860
 Fiberglass rod has a diameter of 5 mm (3/16") and is supplied in continuous lengths. Protective polyethylene tubing is supplied in continuous lengths.

STAINLESS STEEL RODS

Stainless Steel Rod. 51704310
Protective Pipe. 51704321
 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.

REFERENCE HEAD

Head Diameter: 2.375"
1 Position Head, Stainless 51836310
1 Position Head, Fiberglass 51836312
2 Position Head, Stainless 51836272
2 Position Head, Fiberglass 51836252
Head Diameter: 3.50"
3 Position Head, Stainless 51836273
3 Position Head, Fiberglass 51836253
4 Position Head, Stainless 51836274
4 Position Head, Fiberglass 51836254
VW Sensor, 200mm range 42636200
Digital Depth Micrometer 51809620
 Mechanical 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.
 VW sensor provides resolution of 0.01% FS. Repeatability is better than ±0.5% FS.
 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.

SIGNAL CABLE

Signal Cable, 4-Wire50613824
 For one VW sensor.
Signal Cable, Multicore.50613810
 For up to five VW sensors.

Universal Terminal Box57711600
 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

Flange for 2.5" Head. xxxxxxxx
Flange for 3.5" Head. xxxxxxxx
 Optional adapters for anchoring reference head to concrete pad at borehole collar.
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).