Rod Type Multiple Point Borehole Extensometers

Stability and movement behavior of soil and rock masses can be determined by the use of borehole extensometers. A typical rod extensometer consists of a reference head, usually installed at the collar of a drill hole, and one or more in-hole anchors, each of which is fixed in place at a known depth in the borehole. As the soil or rock deforms, the distances between adjacent in-hole anchors change, as do the distances between the individual in-hole anchors and the reference head. This allows an accurate determination of distribution, magnitude, rate and acceleration of deformation in the rock or soil mass intersected by the drill hole.

Selection of Rod Extensometers

The number of anchors and anchor depths should be selected based on site geology, geometry of structures in the area, and other site-specific details. The use of two, or more, anchors at various depths allows the engineer to distinguish between potentially dangerous deep seated movements and more trivial surface spalling.

Reference Heads

Reference heads are available in either mechanical or electrical types. When there is easy access to the extensometer a mechanical reference head can be attached and displacement readings can be made with a dial indicator or a depth micrometer. If access to the borehole is difficult or if remote reading or datalogging is required, an electrical reference head may be attached. This allows displacement readings to be made with vibrating wire transducers, LVDT’s or linear potentiometers. These can be read with manual read out devices, or can be connected to dataloggers for remote and continuous monitoring. A manual over-ride is available for electrical reference heads to allow manual readings to verify that the electrical system is functioning. All readouts have a standard range of 100 mm (4 in.), but alternate ranges are available as required. Standard cable for remote readouts is a direct burial rated, PVC jacketed type. Armored cable is available for mechanical protection as required.

Applications

- Monitoring deformation around underground excavations.
- Consolidation settlement in soils.
- Bottom heave in open cut excavations.
- Strain in concrete structures.
- Movement behind the face of excavated slopes.
- Subsidence over mines, tunnels, etc.
- Pile load tests.
- Monitoring of mine pillar deformation.
- Deformation of foundations in and under buildings.
- Roof and wall stability in mines and underground workings.

Features

- Accurate and reliable.
- Easily adapted to remote readout.
- Anchor lengths can be varied in the field.
- Simple to operate.
- Easy to install.
- Rugged.
Rod Type Multiple Point Borehole Extensometers (MPBX)

**Anchor Types**

**Expanding Shell Rock Bolt Anchor**
Preferred for single and double point extensometers, it is simple and quick to install. Wide expansion and positive mechanical set make it useful in rough, uneven boreholes within fractured rock. Also suitable for use in areas affected by blasting, and in upland or downward holes.

**Groutable Anchor**
Simple to install and the preferred anchor for downward directed holes. It is unaffected by blasting. It is not suitable for use in soft ground or soils as the grout column may inhibit performance. It can be used in upward directed holes with a special grouting technique. Up to six can be placed in a single 3 in. (NX) borehole.

**Snap Ring Anchor**
For use in hard, competent rock, where smooth, uniform boreholes can be drilled. It offers the optimum in speed and simplicity of installation, and up to eight can be placed in a single 3 in. (NX) borehole. It is preferred for upward holes where grouting may be difficult. It is not likely affected by blasting. Snap ring anchors are borehole size specific and must therefore be custom sized to each hole.

**Hydraulic Anchor**
For use in soft ground and soil, especially where hole squeezing is anticipated. It is the most difficult to install and is not suitable in blast affected areas. Three types are available: the standard expanding tube type, single acting borros prong type, and double acting borros prong type. Up to six can be placed in a single 3 in. (NX) borehole.

**Bayonet Modification Fitting**
A special bayonet modification fitting is available for all anchor types. This allows the measurement rod to be disconnected from the anchor and moved a known distance. With this feature the frictional effects and freedom of rod movement can be examined at any time and the reliability of readings greatly increased. Also available is an anchor tell-tale. This can be attached to the bottom of the anchor in such a way that it will project into an underground opening when the opening is excavated. This enables the extensometer to be accurately located at its lower end without resorting to expensive borehole surveying procedures.

**Rods Types**
Rods are available from RST in various lengths, with individual rod pieces a maximum of 3 m (10 ft.), that can be coupled together to place anchors at any required depth. Typically, rods have an O.D. of 6.4 mm (¼ in.), but larger diameters are available for site specific applications - please consult RST.

Rods are available from RST Instruments in 4 different types:
1. Steel: short term, typically used with groutable anchors. Flush coupled.
2. Stainless Steel: most common and applicable. Typically used with all anchor types. Flush coupled.
3. Rigid Fiberglass: light weight allowing easy transport and installation. Non-corrosive for longevity and can be used with all anchor types. Non flush coupled.
4. Carbon Fiber: for special high temperature and changing temperature environments. The carbon-fiber has a coefficient of thermal expansion that is virtually zero (<0.5 x 10^-6/°C), therefore eliminating any thermal effects. Non flush coupled can be used with all anchor types. Carbon fiber rods are available only as special orders.

Rods may be sheathed in individual PVC protective pipe (nominal ¼ in. I.D.) to minimize frictional effects between different rods and between rods and the borehole wall. Protective pipe may also be filled with oil, if the borehole is inclined downward to lubricate the rods and further minimize frictional effects. Installation tools are available from RST Instruments. In small boreholes (less than 2 in.), snap ring anchors can be set using the measuring rod for restraint. In larger boreholes, the force required to set snap ring anchors requires the use of installation rods. When several anchors are employed in one borehole, self-aligning installation rods are recommended to maintain anchors in correct alignment and prevent weaving of the measurement rods. Rod spacers are available to space out and support longer rods. By placing rod spacers at various places along a rods’ length, “sagging” is prevented and accurate measurement is assured.

**Ordering Info**

**Item** | **Part #**
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Expanding shell rock bolt anchor | EXEX11000
Snap ring anchor (specify borehole diameter) | EXSR11000
Groutable anchor | EXMP11000
 Hydraulic anchor (expanding tube type) | EXHY11000
 Hydraulic anchor (borros type-single acting) | EXHY12000
 Hydraulic anchor (borros type-double acting) | EXHY13000
Bayonet modification fitting (1 per anchor) | EXPI11000
Anchor tell tales | EXPI12000

**Rods and Accessories**

- **Measurement rod, 6.4 mm (¼ in.) O.D., steel X 10 ft.**
- **Measurement rod, 6.4 mm (¼ in.) O.D., stainless steel X 10 ft.**
- **Measurement rod, 6.4 mm (¼ in.) O.D., rigid fiberglass X 10 ft.**
- **Measurement rod, 6.4 mm (¼ in.) O.D., carbon-fiber X 10 ft. (special order)**
- **PVC protective pipe, 6.4 mm (¼ in.) I.D., flush coupled X 10 ft.**
- **PVC protective pipe, 6.4 mm (¼ in.) I.D., non flush coupled X 10 ft.**
- **Installation rods (for boreholes=2 in.), self-aligning**
- **Installation rods (for boreholes=2 in.), non-aligning**
- **Rod spacers (specify borehole diameter)**
- **Snap ring anchors require the use of installation rods. When several anchors are employed in one borehole, self-aligning installation rods are recommended to maintain anchors in correct alignment and prevent weaving of the measurement rods. Rod spacers are available to space out and support longer rods. By placing rod spacers at various places along a rods’ length, “sagging” is prevented and accurate measurement is assured.**

**Reference Heads and Accessories**

- **Mechanical reference head (specify no. of points)**
- **Electrical reference head (specify no. of points)**
- **Linear potentiometer, 4 in. range (standard)**
- **Vibrating wire displacement transducer, 4 in. range (standard)**
- **LVDT, 4 in. range (standard)**

**Readout Devices and Accessories**

- **Dial indicator readout, 6 in. range**
- **Depth micrometer, 6 in. range**
- **Potentiometric manual readout device**
- **Vibrating wire manual readout device**
- **LVDT manual readout device**
- **Data logger logger—8 channel (16 optional)**
- **CR-10 data logger**

**Additional Info**

- **Model/Part number**
- **Anchor type**
- **Number of anchors**
- **Individual anchor depths**
- **Rod type**
- **Reference head type**
- **Installation rods/tools**
- **Borehole diameter**
- **Accessories required**
- **Cable length**
- **Cable armour**
- **Range**
- **Environmental considerations**

**Optional Equipment**

- **Dial indicator**
- **Depth micrometers**
- **Setting tools**
- **Data loggers**
- **Grout and/or bleed tubes**
- **Rod spacers**
- **Terminal stations**
- **Electrical readout**

**Rod spacers (specify borehole diameter)**

- **EXIR002000**
- **EXIR002200**

RST Instruments Ltd. reserves the right to change specifications without notice.