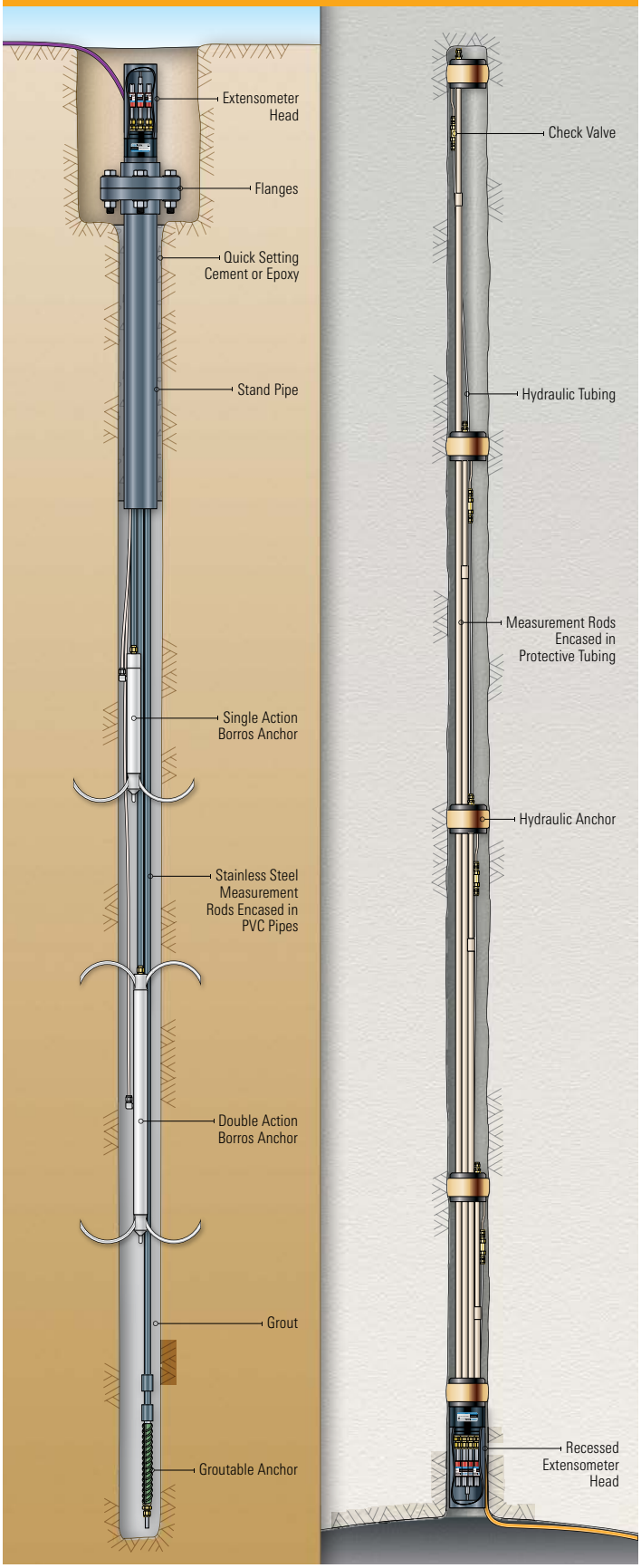
ROD TYPE BOREHOLE EXTENSOMETERS

GEOKON®

MODEL 1100



Flange type Model 1100 Extensometer with Borros and Rebar borehole anchors (left) and Flangeless type with bladder anchors (right).

APPLICATIONS

Typical applications include the measurement of:

- Ground movements around tunnels
- Deformation of dam abutments and foundations
- Fracturing in the roofs and walls of underground caverns
- Ground movements in the walls of open pit mines
- Ground movement behind retaining walls, sheet piling, slurry walls, etc.
- Subsidence above tunnels and mine openings
- Settlement and heave of foundations in soft soil

OPERATING PRINCIPLE

Rod Type Borehole Extensometers utilize measurement rods to connect sensors inside the head of the extensometer to anchors installed in the borehole. Movement of the anchors in relationship to the head of the extensometer, which is anchored at the mouth of the borehole, can be analyzed to reveal the magnitude of the deformation between the anchors.

Readout is achieved by connecting the head of the extensometer to a portable readout, datalogger, or similar device.

ADVANTAGES AND LIMITATIONS

Model 1100 Rod Type Borehole Extensometers allow up to six anchor points to be secured along the axis of the borehole, in soil, rock, or concrete, to measure longitudinal displacements at each anchor location.

There are two main types of extensometer head. The Flange type is designed to sit on the surface of the rock, soil or concrete structure at the mouth of the borehole. The Flangeless type is designed to be recessed into the borehole or into an enlarged section of the borehole. This can provide protection from traffic, vandalism, blasting, construction activity, etc.

Two types of measurement rods are available, stainless steel and fiberglass.[1] The stainless steel type is assembled on site according to customer-specific anchor depths, whereas the lighter fiberglass rod type is delivered preassembled to facilitate installation. The measurement rods are encased in protective tubing ensuring they are isolated from grout and debris and allowed to move freely with the anchors.

A variety of anchor types are available for use in soil and rock, and in grouted and non-grouted installations.

Movement of the measurement rods in relationship to the head of the extensometer is sensed electronically using the requisite number of Model 4450 Vibrating Wire Transducers.[2]

[1]Other rod types, including Invar and Carbon Graphite (for use where temperature effects need to be minimized) are available on request.
[2]Other readout types including linear potentiometers, DCDTs and manual readouts are available on request.

MODEL 4450 VIBRATING WIRE DISPLACEMENT TRANSDUCERS

Model 4450 VW Displacement Transducer

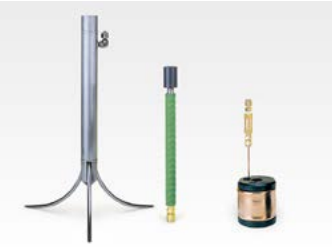
The Model 4450 VW Displacement Transducer provides remote readout for Model 1100 Extensometers. VW transducers are especially beneficial in locations where other vibrating wire sensors are used or where long cable runs are required.

MODEL 4450 TECHNICAL SPECIFICATIONS

Standard Ranges[1]	12.5, 25, 50, 100, 150, 200, 300 mm
Resolution	0.025% F.S.
Accuracy[2]	±0.1% F.S.
Nonlinearity	< 0.5% F.S.

[1]Other ranges available on request. [2]Accuracy established under laboratory conditions. [3]Transducer only

ANCHORS



Model 100-S-BORROS, 1100-GROUTABLE and 1100-BLADDER anchors (left to right)

Three anchor types are available[3] and multiple anchor types may be used on a single extensometer, if required.

GROUTABLE ANCHORS

Groutable anchors, constructed from lengths of steel reinforcing bar, are the preferred option for installation in downward directed boreholes that are easily filled with cement grout.

HYDRAULIC BORROS ANCHORS

Hydraulic Borros Anchors are recommended for soft soils. These feature a set of curved prongs spaced 120° apart, which are recessed within the anchor body until activated. Under hydraulic pressure the prongs (3 on single action anchors, 6 on double action anchors) extend 150 mm from the anchor body and into the borehole wall.

HYDRAULIC BLADDER ANCHORS

Hydraulic bladder anchors can be easily installed in boreholes oriented in any direction. They are particularly useful in boreholes which are fractured, oriented upwards, or difficult to grout. They consist of a copper bladder wrapped around a spool of high strength plastic. Attached to the copper bladder is a high pressure nylon inflation line and check valve. The inflation is accomplished with a hydraulic pump causing the copper bladder to expand and "unwind," and permanently deform so that the grip is not lost even if the check valve fails.

Bladder anchors are custom sized for each borehole and accommodate up to 30 mm of oversize without loss of grip.

[3] Snap ring anchors are available on request. They are designed for boreholes also in hard or competent rock, with a smooth wall and uniform diameter. Snap ring anchors are installed using setting rods to push to the required depth. A pull cord is used to remove the locking pin, which activates two retaining rings that snap outward and grip the borehole.

ROD TYPES

Extensometer rods are available in continuous lengths of fiberglass, or in 3 m or 1.5 m lengths of flush coupled 303 stainless steel.

ROD PROPERTIES

Material	Diameter	Weight/Meter	Young's Modulus	Temp. Coefficient
303 Stainless Steel	6 mm	0.25 Kg/m	200 GPa	17.5 ppm/°C
Fiberglass	6 mm	0.06 Kg/m	20 GPa	3.0 ppm/°C

Rod Length Tolerances	0-1.5 m	1.5-3 m	3-6 m	6-30 m	30+ m
303 Stainless Steel	±1.5 mm	±6.3 mm	n/a	n/a	n/a
Fiberglass	±1.5 mm	n/a	±6.3 mm	±12.7 mm	±25.4 mm

TUBE TYPES

Three protective tube types are available: PVC for use with stainless steel rods and polyethylene and/or nylon for the fiberglass rod type.

Where extensometers are used to measure settlement (compression) slip couplings are available to accommodate the shortening of the rod/tube columns. This is especially important if more than 25 mm of compression is expected.

TUBE PROPERTIES

Model #	Material Type	I.D.	O.D.	Wall Thickness	Collapse Pressure
TUB-101	Schedule 40 PVC	9.2 mm	13.9 mm	2.2 mm	5,378 kPa
TUB-103	Polyethylene	9.5 mm	12.7 mm	1.6 mm	931 kPa
TUB-109	Nylon	9.5 mm	12.7 mm	1.6 mm	1,724 kPa

ORDERING INFORMATION

1100-1:* Head assembly for rod type extensometers, 1 measurement point. Minimum borehole ID = 73 mm.
1100-2:* Head assembly for rod type extensometers, 2 measurement points. Minimum borehole ID = 73 mm.
1100-3:* Head assembly for rod type extensometers, 3 measurement points. Minimum borehole ID = 89 mm.
1100-4:* Head assembly for rod type extensometers, 4 measurement points. Minimum borehole ID = 89 mm.
1100-5:* Head assembly for rod type extensometers, 5 measurement points. Minimum borehole ID = 114 mm.
1100-6:* Head assembly for rod type extensometers, 6 measurement points. Minimum borehole ID = 114 mm.
1100-KIT: Installation kit with extension rods. Specify measurement points and transducer range. (Number of kits required equals maximum number of extensometers to be installed in a single day.)

1100-COUPLING: PVC standpipe, 0.75 m long, with coupling. Specify number of measurement points.
1100-FLANGE: PVC standpipe, 0.75 m long, with flange. Specify number of measurement points.
1100-GROUTABLE: Groutable anchor. Specify rod type.
1100-BLADDER: Hydraulic bladder anchor with check valve. Specify measurement points and rod type.
1100-S-BORROS: Hydraulic Borros type anchor, single action. Specify rod type.
1100-D-BORROS: Hydraulic Borros type anchor, double action. Specify rod type.
1100-PUMP: Hydraulic pump with quick connect for inflating hydraulic anchors.
1100-SLIP-10CM: Inline slip coupling, 10 cm range. Specify rod type.
1100-SLIP-30CM: Inline slip coupling, 30 cm range. Specify rod type.
1100-GROUT-DOWN: Set of grouting acces- sories for inclined downwards installations.

1100-GROUT-UP: Set of grouting accessories for overhead/upward installations. Note: One set may be required per overhead extensometer.
1100-TOOLKIT: Set of installation tools.
1100-RECESSED-TOOLS: Additional tools required for recessed installations.
1100-UPWARD-TOOL: Additional tools required for upward installations.
ROD-101: Flush coupled SS rod, 6 mm Ø.
ROD-104: Continuous fiberglass rod, 6 mm Ø.
TUB-101: Schedule 40 PVC tubing, 6 mm Ø.
TUB-103: Polyethylene tubing, 13 mm Ø. For use with 6 mm Ø fiberglass rod at anchor depths <30 m.
TUB-104: Grout tube, 19 mm Ø.
TUB-105: Polyethylene vent tube, 6 mm Ø.
TUB-108: Nylon pressure tube, 5 mm Ø.
TUB-109: Nylon tubing, 13 mm Ø. For use with 6 mm Ø fiberglass rod at anchor depths >30 m.

4450-1: VW Displacement Transducer for use with Rod Type Borehole Extensometers. Specify range: 12.5, 25, 50, 100, 150, 200, 300 mm
02-250V6: Blue PVC cable, 6.35 mm (±0.25 mm) [0.250"] Ø, 2 twisted pairs, for single point extensometers.
02-250P9LT: Purple polyurethane cable, 6.35 mm (±0.25 mm) [0.250"] Ø, 2 twisted pairs, for single point extensometers.
04-375V9: Violet PVC cable, 9.50 mm (±0.38 mm) [0.375"] Ø, 4 twisted pairs, for 2 and 3 point extensometers.
05-375V12: Tan PVC cable, 9.50 mm (±0.38 mm) [0.375"] Ø, 5 twisted pairs, for 4 point extensometers.
06-500V7: Orange PVC Cable, 12.70 mm (±0.38 mm) [0.500"] Ø, 6 twisted pairs, for 5 point extensometers.
12-625V5: Brown PVC cable, 15.90 mm (±0.38 mm) [0.625"] Ø, 12 twisted pairs, for 6 point extensometers.

**Specify rod type and transducer range.*

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