INSTRUCTION MANUAL

SELF-ALIGNING PLASTIC INCLINOMETER

CASING IN BOREHOLES

Model GEO-LOK

CE

Tel.: 1.450.465.1113 • 1.877.ROCTEST (Canada, USA) • 33.1.64.06.40.80 (France) • 41.91.610.1800 (Switzerland)
www.roctest.com

E10280-130828

NOVA METRIX

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1 PRODUCT

1.1 DESCRIPTION

The inclinometer casing model GEO-LOK consists of 1.5 or 3 meters length of ABS pipe with 4 internal grooves spaced 90 degrees apart and running along the entire casing length. Adjoining casing sections are assembled using GEO-LOK's tightening system: a mating key located within the coupling ensures precise alignment of the casing grooves as succeeding casing lengths are assembled by simply rotating the coupling ring. The casing comes in two diameter sizes: 85 mm and 70 mm OD (3.34"and 2.75").

1.2 APPLICATIONS

The GEO-LOK inclinometer casing is designed to be used in conjunction with the PROFIL inclinometer probe manufactured by Roctest. Inclinometer probes from other manufacturers can also be used in the GEO-LOK casing (please confirm with Roctest for compatibility).

The casing, whether installed within boreholes or fastened to the surface of a structure, responds to any deflection or deformation of the surrounding material or structure. An inclinometer probe, fixed or wheel-mounted and oriented by the internal grooves, measures the tilt angle of the casing from the vertical. Changes in the tilt angle caused by casing deflection or deformation are converted to displacements normal to the casing axis and are incrementally summed to provide profiles of total displacement versus depth.

The casing can also be fitted with magnetic anchors and be used as a settlement extensometer in which a reed switch probe is inserted using a graduated cable in order to locate the anchors.

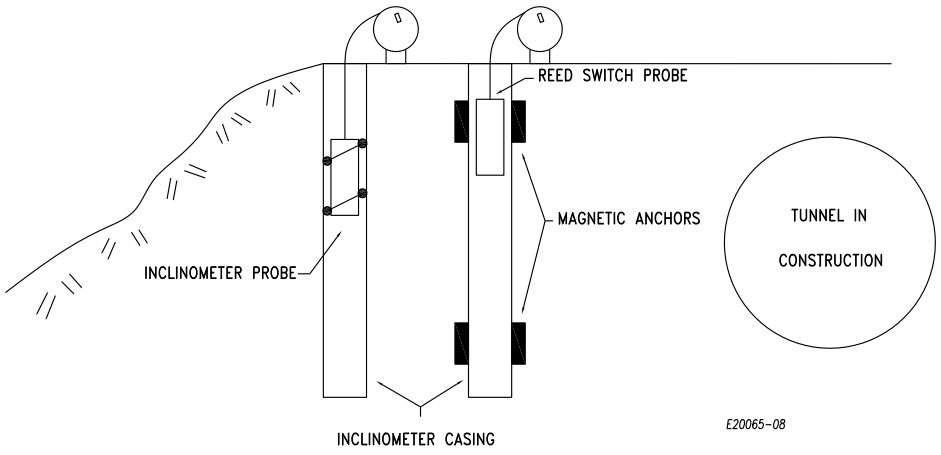


FIGURE 1: Typical casing applications

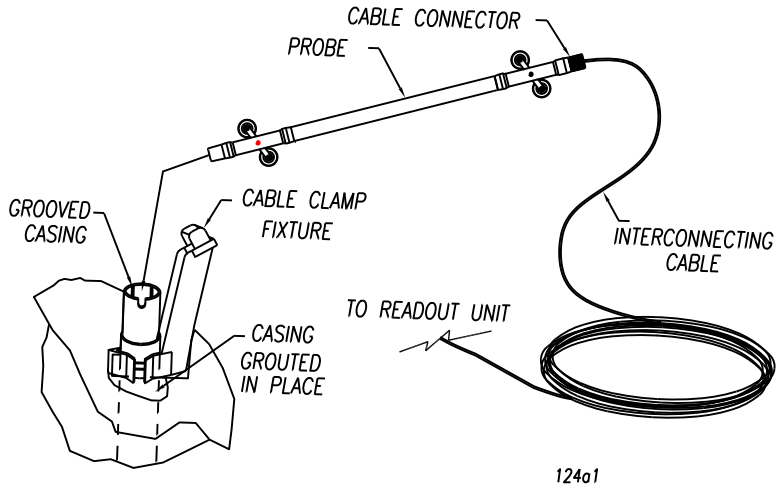


FIGURE 2: Inclinometer probe insertion into GEO-LOK casing

1.3 SPECIFICATIONS

CASING		
Nominal diameter:	70 mm OD x 59 mm ID	85 mm OD x 72 mm ID
Length:	1.572 m / 3.096 m	
Material:	ABS	
Weight: (1.5 m / 3 m)	1.79 kg / 3.42 kg	2.25 kg / 4.81 kg
Maximum compression/ extension of casing length	1% of casing length	

COUPLING RING		
Diameter:	72 mm OD	87 mm OD

TELESCOPIC SECTION		
Diameter:	73 mm OD x 59 mm ID	89 mm OD x 72 mm ID
Length fully extended:	791.2 mm	
Length fully compressed:	638.8 mm	
Weight:	0.76 kg	1.04 kg

TOP CAP		
Diameter:	69.9 m OD	84.8 mm OD
Weight:	0.033 kg	0.048 kg

BOTTOM CAP		
Diameter:	69.9 m OD	84.8 mm OD
Weight:	0.11 kg	0.15 kg

TABLE 1: Specifications

2 INSTALLATION

2.1 GENERAL

2.1.1 BORING

Borehole diameter and the method of accomplishing the boring depend upon the type of materials encountered, the depth of the hole, and the equipment available.

If the ground is firm, the borehole will remain open without steel casing. Either a dry borehole (drilled with a continuous-flight auger) or a water-filled hole (drilled with a chopping or a rotary bit and water to flush out the cuttings) is satisfactory. If the hole is likely to cave in, drilling mud may be used and left in the hole upon completion of the boring.

Percussion drilling also may be used for the boring and the steel casing pulled after the casing has been installed. A careful check must be made before pulling the steel casing to insure that backfill material has not filled the annular space between the casing and the lower portion of the steel casing. Backfill material can lock the inclinometer casing to the steel casing and will cause it to be pulled from the boring with the steel casing. In extremely difficult cases, steel casing may be left in place upon completion of the boring. However, steel casing tends to thicken zones of movement.

2.1.2 SELECTION OF CASING AND BOREHOLE SIZE

Proper casing installation can make the difference between a successful measurement program and an unsuccessful one. The procedure is simple and should be followed rigorously.

1. The first step is to select the size of casing to be used. The casing size has no effect upon overall system accuracy, but care should be exercised to match the casing size to the type of deformation expected. The reason for this is that as the casing size increases, the probe will pass through a smaller radius of curvature without becoming wedged in the casing.

2. The second step is to select a standard or telescopic casing assembly. If no significant settlement is expected, the casing ends should butt together within the coupling. If significant settlement is expected, then telescopic casings should be used. The standard casing will accept axial deformations of 1%, while each telescopic casing will allow an additional 152 mm of axial deformation. In installations where the expected axial compression is to exceed approximately 1%, compliance of the casing with the host material is ensured by using the appropriate type, quantity and location of telescopic sections. Be aware that settlement may not be uniform along the borehole; in that case, more telescopic sections must be installed in zones where important settlement is expected.

3. The third step is to select the hole size to be drilled, based upon the maximum OD of the casing chosen, the material to be drilled and the type of equipment available. In soft or sandy material, it will be necessary to case the hole to keep it open while installing the casing. The clearance should include space for the tape and the grout tube. Minimum clearance around the casing in an uncased hole should be at least 5 mm. In cased holes, the OD clearance can be as little as 1.25 mm. This clearance must be increased to allow the passage of the grout tubing.

2.2 CASING ASSEMBLY

Before starting casing installation, be sure to have all tools, equipment and materials needed, namely: adequate casing, end plugs (top and bottom), grout, tubing and pump, plus, of course, the drill rig and associated equipment. Always have a spare length of casing and spare end caps before going into the field.

While drilling the boreholes for the casing, pre-assemble the casings into 6 meter lengths if possible. The casing at the bottom of the hole is fitted with a bottom cap to prevent entry of material into the casing.

2.2.1 GEO-LOK COUPLINGS

GEO-LOK casings do not require rivets or glue to be joined. Ensure that a lubricated O-ring is well placed on the male end of the casing. (Figure 3) Line up the buttons of the female end with the alignment slots of the male end and push together. (Figure 4) Turn the coupling ring clockwise (relative to female end) until joint is tight. (Figure 5) Simply reverse the process to undo the joint.

Figure 3

Figure 4

Figure 5

2.2.2 TELESCOPING SECTIONS

The telescopic casings are attached to standard couplings exactly the same way as standard casings are. For more details, user will refer to Section 2.2.1.

NOTE: BE SURE TO INSTALL TELESCOPIC CASINGS IN OPEN POSITION. TELESCOPIC CASINGS MUST BE FULLY OR PARTIALLY EXTENDED DEPENDING ON THE ANTICIPATED MOVEMENT. FOR EXAMPLE, IF A HIGH SETTLEMENT IS ANTICIPATED, THEY SHOULD BE INSTALLED FULLY EXTENDED.

2.3 CASING INSTALLATION

2.3.1 STANDARD INSTALLATION

2.3.1.1 WITH THE USE OF A GROUTING TUBE

a) After the hole(s) is prepared, attach the grouting tube to the first section of casing with PVC or duct tape, running longitudinally along the casing. To prevent the end of the grout tube from getting plugged up, cut a few lateral openings within the first meter of the end of the tube. (Figure 6) This tube will be extended to the surface, so it must be at least 6 meters longer than the hole depth, or long enough to reach the grout pump.

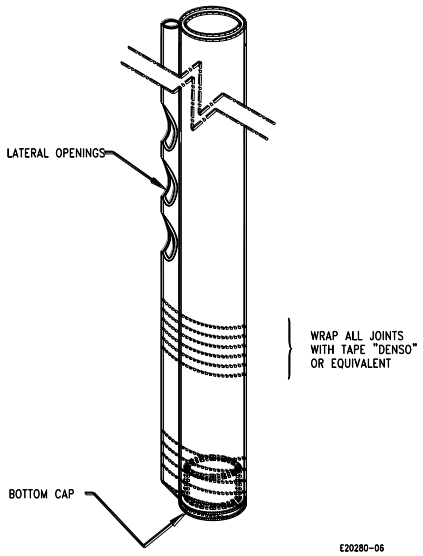


FIGURE 6: Grouting tube assembly

When using telescopic sections do not force the casing down the hole or allow it to sit on the bottom of the borehole. The force or weight of the casing can cause it to collapse longitudinally and preventing the further extension or shortening of the casing with the potential for buckling.

The first section of casing has the bottom cap tightened in place. The cap must be securely fastened to the bottom section of the casing, otherwise there is a risk that an accidental abrupt contact of the probe with the end cap bottom will cause the wheel assemblies of the probe to travel beyond the casing and become stuck.

When installing casing lengths greater than 30 m in dry holes, a lowering wire should be tied to the lower end cap. The lowering wire supports the weight of the casing with the potential for buckling.

b) Lower the first 6-meter section of pre-assembled casing into the hole, stopping at a depth which will permit about 0.6 meter of casing to extend above the top of the hole. Clamp the casing in place with the casing clamp in the kit, using it to prevent the casing from dropping into the hole (in deep installations, use a second clamp).

   The casing should be filled with water only to overcome buoyancy if any exists and, later on, the ingress of grout.

c) Place the second 6 meters of pre-assembled casing section in place on top of the first section, joining sections by aligning the coupling key with the slot in the coupling. Tighten the couplings together and lower the section into the hole. Stop the casing when about 1/3 meter of casing extends above the top of the hole. Feed the grout tube down the hole during the lowering process.

d) Repeat step c) as often as needed to reach the bottom of the hole. If there is water in the hole, it will be necessary to add water in the casing to compensate the buoyancy. As the grout fills the borehole, it will apply an even greater buoyancy on the casing. Therefore, if the grout is particularly dense, a steel pipe inside the casing or another weight outside the casing may be installed at the bottom.

e) Rotate the inclinometer casing to orient the casing grooves as required by the monitoring program.

f) If an intermediate casing has been used to hold the hole open, withdraw this casing, being careful not to sever the grout tube or change the groove orientation.

g) Mix a thin slurry of grout and pump it down the hole, filling it from the bottom. The grout is usually a bentonite cement mixture with strength comparable to that of the surrounding soil or rock.

h) Remove the grout tube. The section of the grout tube has been weakened; it should be possible by pulling up on the grout tube to free it from the casing when the grouting is completed (or leave it in place and cut it off at the top of the hole).

i) Place a top cap on the top end of the casing. A steel standpipe with lock and hasp is then cemented in place over the protruding end of the casing. The standpipe is anchored either in concrete placed in the upper meter of the borehole or by anchoring it in a concrete pad cast at the collar of the borehole.

j) Allow the grout to cure and proceed with initial measurement.

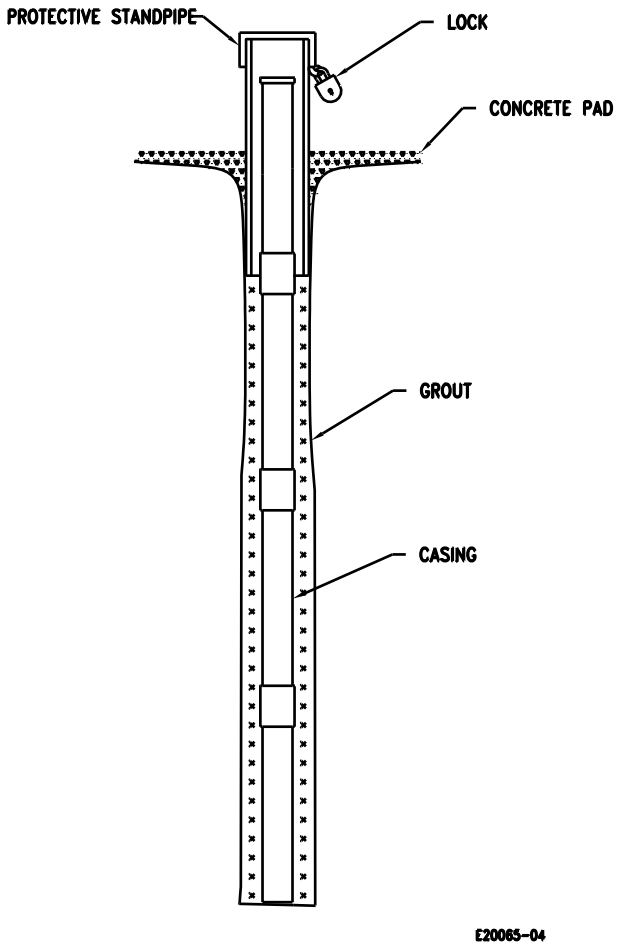


FIGURE 7: Typical final installation

2.3.1.2 WITH THE USE OF A GROUTING PLUG

The grouting can also be performed with a grout plug instead of using a grouting tube. In that case, the casing installation and grouting procedure remain the same as described above except for the following.

a) The grout plug must be securely tightened to the first section of casing.

b) The female plug for grout tube must be screwed to a grouting pipe.

c) To connect them together, the female connector must be pushed onto the grout plug male connector by keeping a load on the grout pipe. The connection will remain as long as the user applies this load. As soon as he removes it, disconnecting occurs.

d) After grouting and removal of the female connector and grout pipe from the casing, the inside of the latter must be cleaned with pressurized water to remove possible grout left there.

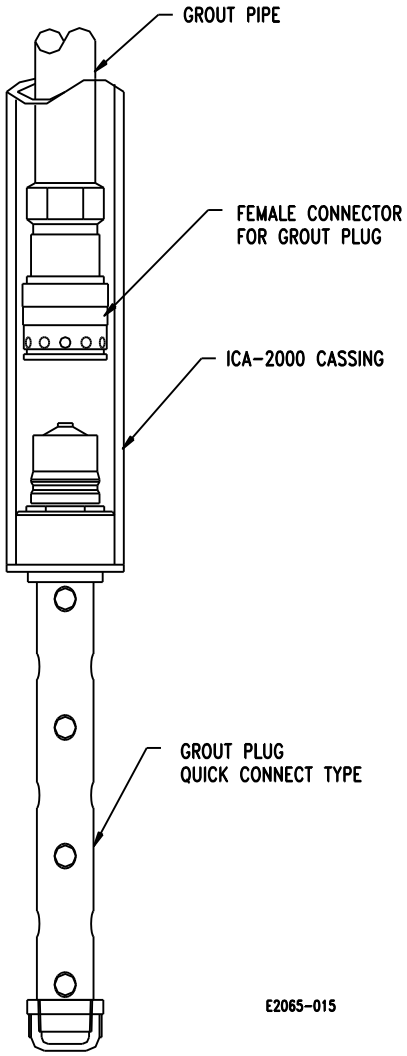
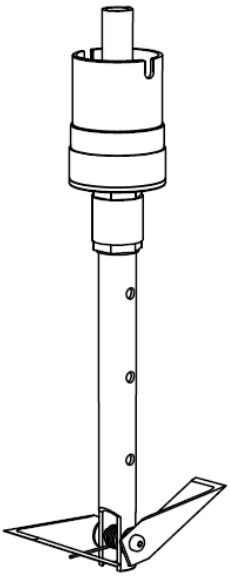


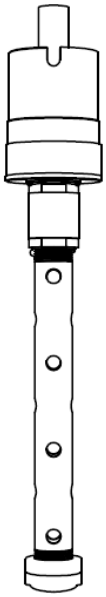
FIGURE 8: Grout plug assembly

2.3.1.3 ANCHORS OR GROUT PLUGS (OPTIONNAL ITEMS)



ANCHOR GROUT VALVE WITH GASKET
ANCRAGE ET VALVE DE COULIS AVEC JOINT D'ÉTANCHÉITÉ

FR-1280050600D ↔ 70mm (2.75")
FR-1280A50600D ↔ 85mm (3.34")



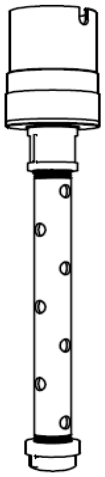
PLUG GROUT VALVE WITH GASKET
BOUCHON ET VALVE DE COULIS AVEC JOINT D'ÉTANCHÉITÉ

FR-1280050600A ↔ 70mm (2.75")
FR-1280A50600A ↔ 85mm (3.34")

HYDRAULIC COUPLING
SOCKET, #B8HP36

COUPLEUR HYDRAULIQUE
FEMELLE, #B8HP36

05-R01LA8H36



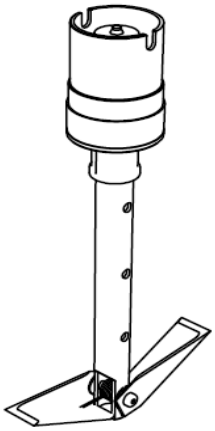
PLUG GROUT VALVE WITH QUICK CONNECT
BOUCHON ET VALVE DE COULIS AVEC RACCORD RAPIDE

FR-1280050600B ↔ 70mm (2.75")
FR-1280A50600B ↔ 85mm (3.34")

HYDRAULIC COUPLING
SOCKET, #B8HP36

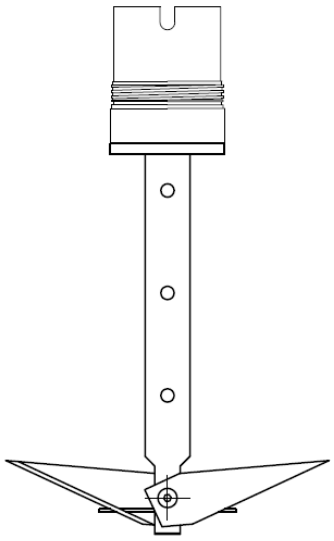
COUPLEUR HYDRAULIQUE
FEMELLE, #B8HP36

05-R01LA8H36



ANCHOR GROUT VALVE WITH QUICK CONNECT
ANCRAGE AVEC RACCORD RAPIDE

FR-1280050600E ↔ 70mm (2.75")
FR-1280A50600E ↔ 85mm (3.34")



ANCHOR
ANCRAGE

FR-1280050600C ↔ 70mm (2.75")
FR-1280A50600C ↔ 85mm (3.34")

2.3.2 MISCELLANEOUS INSTALLATION PROCEDURES

If grout is not available, an alternate method may be used, replacing step g) of section 2.3.1.1 above by the following. Clean sand or fine gravel may be used in place of grout, pouring it into the hole around the casing and compacting using a mechanical vibrator. This alternate method is less desirable than grouting, since there is a chance of having voids in the sand.

Installations in rock or earth fill must be protected from damage during the compaction while ensuring that the fill material around the casing is as well compacted as elsewhere in the embankment. Small portable compaction tools or equipments are generally preferred to conduct compaction around the casing.

Casing lengths are added one at a time to keep pace with the fill operation. An end cap is fitted at each stage to prevent entry of dirt. In rock fill particularly, it may be necessary to protect the casing by surrounding it with sand or with a secondary compatible protective tubing that will follow the deformation of the fill.

When installing a telescopic casing in an embankment, the casing should be supported in its extended position to maintain a gap of 152 mm for future telescoping; otherwise the casing can collapse prematurely.

For installations in concrete, the pre-assembled casing is tied to the reinforcing steel before the concrete is poured.

The casing may be also fixed to a surface with mounting clamps grouted or mechanically anchored in short boreholes.

3 MISCELLANEOUS

3.1 CONVERSION FACTORS

	To Convert From	To	Multiply By
LENGTH	Microns	Inches	3.94E-05
	Millimeters	Inches	0.0394
	Meters	Feet	3.2808
AREA	Square millimeters	Square inches	0.0016
	Square meters	Square feet	10.7643
VOLUME	Cubic centimeters	Cubic inches	0.06101
	Cubic meters	Cubic feet	35.3357
	Liters	U.S. gallon	0.26420
	Liters	Imperial gallon	0.21997
MASS	Kilograms	Pounds	2.20459
	Kilograms	Short tons	0.00110
	Kilograms	Long tons	0.00098
FORCE	Newtons	Pounds-force	0.22482
	Newtons	Kilograms-force	0.10197
	Newtons	Kips	0.00023
PRESSURE AND STRESS	Kilopascals	Psi	0.14503
	Kilopascals	Atmospheres	0.00987
	Kilopascals	Bars	0.01
	Kilopascals	Meters head of water*	0.10199
	Pascals	Newtons / square meter	1
	Bars	Psi	14.4928
	Inches head of water*	Psi	0.03606
	Inches head of Hg	Psi	0.49116
TEMPERATURE	Temp. in °F = (1.8 x Temp. in °C) + 32 Temp. in °C = (Temp. in °F – 32) / 1.8		

* at 4 °C

E6TabConv-990505

TABLE 2: Conversion factors

EC Declaration of Conformity

Roctest Limited, located at 680 Birch, Saintt-Lambert, QC, Canada J4P 2N3

Declares under its sole responsibility, that the following product:

- **GEO-LOK, INCLINOMETRIC CASING MODEL 85 mm OD**
- **GEO-LOK, INCLINOMETRIC CASING MODEL 70 mm OD**

To which this declaration relates, is in conformity with the following standards:

- **EN 61326-1:2006 Lab Equipment, EMC**

In accordance with the provisions of the following Council Directives:

- **2004/108/EC (Electromagnetic Compatibility directive, as amended by EN61326-1, ed2)**
- **2006/42/EC (Machinery directive)**

Year of CE Marking: **2013**

I, the undersigned, hereby declare that the equipment specified above conforms to the listed directives and standards.

François Juneau, Eng.
Engineering Manager

Issued in: Saint-Lambert, QC, Canada **Date:** August 20, 2013