GeoFlex in place inclinometer specifications

The in-place string inclinometer shall be composed of 10 ft segments, each segment shall have 5 sensor nodes spaced at 2 ft.
The 10 ft segments with serialized nodes shall be able to be connected to each other to form strings that can cover the entire depth to be monitored.
Each 10 ft segment must include electrical signal cables and electric water proof connectors assembled at the factory to avoid unnecessary assembly work at the job site.
Each high impact epoxy enclosure (sensor node) shall be securely bonded to the 0.5” diameter stainless steel guide rod.

The vertical string shall be capable of being installed in either 2.75-inch (70mm) or 3.34-inch (85mm) inclinometer casing.
The joints between each sensor shall be robust and made from stainless steel, allowing the system to maintain a consistent orientation of all the nodes, regardless of whether it is installed in PVC pipe or ABS inclinometer casing.

Inclination measurements from the nodes shall provide graphs of the casing profile and changes in the profile. Changes indicate displacement (movement).

GeoFlex systems shall have joints capable of bending to 90°, allowing for a compact shipping option. Five segments, each 3 meters (10 feet) long, shall be able to be shipped in a carton measuring approximately 26 x 26 x 26 inches and which weighs less than 50 pounds. This allows for the system to be shipped via common overnight carrier as well as fit in most standard vehicles.

The GeoFlex system shall also be able to be installed with sensorless nodes at the top of the system, allowing the designer to economize by only monitoring the zone of interest and bypassing the upper layers.

The GeoFlex system shall output the displacement as engineering units. The nodes shall be preloaded with the calibration information, allowing the segments to be installed in any order.

Additional specifications:

Sensor Type: MEMS (Micro Electro-Mechanical Systems) tilt sensor for inclination readings.
Requirements: Minimum supply voltage of 10 Vdc. Maximum supply voltage of 30 Vdc. Digital RS485 signal requires Campbell Scientific or GTechLink data logger.
Calibrated Range: ±30 degrees from vertical over a temperature range of -10°C to +40°C.
Resolution: 9 arc seconds or 0.04 mm/m using the CR1000 data logger.
Repeatability: ±82 arc seconds or ±0.4 mm/m.
Required Casing: Fits 70 mm (2.75") or 80 mm (3.34") diameter inclinometer casing.
Waterproof: Waterproof to 2 MPa (300 psi).
Weight: 0.54 kg per 0.6m (1.2 lb per 2 feet) gauge length.
Signal Cable: Jumper Cable for connecting the system to the datalogger. Connectors are rated to 70 MPa (10,000 psi).

Casing Installation

The casing to be used shall be the QC, CPI or EPIC 70 mm casing manufactured by DGSI. Follow the manufacturer instruction manual for assembly. The installation must be as vertical as possible, avoiding the casing to curve inside the borehole.

Casing Buoyancy

Casing will float in water-filled boreholes, so you must fill it with water to install it down hole. However, when you pump grout into the borehole, the water-filled casing becomes buoyant again, because the grout is denser than water.

To counter this buoyancy, you shall apply a down force at the bottom of the casing. You can lower a steel pipe to the bottom of the casing or you can suspend a non-retrievable weight from the bottom of the casing when you install it. A suspended weight requires a deeper borehole and may require use of a safety line.

Note that a down force applied at the top of the casing is likely to distort the casing profile (cuvature). For this reason, we recommend that you do not park a drill rig over the casing or apply any other top-down method of counteracting buoyancy.

Grouting

You will need a mixer, a grout pump, a pipe or hose for delivering the grout, and optionally, a grout valve installed in the bottom section of the casing. We recommend that you do not mix the grout by hand. We also recommend that you do not use a water pump to place the grout, since pumping grout would damage it.

Properly mixed grout should be free of lumps. It has to be thin enough to pump but thick enough to set in a reasonable length of time. If the mixture is too watery, it will shrink excessively, leaving the upper portion of the borehole ungrouted.

Also, avoid the use of admixtures and grouts that cure at high temperature since these may damage the casing. Ideally, the grout should be mixed to match the strength and deformation characteristics of the ground around the borehole.

In practice, the main consideration is to use a grout that allows the casing to move with the surrounding soil. If you have no other guidance, try one of the following “general purpose” mixtures.

The compressive strength of these mixtures is about 500 lb/ft2 at a 28 day cure time. The bentonite mixture swells to seal the borehole, but the lime mixture does not.

Bentonite-Cement Grout

Materials	Weight	Percent
Portland Cement	94 lb (1 bag)	15%
Bentonite*	39 lb	6%
Water	75 gallons	79%

*Mix bentonite with water first, then with the cement

Lime-Cement Grout

Materials	Weight	Percent
Portland Cement	94 lb (1 bag)	15%
Hydrated LIme	150 lb	33%
Water	25 to 30 gallons	46%