Inclinometer Probes

Applications

The 6000 and 6100 Series Portable Inclinometer Systems are used to determine and measure lateral movements in and around...

- **Landslides**
- **Unstable Slopes**
- **Dam Embankments**
- **Landfills**
- **Slurry walls**
- **Caissons**
- **Piles**
- **Sheet Piling**
- **Tunnels**

- *Model 6000/6100 Inclinometer Probe (probe appearance is essentially identical).*

Operating Principle

Inclinometer probes are designed for use with standard, grooved inclinometer casing. Spring-loaded wheels on the probe engage the grooves in the casing thus maintaining the probe in a known orientation. Casing is grouted inside near-vertical boreholes (boreholes at other angles can be accommodated with some loss of resolution); cast inside concrete piles or slurry walls; or attached to steel pilings.

In use, the inclinometer probe is connected to a cable and lowered to the bottom of the casing and then raised in increments equal to the wheel spacing. At each increment the probe is read by a readout connected to the upper end of the cable. The readout gives a measurement of the tilt of the casing to the vertical, at each depth increment. Repeat surveys of the casing reveal changes in these tilts, which can be analyzed to provide plots of lateral deflections of the casing, in orthogonal directions, at every depth increment.

Advantages and Limitations

The connector on the end of the probe is of extra-high quality (hermetically sealed, with gold plated pins) which helps improve signal accuracy. It's design is such that the connector can be easily removed and replaced if it suffers from damage or excessive wear. A protective cap is supplied to cover the cable connector when not in use.

Wheels are self lubricated for longer life. In addition, the wheels are designed to be replaceable with minimal effort and expense, should wear become excessive.

Model 6000 Inclinometer Probe

Model 6000 Inclinometer Probe.

The Model 6000 Inclinometer Probe is designed to measure the tilt of vertical inclinometer casing at selected depth increments, consists of a waterproof, stainless steel housing, and contains two force-balanced accelerometers, one with its axis in the plane of the spring-loaded wheels, the other at 90 degrees.

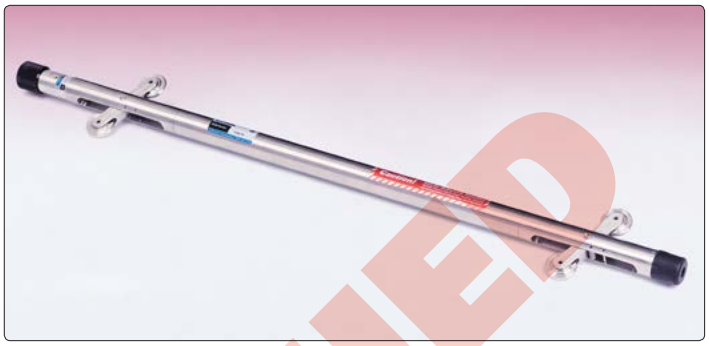
At the base of the probe there is a rubber cushion designed to reduce shock loading on the accelerometer should the probe be dropped on to a solid surface. The accelerometers are capable of withstanding a certain amount of rough handling (shocks < 1000 g) but allowing the probe to fall against hard surfaces can permanently damage the accelerometer requiring expensive factory repairs. Therefore, it is very important to handle the probe with care at all times.

Technical Specifications

Standard Range[1]	±53°
Sensors	2 force-balanced accelerometers
Output @ 30°	±5 VDC
Resolution[2]	±0.025 mm/500 mm (±0.0001 ft/2 ft) (±10 arc seconds)
Linearity	0.02% F.S.
Repeatability	±2 mm/30 m
Total System Accuracy[3]	±6 mm/30 m (±0.25 in/100 ft)
Temperature Range	0°C to +50°C (32°F to 122°F)
Temperature Coefficient	0.002% F.S./°C (0.001% F.S./°F)
Wheel Base	0.5 m, 1 m or 2 ft
Length × Diameter[4]	700 × 25 mm, 1200 × 25 mm or 32 x 1 in
Casing Size I.D.[5]	51 to 89 mm (2 to 3.5 in)
Weight (with case)	7.5 kg (16 lb)
Shock Survival[6]	1000 g (2.2 lb)

[1] The calibrated range of the inclinometer is ±30 degrees from vertical, but the inclinometer can be used at greater inclinations with a lessening in performance.
[2] ±10 arc seconds. The resolution shown is only true in the range of ±5 degrees from vertical. Beyond this, the resolution is diminished (by the cosine of the angle from vertical). Resolution also depends on readout instrument used.
[3] Within 3° of vertical. This takes into account the accumulation of the error inherent with each reading, and normal placement errors in positioning the probe inside the casing; also the effect of debris in the casing, or casing damage.
[4] The cable connector adds 150 mm to the length of the probe.
[5] The probe is designed for use in all standard inclinometer casing up to a maximum diameter of 89 mm (3.5 inches).
[6] The Inclinometer Probe is a highly sensitive device and should be treated with great care at all times in order to maintain calibration. Particular attention should be given to preventing the probe from hitting the bottom of the casing with any impact.

Model 6100 MEMS Inclinometer Probe



Model 6100 MEMS Inclinometer Probe.

The Model 6100 MEMS Inclinometer Probe is identical to the Model 6000, except that it uses two MEMS (Micro Electro Mechanical Sensors) in place of the two force-balanced accelerometers.

At the base of the probe is a rubber cushion designed to reduce shock loading on the accelerometer, should the probe be dropped on to a solid surface. The accelerometers are capable of withstanding a certain amount of rough handling (shocks < 2000 g), but allowing the probe to fall against hard surfaces can permanently damage the accelerometer requiring factory repairs. Therefore, it is very important to handle the probe with care at all times.

The 6100 MEMS Inclinometer Probe has a restricted range of ±30°. This is more than ample for all nominally vertical boreholes. Custom-built 6100 MEMS probes can be made to accommodate special applications, such as casings installed on the sloping face of a dam embankment.* Horizontal versions can also be supplied.

**Special sensors for inclined slopes are not reversible.*

Technical Specifications

Standard Range	±30°
Sensors	2 MEMS sensors
Output @ 30°	±4 VDC
Resolution[1]	±0.025 mm/500 mm (±0.0001 ft/2 ft)
Linearity	0.02% F.S.
Repeatability	±1 mm/30 m
Total System Accuracy[2]	±3 mm/30 m (±0.125 in/100 ft)
Temperature Range	0°C to +85°C
Temperature Coefficient	0.002% F.S./°C
Wheel Base	0.5 m, 1 m or 2 ft
Length × Diameter[3]	700 × 25 mm, 1200 × 25 mm or 32 × 1 in
Casing Size I.D.[4]	51 to 89 mm (2 to 3.5 in)
Weight (with case)	7.5 kg (16 lb)
Shock Survival[5]	2000 g

[1] ±10 arc seconds. The resolution shown is only true in the range of ±5 degrees from vertical. Beyond this, the resolution is diminished (by the cosine of the angle from vertical). Resolution also depends on readout instrument used.
[2] Within 3° of vertical. This takes into account the accumulation of the error inherent with each reading, and normal placement errors in positioning the probe inside the casing; also the effect of debris in the casing, or casing damage.
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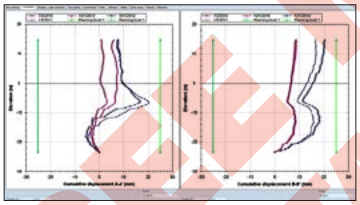
Model GK-604 Inclinometer Readout

Model FPC-1 Field PC showing an inclinometer data reading screen shot.

Model GK-604-4 Interface.



SiteMaster Software graph showing cumulative inclinometer displacements.

The Model GK-604 Inclinometer Readout is a rugged, weather tight, easy-to-use, analog inclinometer system capable of reading MEMS analog, Spiral Indicator and force balance type inclinometer probes. In use, the MEMS analog and force balance type inclinometers are connected, by their control cables, to an interface, which may be stand alone (Model GK-604-4), or located inside the control cable reel (Model GK-603-3). The interface converts the probe signal and wirelessly transmits the data to the Model FPC-1 Field PC running the GK-604D IRA application.

Readings are stored by tapping "Record," or pressing the "Enter" button on the Field PC display. An audible beep indicates the completion of the reading storage. During the running of a deflection survey the Field PC has the capability of displaying the check sum on the LCD screen, a useful tool for checking the survey data in the field so that reading errors are minimized.

Once surveys are complete, readings saved to the internal SSD can be transferred to a host computer where data reduction, graphing and reporting can be accomplished using SiteMaster Software (sold separately—please see the SiteMaster data sheet for further details).

The Field PC comes complete with a hand strap, stylus, USB sync cable, Lithium-Ion battery, AC wall charger (with international plug kit), screen protector, CD-ROM (with license and manuals) and Quick Start Guide.

Technical Specifications (FPC-1 Field PC)

Operating Temperature	–30 °C to 60 °C
Storage Temperature	–40 °C to 70 °C
Processor	Marvell PXA310 806 MHz
Memory	128 MB SDRAM
Data Storage	4 GB iNAND Flash
Operating System	Microsoft Windows® Mobile 6.1
Screen	480 × 640 pixel Anti-glare 3.5" VGA resolution, touchscreen, sunlight readable 262K colors (18 bit), with LED backlight
Keypad	Numeric keypad with backlighting, on-screen QWERTY keyboard
Battery	5600 mAh Li-ion battery pack
Connections	1 × USB host and client (Mini AB USB OTG, 1.2 host, 2.0 client), Power jack, 1 × SDIO slot, 9-pin serial RS-232 connector
Communication	Ubiquitous short-range wireless PAN, WLAN: Integrated 802.11 b/g supports AES, TKIP, WEP, WPA and WPA2, GSM/UMTS (HSDPA/EDGE)
Navigation	Integrated GPS SiRF Star III chipset with WAAS/EGNOS support, Integrated E-Compass and G-Sensor, Integrated Altimeter
Camera	Integrated 3 megapixel camera with autofocus and LED Flash
Weight	490 g, including rechargeable battery
L × W × H	179 × 97 × 37 mm

Technical Specifications (GK-604-4 Interface)

Standard Range	±8 V
Resolution	16 bit
Accuracy	±0.1% F.S.
Battery	>16 hours continuous operation, per charge
Temperature Range	–30°C to +50°C
Dimensions (L × W × H)	160 × 75 × 75 mm

Ordering Information

Model GK-604-2: Inclinometer Readout with FPC-1 Field PC, Software and Probe Interface.

Model GK-604-3: Inclinometer Software and Probe Interface, installed.

Model GK-604-4: Inclinometer Software and Probe Interface, installed in enclosure.

Model GK-604-5: Inclinometer Readout Software for FPC-1 Field PC.

Model FPC-1: Field PC and accessories only.

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