

# Horizontal Digitilt Inclinometer Probe

## Applications

Horizontal inclinometers are used to obtain profiles of settlement or heave. Typical applications include monitoring settlement and heave under storage tanks, embankments, dams, and landfills.

## Operation

The horizontal version of the Digitilt inclinometer system consists of inclinometer casing, a horizontal probe, control cable, pull cable, and a readout unit.

The inclinometer casing is installed in a horizontal trench or borehole with one set of grooves aligned to vertical. When the far end of the casing is not accessible, a dead-end pulley and cable-return pipe are installed along with the casing.

The probe, control cable, pull-cable, and readout unit are used to survey the casing. The initial survey establishes the profile of the casing, and subsequent surveys will reveal changes in the profile if ground movement occurs.

The horizontal inclinometer probe employs a force-balanced servo-accelerometer to measure tilt in the plane of the probe wheels.

During a survey, tilt measurements are obtained at half-meter or 2-foot



intervals as the probe is drawn from one end of the casing to the other. The probe is then reversed end-for-end and drawn through the casing a second time. Tilt measurements from the reversed probe are used to eliminate any error due to sensor bias and to generate checksums for validating the survey.

Settlement and heave are calculated as  $L(\sin \theta_1 - \sin \theta_0)$ , where  $L$  is the measurement interval,  $\theta_1$  is the current tilt, and  $\theta_0$  is the initial tilt.

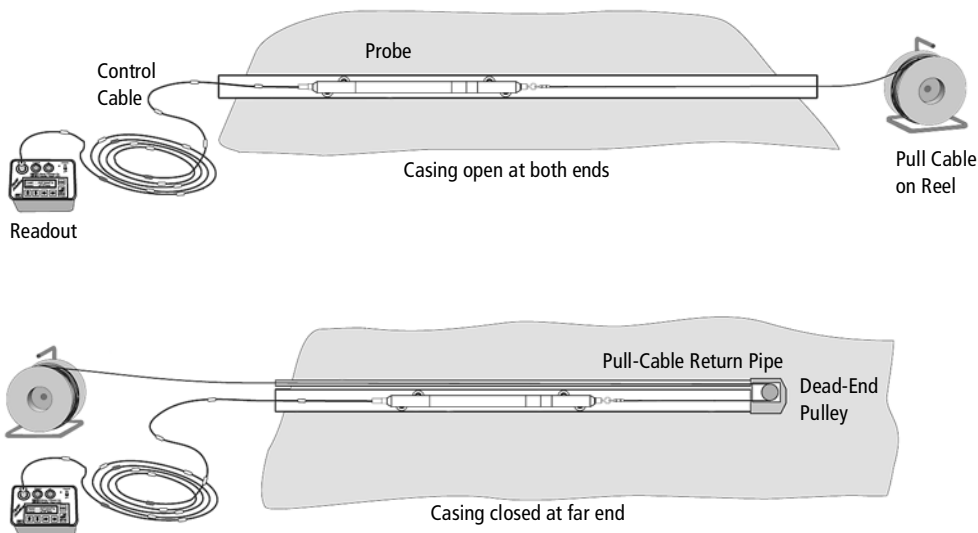
Settlement profiles are generated by summing displacements and plotting them.

## Advantages

**Full Settlement Profiles:** Horizontal inclinometers provide complete profiles of differential settlements.

**Simple Operation:** Horizontal inclinometers are much easier to use than other types of settlement profilers. There are no liquid reservoirs or pressure sources to adjust and maintain.

**Proven Reliability:** The Digitilt inclinometer probe has earned a world-wide reputation for high precision and durability.



## METRIC PROBE SPECIFICATIONS

**Sensor Type:** Digitilt servo-accelerometer.  
**Wheel base:** 500 mm.  
**Range:**  $\pm 53^\circ$  from horizontal.  
**Resolution:** 0.02 mm per 500 mm.  
**Repeatability:**  $\pm 0.01\%$  FS.  
**Calibration:** 14 point calibration with NIST traceable calibration device.  
**Temperature Range:** -20 to +50 °C.  
**Dimensions:** 38 x 650 mm.  
**Weight:** 4.6 kg.  
**Material:** Stainless steel.  
**Casing Required:** 70 or 85 mm.

## ENGLISH PROBE SPECIFICATIONS

**Sensor Type:** Digitilt servo-accelerometer.  
**Wheel base:** 24".  
**Range:**  $\pm 35^\circ$  from horizontal.  
**Resolution:** 0.0012 per 24".  
**Repeatability:**  $\pm 0.01\%$  FS.  
**Calibration:** 14 point calibration using NIST traceable calibration device.  
**Temperature Range:** -20 to +50 °C.  
**Dimensions:** 1.5 x 39".  
**Weight:** 10.6 lb.  
**Material:** Stainless steel.  
**Casing Required:** 2.75 or 3.34".

## SYSTEM ACCURACY

**Metric Systems:**  $\pm 0.25$  mm per reading and  $\pm 6$  mm per 50 readings.

**English Systems:**  $\pm 0.01$  inch per reading and  $\pm 0.3$  inch per 50 readings.

These specifications were derived empirically from the analysis of a large number of surveys and include both random and systematic errors introduced by casing, probe, cable, readout, and operator. Casing was installed within 3 degrees of vertical, and operators followed recommended reading practices.

When corrections for systematic error are made, only random error remains, and it accumulates with the square root of the number of readings. Thus the best precision obtainable with a metric system is approximately  $\pm 1.4$  mm per fifty readings, and the best precision of an English unit system is approximately  $\pm 0.05$  inch per fifty readings.

## DIGITILT INCLINOMETER PROBE

**Horizontal Probe, Metric-Units . . . 50303510**  
**Horizontal Probe, English-Units . . 50303500**  
 Digitilt inclinometer probe includes a carrying case, accessories and an instruction manual. Control cable and readout are not included.

## CONTROL CABLE

**50m Control Cable, Complete . . . 50601050**  
**100m Control Cable, Complete . . 50601100**  
**150 ft Control Cable, Complete . . 50601003**  
**300 ft Control Cable, Complete . . 50601004**  
**Metric Cable, Custom Length . . . 50601010**  
**English Cable, Custom Length . . . 50601000**  
**Connector for Readout . . . . . 50301800**  
**Connector for Probe . . . . . 50303100**

Control cable is compatible with both vertical and horizontal Digitilt probes. Complete cables above are standard lengths of cable with connectors attached. If you order a custom length cable, you must also order connectors.

Control cable is supplied with no splices or surface defects and has a rated strength of 480 lb. and a working strength of 120 lb.

Metric cable has 0.5-meter graduations marked in yellow at half meter, red at meter, and numerics at 5 meter intervals. English cable has two foot graduations marked in yellow, with red marks and numerics at 10-foot intervals.

Cable has a steel core wire to control stretching, a dacron torsion braid to counter cable torque and eliminate slipping of cable jacket relative to the steel core, and depth marks that are molded onto the cable jacket. The Santoprene cable jacket resists chemicals and abrasions and stays flexible in cold temperatures.

## READOUTS

**Digitilt DataMate . . . . . 50310900**  
 The Digitilt DataMate is a recording readout. For more information see the Digitilt DataMate datasheet.

## PULL CABLE

**Pull Cable . . . . . 50402310**  
**Extra Carabiner . . . . . 02750012**  
**Extra Saddle Clamp . . . . . 02700067**

Pull cable is 1/8" stranded stainless steel cable and is used to draw probe to far end of casing. Order one pull cable for each casing installation. If using a dead-end pulley, length of pull cable should be at least twice the length of the casing.

A carabiner and saddle clamp are included with the probe. These are installed on the pull cable and left in the casing with the pull cable. Additional carabiners, saddle clamps, (and pull cable) should be ordered if there is more than one casing installation to be monitored.

## DEAD-END PULLEY

**Dead-End Pulley . . . . . 50302951**  
**Cable-Return Pipe . . . . . 50711104**  
**Coupling for Pipe . . . . . 50711604**

Dead-end pulley is required when far end of casing is not accessible. Rated for casing up to 60 m (200') long.

Cable-return pipe is used with dead-end pulley. 1/2" schedule 40 PVC pipe is supplied in 10" (3.05 m) lengths.

Couplings are used to join lengths of pipe. PVC cement is required for assembly.

## SLIP-RING REEL

**200 m (650') capacity . . . . . 50503100**  
**300 m (1150') capacity . . . . . 50503300**

Slip-ring cable reel allows the readout to remain connected while the reel is operated. Includes jumper cable to connect reel to readout.

## STORAGE REEL

**30 m (100') capacity . . . . . 50502030**  
**50 m (164') capacity . . . . . 50502050**  
**100 m (360') capacity . . . . . 50502110**  
**200 m (600') capacity . . . . . 50503000**

Sturdy storage reels have large diameter hub keeps cable neat when not in use. 30, 50, and 100 m reels are heavy-duty plastic. 200 m reel is steel.

Note: The use of reels is optional. Cable can also be stored in a figure-8 or using the over-under method of coiling cable, as presented in the manual. If you choose to use a reel, be sure that the hub of the reel has a diameter of eight inches or larger (as do the reels above). Power reels should be sixteen inches or larger.