

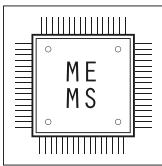
S200D

**DIGITAL MEMS
INCLINOMETER SYSTEMS**

INCLINOMETERS
& PENDULUMS



DIGITAL MEMS INCLINOMETER SYSTEMS



The MEMS digital inclinometer represents the most advanced evolution of SISGEO's inclinometer systems.

The stainless steel probe is manufactured in one piece to ensure long-term alignment and waterproofing. Inside, the advanced MEMS chip and 24-bit A/D converters for each axis ensure rapid and precise measurements.

The rugged Archimede readout connects by cable, for trouble-free operation in the field. It also provides an ergonomic hand switch for convenient one-man surveys.

The digital inclinometer system includes the biaxial MEMS probe, operating cable mounted on reel, and the rugged Archimede readout.

APPLICATIONS

- Landslides and unstable slopes
- Dams and embankments
- Diaphragm walls
- Tunneling
- Deep excavations

FEATURES

- Rugged, high-G probe
- High precision readings
- Available with 500 or 1000mm probe gauge length
- Choice of HD or light-weight cable
- High resolution plots on readout display



Meets the essential requirements of the EMC Directive 2004/108/EC

INCLINOMETER SYSTEM PERFORMANCE, 500 MM GAUGE LENGTH (WITH $\pm 30^\circ$ MEMS PROBE AND ARCHIMEDE READOUT)

Readout value	20'000 sin alpha (other on request)	The units displayed on the readout.
Repeatability	± 0.050 mm / 500 mm	The maximum variation observed in repeated readings taken at the same inclination.
Resolution	0.025 mm / 500 mm	The value of 1 digit on the display.
Sensor orientation	< 0.5 degrees	It is the maximum azimuthal rotation between the probe wheels and sensitive axis of the sensor. Differences in rotation introduce systematic error declared in the calibration sheet. The value of 0.5° introduces a negligible error that doesn't require any data correction
System accuracy	± 2.00 mm / 25 m	The best accuracy obtainable in field measurements in casing within 3 degrees of vertical, measuring step 500 mm. Expressed as lateral deviation over a length of 25mm of casing.

PROBES TECHNICAL SPECIFICATIONS 500 MM GAUGE LENGTH

	0S242DV3000 MODEL	0S241DH3000 MODEL
Applications	vertical casing	horizontal casing
Sensor type	biaxial digital MEMS inclinometer	uniaxial digital MEMS inclinometer
Measuring range	$\pm 30^\circ$ ($\pm 90^\circ$ optional)	$\pm 30^\circ$
Communication interface	opto-isolated RS485 (half duplex)	opto-isolated RS485 (half duplex)
Signal output and protocol	RS485 modbus RTU	RS485 modbus RTU
A/D converter	sigma-delta 24 bit for each axis	sigma-delta 24 bit for each axis
Resolution	0.0013° (0.02 mm/m)	0.0013° (0.02 mm/m)
Total accuracy (linearity+hysteresis+repeatability)	< $\pm 0.05\%$ FS	< $\pm 0.05\%$ FS
Repeatability	<0.005% FS (0.0015°)	<0.005% FS (0.0015°)
Temp. operating range	-30°C to +60°C	-30°C to +60°C
Shock resistance	20000 g	20000 g
Material	stainless steel	stainless steel
Diameter	28 mm	28 mm
Total length (without connector)	750 mm (500mm gauge length)	810 mm
Wheel carriage	pair of wheels mounted on long-life sealed ball bearings	pair of wheels mounted on long-life sealed ball bearings
Wheel diameter	32 mm	32 mm
Gauge length (distance between wheels)	500 mm	500 mm
Weight	2.0 kg	2.0 kg

INCLINOMETER SYSTEM PERFORMANCE, 1000 MM GAUGE LENGTH (WITH $\pm 30^\circ$ MEMS PROBE AND ARCHIMEDE READOUT)

Readout value	20'000 sin alpha (other on request)	The units displayed on the readout.
Repeatability	± 0.100 mm / 1000 mm	The maximum variation observed in repeated readings taken at the same inclination.
Resolution	0.050 mm / 1000 mm	The value of 1 digit on the display.
Sensor orientation	< 0.5 degrees	It is the maximum azimuthal rotation between the probe wheels and sensitive axis of the sensor. Differences in rotation introduce systematic error declared in the calibration sheet. The value of 0.5° introduces a negligible error that doesn't require any data correction
System accuracy	± 2.00 mm / 25 m	The best accuracy obtainable in field measurements in casing within 3 degrees of vertical, measuring step 1000 mm. Expressed as lateral deviation over a length of 25mm of casing.

PROBES TECHNICAL SPECIFICATIONS 1000 MM GAUGE LENGTH

	0S242DV3010 MODEL	0S241DH3010 MODEL
Applications	vertical casing	horizontal casing
Sensor type	biaxial digital MEMS inclinometer	uniaxial digital MEMS inclinometer
Measuring range	$\pm 30^\circ$ ($\pm 90^\circ$ optional)	$\pm 30^\circ$
Communication interface	opto-isolated RS485 (half duplex)	opto-isolated RS485 (half duplex)
Signal output and protocol	RS485 modbus RTU	RS485 modbus RTU
A/D converter	sigma-delta 24 bit for each axis	sigma-delta 24 bit for each axis
Resolution	0.0013° (0.02 mm/m)	0.0013° (0.02 mm/m)
Total accuracy (linearity+hysteresis+repeatability)	< $\pm 0.05\%$ FS	< $\pm 0.05\%$ FS
Repeatability	<0.005% FS (0.0015°)	<0.005% FS (0.0015°)
Temp. operating range	-30°C to +60°C	-30°C to +60°C
Shock resistance	20000 g	20000 g
Material	stainless steel	stainless steel
Diameter	28 mm	28 mm
Total length (without connector)	1250 mm	1310 mm
Wheel carriage	pair of wheels mounted on long-life sealed ball bearings	pair of wheels mounted on long-life sealed ball bearings
Wheel diameter	32 mm	32 mm
Gauge length (distance between wheels)	1000 mm	1000 mm
Weight	4.0 kg	4.0 kg

ARCHIMEDE READOUT

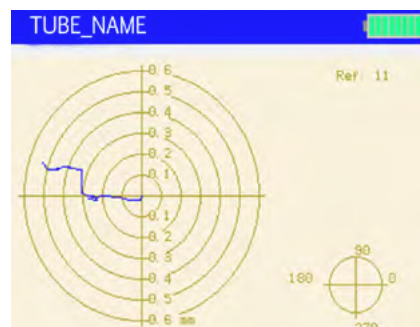
ARCHIMEDE is a rugged, portable readout designed for inclinometer applications. It features a large, daylight-readable display that can display inclinometer graphs. Other features include a rugged, water resistant case and a convenient hand-switch for one-man surveys. The Archimedes connects by cable for reliable field operations. SISGEO's SMART Manager Suite for Windows, included with the readout, is used to manage the Archimede and provides a way to update its firmware and software.

TECHNICAL SPECIFICATIONS

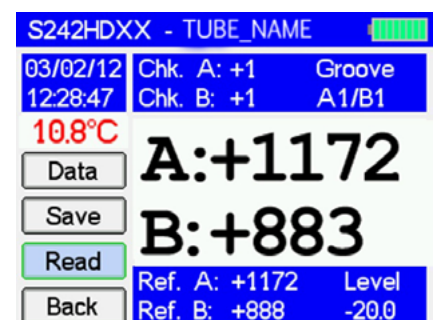
	0CDL300INCL	CE
A/D converter	2 x 24 bit, with autocalibration	
Storage memory	2 GB	
Resolution	100 μ V with FS \pm 5 V 100 μ V with FS \pm 12 V	
Accuracy	0.01% FS	
Input impedance	>10 M Ω for voltage <2.5 V	
LCD color graphic display	5.7" (320 x 240 pixel), sunlight reliable	
Communication with pc/notebook	USB 2.0, 1.0 Mbit / sec	
Communication with digital probe	RS485 modbus	
Temperature operating range	-20°C +60 °C	
Case	Crushproof ABS, IP67	
Dimensions and weight	200 x 280 x 75mm (LxWxH), 2 kg	
Probe power supply	24 V for digital MEMS probes \pm 2.5 V for spiral probe	
Battery	12V - 4.5 Ah, Ni-MH	
Operating time	approx. 8 hours	



SURVEY AND PLOT



Archimede can display high-resolution plots when the survey is finished.



At each reading interval, Archimede displays depth, A and B readings, and checksums. Reference (zero) readings and temperature are also displayed.

INCLINOMETER CABLES

Inclinometer cables are used to control the depth of the probe and transmit readings from the probe to the readout. The HD (Heavy Duty) and Light cables are supplied on reels and include a factory-attached connector for the probe. The back bag cable is supplied without reel and has factory-attached connectors at both ends. Probe-end connectors are watertight to 20 bar.



Back bag cable OS2SB600000

HD CABLE OS2RC600000

It has a stainless steel core wire to control stretching and a stainless steel torsion braid to prevent twisting. Yellow cable jacket has copper depth marks. Available with both simple reel or slip-ring reel (OS2RCS00000).

LIGHT CABLE OS2RD600000

Light cable has a Kevlar stress member for strength. For digital sensors only. Orange cable jacket has aluminum depth marks. Supplied on reel.

BACK BAG CABLE OS2SB600000

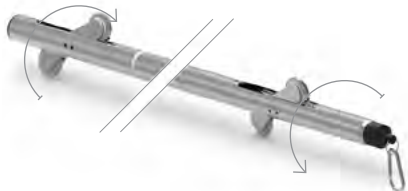
It is the same as light cable, but has connectors attached at both ends. Orange cable has aluminum depth marks. Supplied with back bag, without reel.

	HD CABLE OS2RC600000	LIGHT CABLE OS2RD600000	BACK BAG CABLE OS2SB600000
Cable lengths	30,50,60,100,150,200 m	30,50,60,100,150,200 m	30,50,70,100 m
Conductors	6x0.50 mm ²	2x0.50 + 2x0.22 mm ²	2x0.50 + 2x0.22 mm ²
Depth tactile marks	copper, every 500 mm	aluminum, every 500 mm	aluminum, every 500 mm
Stress member	steel core	kevlar fiber	kevlar fiber
Max strength	500 kg	300 kg	300 kg
Outer jacket	yellow, polyurethane	orange, polyurethane	orange, polyurethane
Cable diameter	10.4 mm	5.7 mm	5.7 mm
Weight (cable+marks)	0,150 kg/m	0,072 kg/m	0,072 kg/m
Total weight with 50 m cable	12 kg with reel	4.50 kg with reel	3.80 kg no reel

SPIRAL PROBE

The Spiral probe is used to measure twist in installed inclinometer casing (tubes). The measurements can be used for correcting readings taken from twisted casing. SISGEO recommends that spiral surveys be taken at the same time as the initial inclinometer readings. The spiral probe is compatible with the Archimede readout and HD inclinometer cable. It is not compatible with light cable or no-reel cable.

INCLI2 inclinometer software is required to process spiral data and apply corrections to inclinometer readings.



Spiral probe: twisting on the probe axis for measuring the inclinometer casing torsion

OS30PR12000

Type of sensor	rotary contactless potentiometer (magneto-resistive)
Measuring range	±5 degrees over the wheel base (1 meter)
Resolution	± 0.01°
Accuracy	< 0.5% FS
Output signal	± 200 mV at FS
Power supply	± 2.5 V DC
Connector	watertight, 6 pins compatible with heavy-duty cable
Body diameter	28 mm
Length	1250 mm (without connector)
Gauge length (distance between wheels)	1000 mm

INCLI2 INCLINOMETER SOFTWARE



INCLI2 is a specially designed software to process inclinometer data from vertical and horizontal probes, providing graphs and reports. Data files may be created by manual data entry or directly from Archimede portable readout via its USB COMM port.

DATA PROCESSING

The deflection curve of inclinometer casing is calculated by reading the probe inclination

- at different measuring depths
- related to the vertical A (z-x) and B (z-y) planes

Data processing allows the following choices:

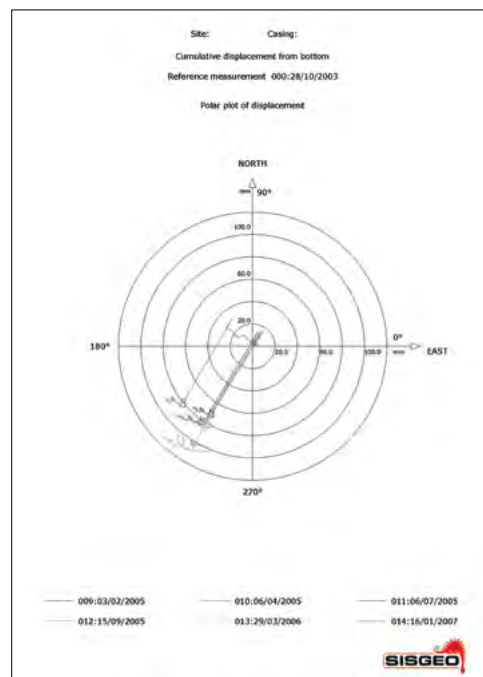
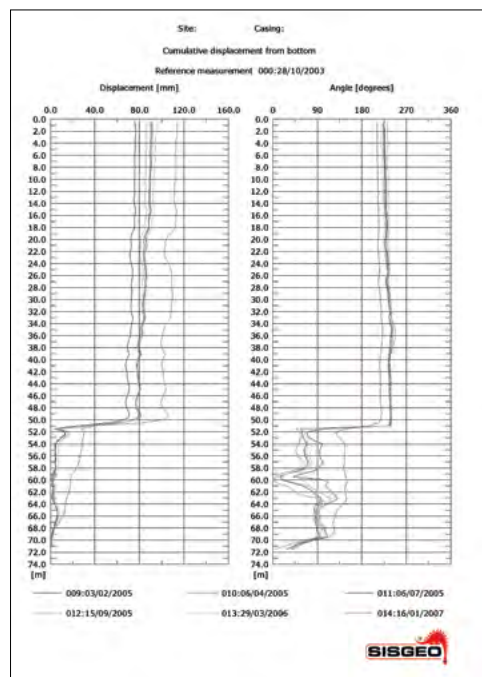
- absolute:** providing the actual profile of the casing;
- cumulative:** the most common type of processing: total displacements of the inclinometer casing related to the zero reading and referred to the reference point (top or bottom);
- local:** showing local displacements at each depth with reference to the zero reading;
- local displacement vs time:** deformation versus time of reading at the same depth.

FEATURES

- Multilanguage: Italian, English, Spanish, Russian, Turkish, German and French;
- Processes both vertical and horizontal surveys;
- Automatic spiral correction when spiral data are present;
- Plot types include: vertical checks, absolute position, displacement/time plots, and various combinations of local and cumulative displacement;
- Up to 30 measures displayed at the same time;
- Numeric and graphic print previews;
- Plots can be annotated;
- Reports can include user's logo.

Operating system requirements:

INCLI2 works on Microsoft® Win 95/98, 2000, Millenium, NT, XP, Vista, Windows 7 and Windows 8.



ACCESSORIES AND SPARE PARTS

TEST (DUMMY) PROBE OS21ST00000

Used to check the integrity of the inclinometer casings before measurements. Supplied with graduated steel wire on reel. Available with 500 or 1000 mm probe.

LOCKABLE TOP CAP OS100CH1000

Top cap for inclinometer casing (tubes). Stainless steel and PVC, with topographic survey pin and ID plate.

PULLEY ASSEMBLY OS1CSU10000

Assists depth control and eliminates abrasion of cable. Includes cable stop and adaptors to fit different sizes of casing.

SWING WHEEL ASSEMBLY OS2SET02B00

Spare set of two stainless steel wheel carriages for inclinometer probe.

CALIBRATION FRAME OS0WCAL1000

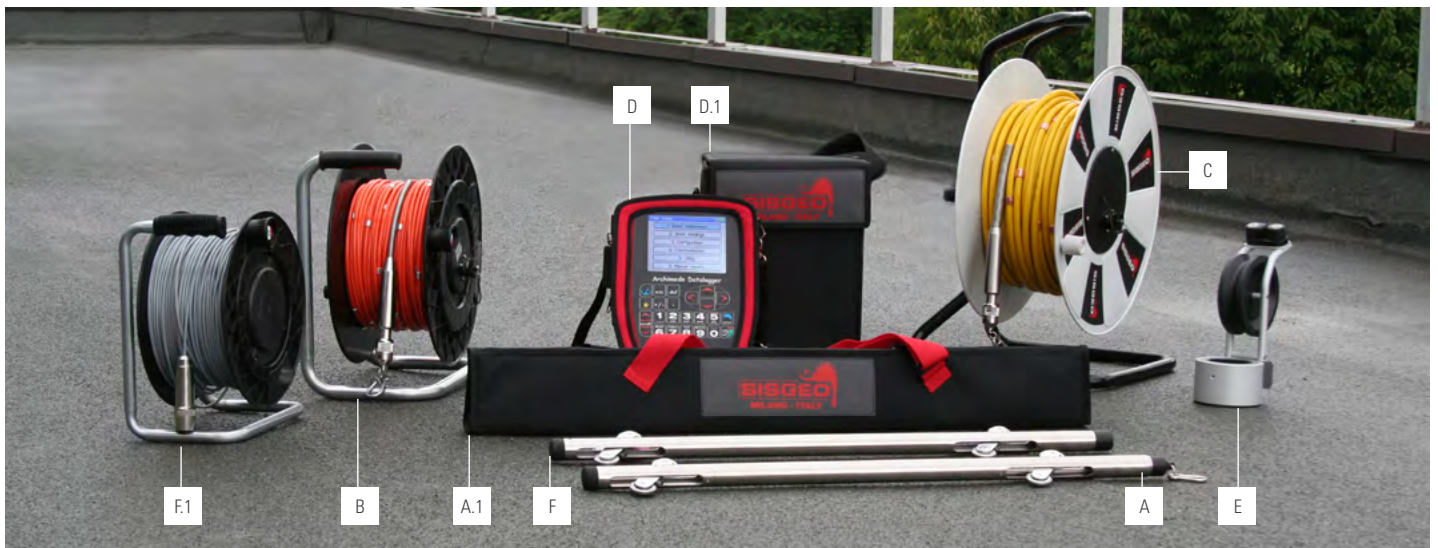
The calibration frame consists of an anodized aluminium frame with a pivoting arm made by a length of epoxy painted inclinometer casing. The pivoting arm permits probe check at -11° , -6° , zero, $+6^\circ$ and $+11^\circ$. The frame is ready for wall mounting.

Overall dimensions: 350x800x127 mm (compatible with 500mm probe only)
Material: epoxy painted aluminium



CONNECTOR FOR PROBE OS2CON06SHD

Spare male connector for digital probe. We suggest to change the connector in our laboratories.



- A Digital inclinometer probe
- A.1 Travel bag for both inclinometer and dummy probes
- B Light inclinometer cable reel

- C Heavy-Duty cable
- D Archimede readout
- D.1 Archimede carrying case

- E Pulley assembly
- F Dummy probe
- F.1 Cable for dummy probe

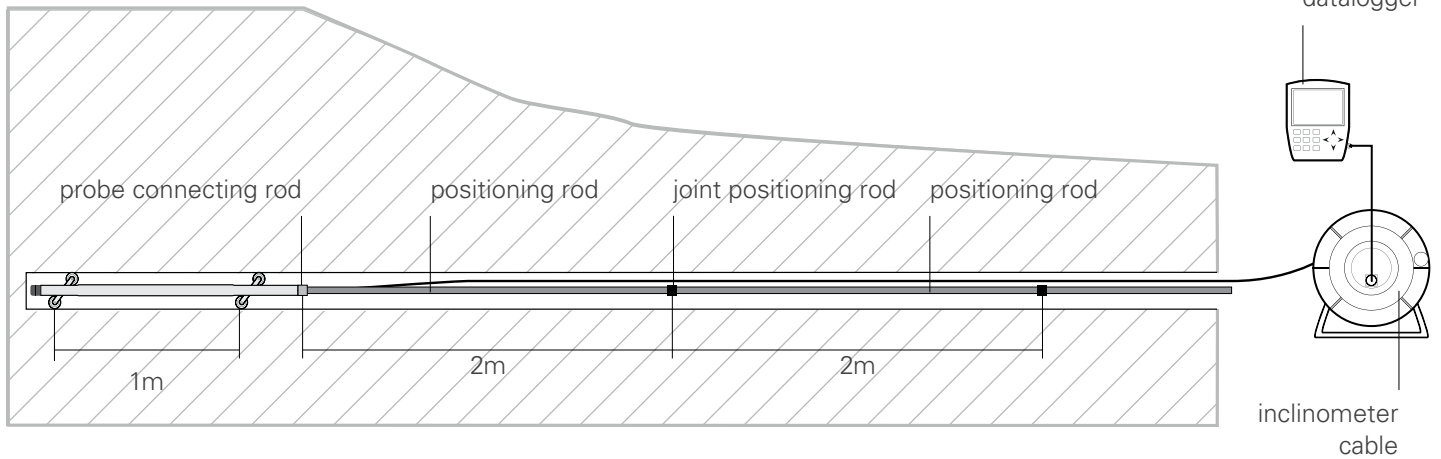
ACCESSORIES FOR HORIZONTAL INCLINOMETERS

PROBE CONNECTING ROD OS20HOROD00

This device permits to connect the positioning rods to the inclinometer probe.

SET OF POSITIONING RODS OREXROD10BX

Set includes 10 positioning rods, each 2m long. Used to push inclinometer probe into the starting position for a survey. Supplied with carrying case.

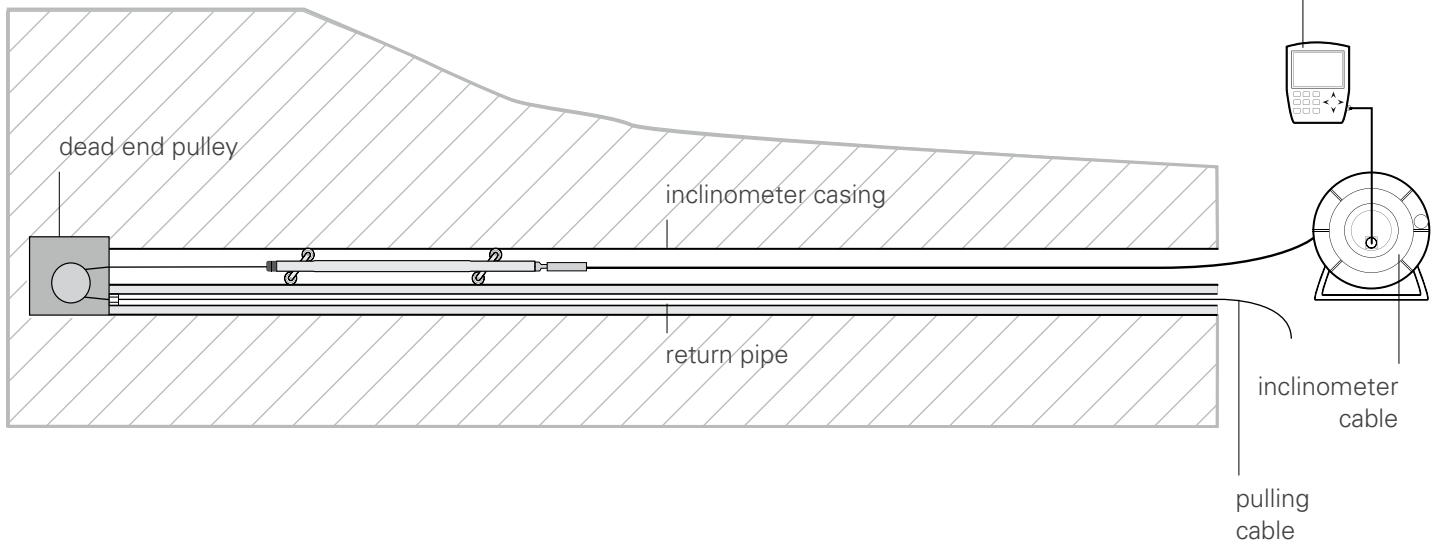


PULLING CABLE OWRACPVCO00

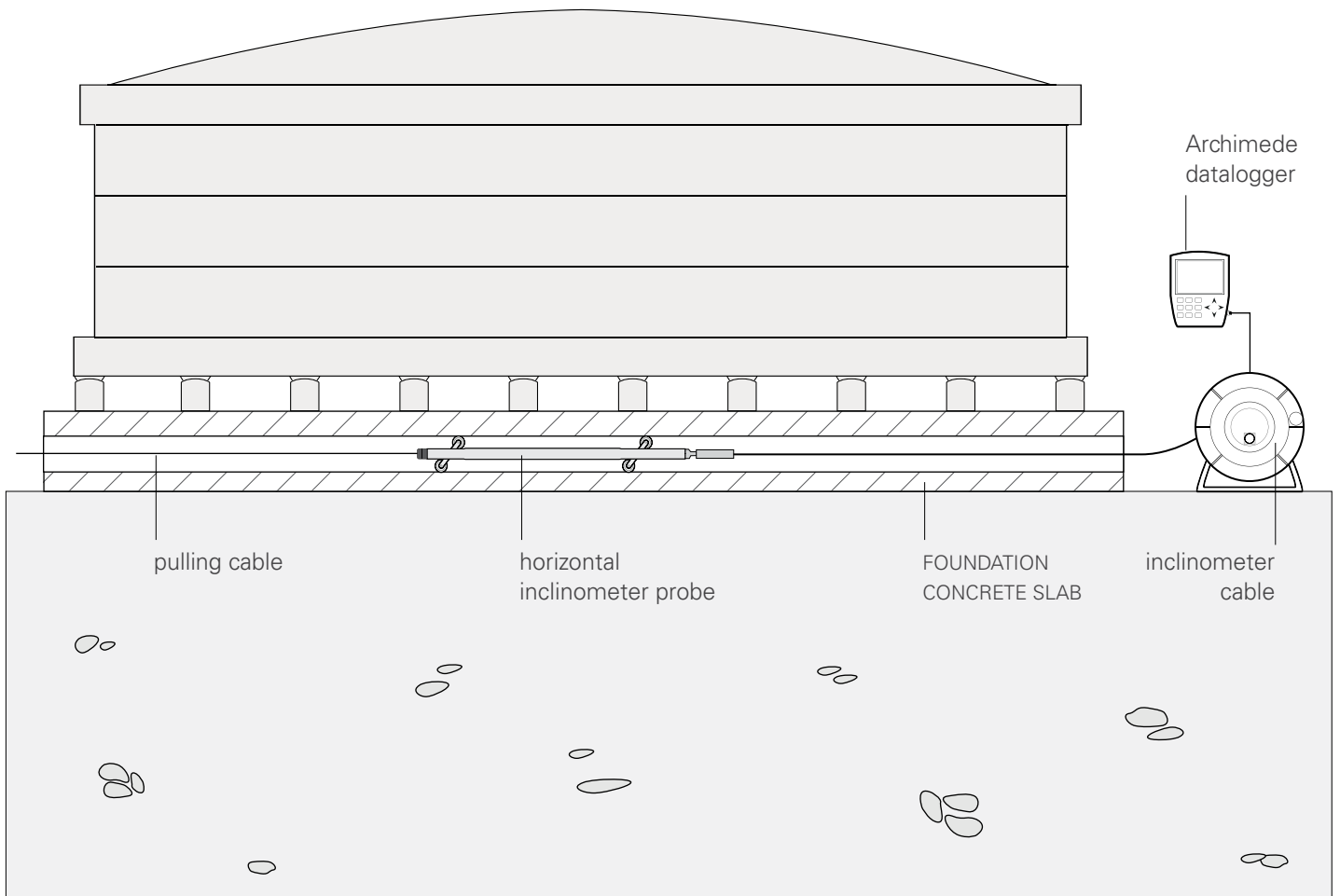
Stainless steel cable with PVC jacket. Used to pull the horizontal inclinometer probe into the starting position for a survey. If dead-end pulley is used, order double length of of positioning cable.

DEAD-END PULLEY OS1RINV7000

Used when inclinometer casing is not accessible at both ends. Requires return pipe for pull cable. Available for 70mm casing and also 3" casing. (code OS1RINV7500).



LNG TANK
APPLICATION



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TECHNICAL ASSISTANCE

SISGEO offers customers e-mail and phone assistance to ensure proper use of instruments and readout and to maximize performance of the system.

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