C1 INVERTED AND HANGING PENDULUM SYSTEMS

Datasheet C1

Description

Inverted and Hanging Pendulums are used for accurate, long term monitoring of horizontal movements in large structures.

The Hanging Pendulum comprises a Stainless Steel wire which is anchored at its top to the structure.

A weight suspended from the lower end of the wire moves in an oil tank, the oil serving to dampen the oscillations of the wire.

Measurements in the X and Y axes are taken along the wire, using a portable optical readout or an automatic CCD (Charge Coupled Device) system.

For both Inverted and Hanging Pendulums, vertical (Z axis) measurements can optionally be taken by using a CCD system in conjunction with a reference mark on the wire.

The Inverted Pendulum uses identical measuring devices but the wire is anchored in stable ground beneath the structure, with a float fixed to the upper end of the wire which floats in a water tank, tensioning the wire and keeping it vertical.

Features

- **Greater measuring accuracy than precise geodetic surveying**
- **Manual or automatic readouts available**
- **Simple to use**
- **Long-term reliability**

Benefits

- **Movements can be observed at frequent intervals without repeated and costly surveys**
- **Ideal for long-term use**
- **Can read X, Y and Z movement**

Comprehensive information about this product and our full range is available at www.soil.co.uk
If you would like to speak with someone directly please call +44 (0)1825 765044 or email sales@soil.co.uk

Operation

Hanging Pendulum: The upper end of a Stainless Steel wire is anchored to the structure under observation. A weight suspended from the lower end of the wire keeps it under tension whilst being free to move in an oil tank.

Inverted Pendulum: The wire is anchored in stable ground beneath the structure. A float is fixed to the upper end of the wire which is then allowed to float free in a water tank whilst keeping tension in the wire.

Readings for both versions of the pendulum are treated in the same way. Displacements relative to the wire are measured using a portable optical readout or, for remote reading, an automatic CCD system. The reading arrays are corrected for temperature and an external digital display can be connected to the readout unit to display the X and Y (and Z, if used) positions in millimetres.

The readout can be incorporated into almost any data acquisition system.

Applications

Hanging and Inverted Pendulum Systems are designed for accurate and long-term measurement of horizontal movements associated with the rotation or tilting of a structure.

Typical applications include:

- Dams and dam foundations
- Abutments
- Bridges and piers
- Towers
- Nuclear power stations
- Tall buildings

Associated products

For details on:	Catalogue code:
Dataloggers	D1
Automatic Pendulum Readout (CCD System)	C1-5
Manual Pendulum Readout System	C1-4
Argus Monitoring Software	D4

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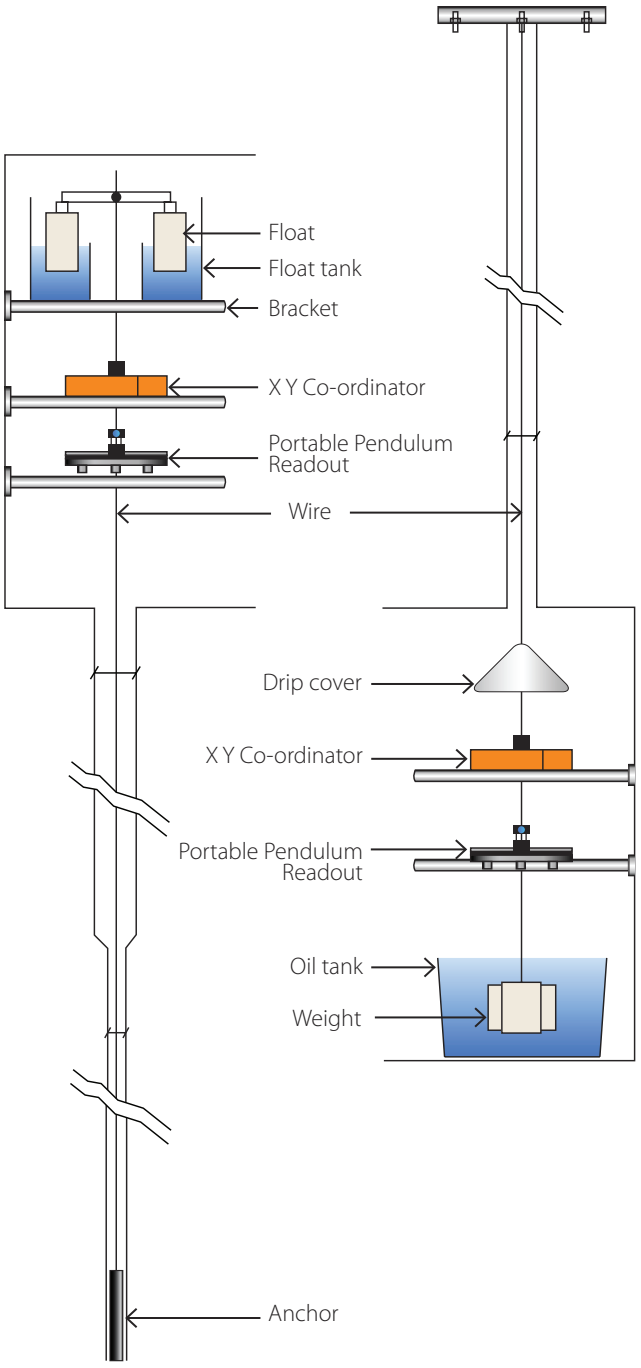
Inverted Pendulum System **Hanging Pendulum System**



THE TECHNICAL RATING FOR THIS PRODUCT:

BASIC

As the correct installation of any monitoring sensor or system is vital to maximise performance and accuracy, Soil Instruments makes the following recommendations, for the skill level of the installation contractor.

ADDITIONAL SUPPORT

We offer installation and monitoring services to support this system. For more information please email : **sales@soil.co.uk** or call : **+44 (0) 1825 765044**

ADVANCED	The installer is trained and experienced in the installation of this type of instrument or systems, and is ideally a specialist Instrumentation and Monitoring contractor.
INTERMEDIATE	The installer already has previous experience and/or training in the installation of this instrument or system.
BASIC	As a minimum the installer has read and fully comprehends the manual, and if possible has observed these instruments or systems being installed by others.

Specifications

Hanging Pendulum

Component	Anchor	Weight	Oil tank
Material	Stainless Steel	Steel	PVC
Weight	3.5kg	29kg	3kg
Dimensions	800mm x 50mm x 50mm	Ø252mm x 203mm	Ø680mm x 520mm

Inverted Pendulum

Component	Float unit	Float tank	Support frame anchor	Anchor
Material	Polypropelene		Stainless Steel	Steel
Weight	11kg	15.5kg	13kg	8kg
Dimensions	Ø610mm x 400mm	Ø790mm x 540mm	1040mm x 550mm x 250mm	600mm x Ø50mm

Wire

Material	316 grade Stainless Steel
Weight	16g/m
Dimensions	Ø1.6mm
Wire breaking load	280kg

Float

Float force	58kgf

Reading Table and Brackets

Component	Table	Brackets
Material	Stainless Steel	
Weight	7.5kg	4kg/pair
Dimensions	450mm x 450mm x 6mm	750mm x 135mm x 40mm

Portable Pendulum Readout

Range	X = ±75mm, Y = ±75mm
Eyepiece	None | 45° | 90°
Resolution	0.1mm
Repeatability[1]	±0.1mm
Accuracy	±0.1mm
Weight	4kg

Automatic Pendulum Readout (CCD)

Range	X= ± 25mm, Y = ±25mm	X = ±25mm, Y = ±50mm	X = ±25mm , Y = ±50mm, Z = ±25mm
Resolution	0.01mm		
Repeatability	±0.1mm		
Accuracy	±0.1mm		
Weight	9kg		
Operating humidity	100% relative humidity non-condensating		
Temperature range	-15 to + 60°C		
Communications	RS485		
Analogue output	4-20mA		
Power supply	AC 85V - 220V ±20% 50Hz - 60Hz		24V DC - option available on request (please contact our Sales department for further information)
Dimensions	380mm x 330mm x 145mm		

[1] Dependent on operator experience

Ordering Information

Inverted Pendulum Float and Anchor

C1-1.1	Float unit with support frame & cover; includes float, tank Ø790mm, tank cover/lid, Stainless Steel frame, wire clamp and wall fixings
C1-1.3	Anchor; 600mm long bar x Ø50mm, includes wire clamp
C1-1.4	Antifreeze fluid; 5 litres
C1-1.5	Verticality Test Spacer; for measurement of lateral deformation of the borehole in rock foundation

Hanging Pendulum Weight and Anchor

C1-2.1	Weight; 29kg, 203mm long, solid steel, supplied complete with damping fins, includes wire clamp
C1-2.2	Oil tank; Ø680mm
C1-2.3	Anchor unit; Ø16mm - supplied complete with 800mm crossbeam, includes wire clamp
C1-3.3	Drip cover

Wire

C1-3.1	Pendulum wire; priced per metre, Ø1.6mm, Stainless Steel wire
C1-3.2	Spare wire clamp; for Ø1.6mm wire

Pendulum Measuring Equipment

C1-4.1	Manual reading table; includes support brackets and Stainless Steel measuring plate
C1-4.3	Portable pendulum readout; range: X axis = 150mm, Y axis = 150mm
C1-4.4	Portable pendulum readout with 45° eyepiece; range: X axis = 150mm, Y axis = 150mm
C1-4.5	Portable pendulum readout with 90° eyepiece; range: X axis = 150mm, Y axis = 150mm

Automatic Pendulum Readout (CCD System)

C1-5.1	Automatic pendulum readout; range: 50mm in X and Y axis. RS485 or analogue output. System requires CR800-based datalogger
C1-5.4	Automatic pendulum readout; range: 50mm in X and 100mm in Y axis. RS485 or analogue output. System requires CR800-based datalogger
C1-5.5	Automatic pendulum readout; range: 50mm in X and 100mm in Y and 50mm in Z axis. RS485 or analogue output. System requires CR800-based datalogger
C1-5.3	Display unit for Pendulum Readout Systems C1-5.1 and C1-5.4
C1-5.6	Display unit for Pendulum Readout System C1-5.5
C1-5.2	Mounting table for automatic pendulum readout

Manual

MAN-73	Inverted Pendulum Wire Equipment
MAN-74	Hanging Pendulum Wire Equipment
MAN-134	Optical Digital Pendulum Readout

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