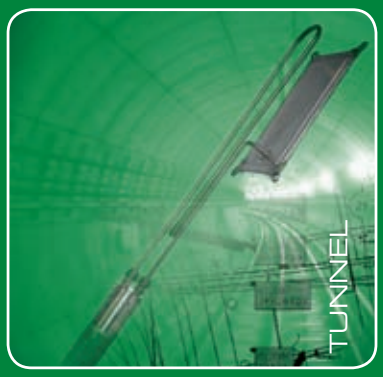
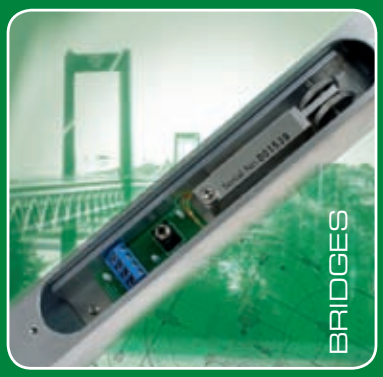




INTERFELS

INTERFELS GMBH

GEOTECHNICAL & STRUCTURAL INSTRUMENTATION

2010/11

INTERFELS GMBH

HISTORY OF INTERFELS GMBH

INTERFELS was founded in the year 1961 in Salzburg/Austria by 32 member of the so-called, Salzburg Geomechanic's Circle' led Leopold Müller. According to its original charta, the objective of the company was technological testing of rock masses in all countries of the world, scientific research in the field of Geomechanics and issuing of official test certificates.
The INTERFELS tradition has over the years been enchaced by innovations in the field of manufacturing geotechnical instrumentation and monitoring, data acquisition, software and technologies.

In 1996 INTERFELS was aquired from Boart Longyear.

In 2007 ITM-Soil Ltd Purchased INTERFELS. The acquisition increases ITM-Soil's geotechnical manufacturing and service base, bringing not only specialist products such as Argus monitoring and the incremental extensometer INCREX, but also expierenced employees and a new factory based in Bad Bentheim, Germany. As December 2009 INTERFELS is certified to DIN ISO 9001:2008.

INTERFELS PRODUCTS

- MEMS-based digital inclinometer systems
- Incremental Extensometer (INCREX) System
- Jointmeter/Crackmeter
- Convergence
- Vibrating Wire and electric piezometers, pressure and load cells
- Tilt sensors
- Automatic data acquisition systems
- Data presentation software

INTERFELS EXPERIENCE

INTERFELS GmbH is known through-out the world for our geotechnical instrumentation including tunnel and brigde monitoring. Dam installation is something that we pride ourselves on, with our experience and equiment is vast and second to none. Listed below are some of the larger dam bridge projects in the world where INTERFELS have installed geotechnical equipment:

• Birecik Dam	Turkey
• Karun 1 and 3 Dam	Iran
• Tehri Dam	India
• Oresund Bridge	Sweden to Denmark

INTERFELS DISTRIBUTOR'S

We either have a distributor in your country or we are able to deal with your requests and orders direct. Our aim is simply which is to ensure that our customer requirements are archieved on time and our time and our technical support you can rely on at all times.

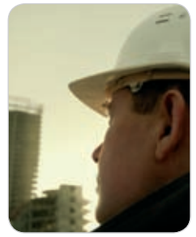
INTERFELS CUSTOMER'S

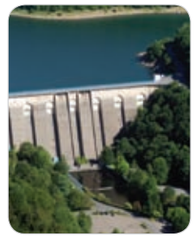
Most of our national and international customers have been with INTERFELS for many years. We are proud of the quality of our instruments and the service we provide to our customers. We recognise that every site and project is unique and our experienced sales engineers always ensure that our customers receive the best possible support and information from us before during and after sales.

OUR GROUP

The ITM-Soil Group operates geotechnical and structural monitoring companies throughout the world:

- Soil Instruments Ltd, UK
- ITM Ltd, UK
- INTERFELS GmbH, Germany
- ITM-Soil Pty Ltd, Australia
- Beijing Soil Instruments, China





CONTENTS

VERTICAL INCLINOMETER SYSTEM

APPLICATIONS

The Vertical Digital Bluetooth Inclinometer provides accurate profiles of lateral deflections in two perpendicular planes (i.e. biaxial). These include:

- Embankments, landslide zones and retaining walls
- Dams and slopes (natural or man made)
- Bridge piers, abutments and landfills
- Ground deformation due to tunnelling and excavation

FEATURES

- Fast and simple data gathering and highly accurate readings of ground deflection
- Bluetooth communication between the probe and a rugged PDA (Personal Digital Assistant) avoids cable resistance, noise issues and connector problems
- The PDA interfaces with most office systems. Data reduction, graphing and reporting are performed using In-Site Inclinometer Software
- Surface mount electronics ensure long and trouble-free use in a site environment
- Metal marker/cable gate system ensures high degree of accuracy and repeatability
- Strong, lightweight and portable

SPECIFICATIONS

Probe gauge length	500mm metric system 24 inches imperial system
Probe diameter	28.5mm (1")
Calibrated ranges	±30° (±250mm), ±60° (±433mm) or ±90° (±500mm)
Resolution	0.01mm (0.001")
Sensor accuracy	±0.02% full scale (±0.1mm) for ±30° unit
Operating temperature	-10 to +50°C
Repeatability	±0.008% full scale
System accuracy[1]	(over 25m) ±2mm for ±30° unit
Minimum casing internal diameter	48mm
Maximum casing internal diameter	83mm

[1]. Derived empirically from surveys that include systematic and random errors introduced by casing, probe and operator

HORIZONTAL INCLINOMETER SYSTEM

APPLICATIONS

The Digital Bluetooth, Uniaxial Horizontal Inclinometer provides high resolution and accurate profiles of settlement or heave in geotechnical and civil engineering structures such as dams, embankments, bridge piers and abutments, storage tanks and landfill areas.

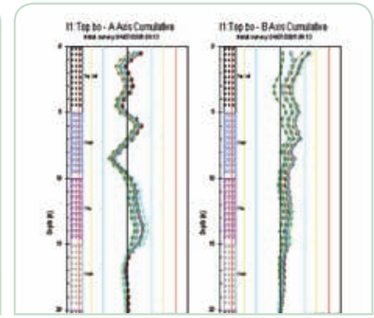
FEATURES

- Fast and simple data gathering and highly accurate readings of ground deflection
- Bluetooth communication between the probe and a rugged PDA (Personal Digital Assistant) avoids cable resistance, noise issues and connector problems
- The PDA interfaces with most office systems and applications with the software offering a range of presentations
- Solid state electronics ensure long and trouble-free use in a site environment
- Metal marker/cable gate system ensures high degree of accuracy and repeatability
- Strong, lightweight and portable

SPECIFICATIONS

Probe gauge length	500mm
Probe diameter	44mm
Calibrated range	±10° (±86.8mm)
Resolution	0.01mm
Sensor accuracy	±0.028% full scale (±0.05mm)
Operating temperature	-10 to +50°C
Repeatability	±0.006% full scale
System accuracy[1]	(over 25m) ±2mm
Minimum casing internal diameter	57mm
Maximum casing internal diameter	73mm

[1]. Derived empirically from surveys that include systematic and random errors introduced by casing, probe and operator



IN-SITE INCLINOMETER DATA PRESENTATION SOFTWARE

APPLICATIONS

In-Site is a Microsoft Windows based data presentation application, designed primarily for the INTERFELS inclinometer systems but able to be used with most commercially available inclinometer systems. In-Site's main functions are data reduction, graphing and reporting. Based on the Microsoft Access Database format, In-Site allows your site-specific databases to grow with your monitoring projects. Licence distribution with a USB dongle allows the freedom to use your In-Site licence for multiple computers.

FEATURES

- Data entry by direct retrieval, single or multiple file import and manual input
- Useful borehole administration tools allowing data management, data reduction, cumulative and incremental displacement plotted against depth or elevation, viewable in graphical and tabular format
- Option to plot site investigation borehole logs against depth and elevation for advanced analysis of movement
- Reports can be previewed on screen before printing and can be fully customised, with graphical and tabular presentation and the ability to add annotations, company details and company logos
- Multiple databases can be opened at the same time
- Inclinometer data can be copied between databases by simply dragging and dropping

ELECTROLEVEL IN-PLACE INCLINOMETER

APPLICATIONS

Ideally suited for automated near real time measurements of lateral displacement of soil, rock and man-made structures with the following specific applications:

- Stability of natural and cut slopes, slurry walls, sheet piling and tie-back walls around excavations
- Lateral ground movement due to excavation and tunnel or shaft construction
- Lateral deformation of embankments, earthfill dams and retaining walls

FEATURES

- Accurate readings of ground deflection (electrolytic tilt sensors)
- Uniaxial and biaxial versions available
- Available for vertical or horizontal profiling of ground deflection
- Heavy-duty mechanical design ideally suited for multiple use on many different projects and applications
- For use with inclinometer casing
- Real time monitoring; ideal for continuous, unattended monitoring, can deliver readings in near real-time

SPECIFICATIONS

Calibrated ranges	±3°[2] or ±10°
Sensor Resolution[1]	<0.0003 arc degrees/ <0.0005 arc degrees
Sensor Symmetry@ ½ linear scale	<2%
Sensor Null Repeatability	<0.0008 arc degrees/<0.001 arc degrees
Operating temperature	-20 to +70°C
Signal output	±2.5VDC // 4-20mA
Minimum casing internal diameter	62mm
Maximum casing internal diameter	70mm
Housing Diameter	40mm
Tube Diameter	28mm (stainless steel)
Ingress protection	IP68 to 100mH2O (1000kPa)
Housing material	brass (nickel plated)

[1] Dependent on readout equipment

[2] For horizontal chains only

STANDARD INCLINOMETER CASING

APPLICATIONS

An essential and integral part of inclinometer systems used for measuring movements in soil, rock and structures. Designed for easy assembly and installation providing accurate inclinometer data in short and long term monitoring. This economical casing is assembled using couplings, rivets and sealing tape, ensuring strong joints.

FEATURES

- Installable in boreholes and piles, set into concrete or attached to structures
- Manufactured from ABS plastic which is flexible, impact and corrosion resistant thus ensuring long service life
- Precision extruded keyway ensures low spiral and perfect fit for the inclinometer probe wheels rendering accurate inclinometer data
- Special couplings at joints safeguard against ingress of water or grout
- Telescopic sections with a 150mm range for accommodating settlement or heave
- Compatible with all inclinometer, settlement probes and IPI sensors
- Available in 70mm and 85mm diameter

SPECIFICATIONS

Material	ABS
Groove spiral	< 0.3°/3m
Collapse rating	1960kPa (1770kPa)
Bend rating	3.07kN (2.65kN)
Maximum temperature	80°C
Tensile strength	705kgF (700kgF)
Torque	520Nm (481Nm)
Casing length	3m
Outside diameter	70mm (85mm)
Inside diameter	62mm (77mm)

Figures in brackets refer to 85mm diameter casing

EASY CONNECT INCLINOMETER CASING

APPLICATIONS

An integral part of inclinometer systems used for measurement of lateral movements of soil, rock and structures. Although typically installed in boreholes its versatility renders it suitable for use in landfills, cast to concrete or attached to structures. It is designed to deflect within the ground, with materials or structural movement and provide inclination information over long periods of time.

FEATURES

- Quick and simple assembly offers significant saving in installation costs
- Self aligning integral coupling reduces casing spiral significantly
- Installable in boreholes and piles, set into concrete or attached to structures
- Manufactured from ABS plastic which is flexible, impact and corrosion resistant thus ensuring long service life
- Precision extruded keyway ensures low spiral and perfect fit for the inclinometer probe wheels rendering accurate inclinometer data
- Provision of O rings at the joints ensures against ingress of water or grout
- Telescopic sections with a 300mm range for accommodating settlement or heave
- Compatible with all inclinometer, settlement probes and IPI Sensors
- Available in 70mm and 58mm diameter

SPECIFICATIONS

Material	ABS
Groove spiral	< 0.5°/3m
Collapse rating	1960kPa
Bend rating	252N
Maximum temperature	80°C
Tensile strength	585kgF
Torque	25Nm
Casing lengths	1m, 2m, 3m (1m, 3m)
Outside diameter	70mm (58mm)
Inside diameter	59mm (49mm)

Figures in brackets refer to 58mm diameter casing

QUICK DRIVE INCLINOMETER CASING

APPLICATIONS

An integral part of the inclinometer system used for measurement of highly accurate lateral movements of soil in highway and railway embankments.

Designed for installation into pre-formed window sampling holes or where ground conditions permit, pushed to required depth using CPT equipment.

FEATURES

- End cone ensures excellent fixity and therefore a stable datum
- Quick and simple assembly offers significant saving in installation costs
- Self aligning and integral coupling reduces induced spiral significantly
- Manufactured from ABS plastic which is flexible, impact and corrosion resistant thus ensuring long service life
- Precision extruded keyway ensures low spiral and perfect fit for the inclinometer probe wheels rendering accurate inclinometer data
- Provision of an O ring ensures against ingress water or grout
- 70mm and 58mm outside diameter versions available
- Compatible with In-Place Inclinometer sensors (70mm OD only)
- 1 and 2 metre sections available

SPECIFICATIONS — 2m drive section

Effective length	1840mm
Length	2090mm
Outside diameter	70mm
Inside diameter	59mm
Cone diameter	76mm
Cone material	steel
Cone taper angle	40°
Weight	5.7kg

HANGING AND INVERTED PENDULUM SYSTEMS

APPLICATIONS

The Hanging and Inverted Pendulum Systems are designed for accurate measurement of horizontal movements associated with the rotation or tilting of a structure. Typical applications include determination of horizontal movements of dams, dam foundations, abutments, bridges, piers, towers, nuclear power stations and tall buildings. Inverted and hanging pendulums often installed in the same structure.

FEATURES

- High accuracy and resolution rendering quality data which is better than surveying
- Provides a primary reference for geodetic surveying
- Very reliable long term monitoring system
- Measurements can be taken at one or several points along the wire
- Provides frequent reading intervals without the need for costly and troublesome geodetic surveys
- Options for manual data monitoring or full remote logging system

SPECIFICATIONS — Manual System

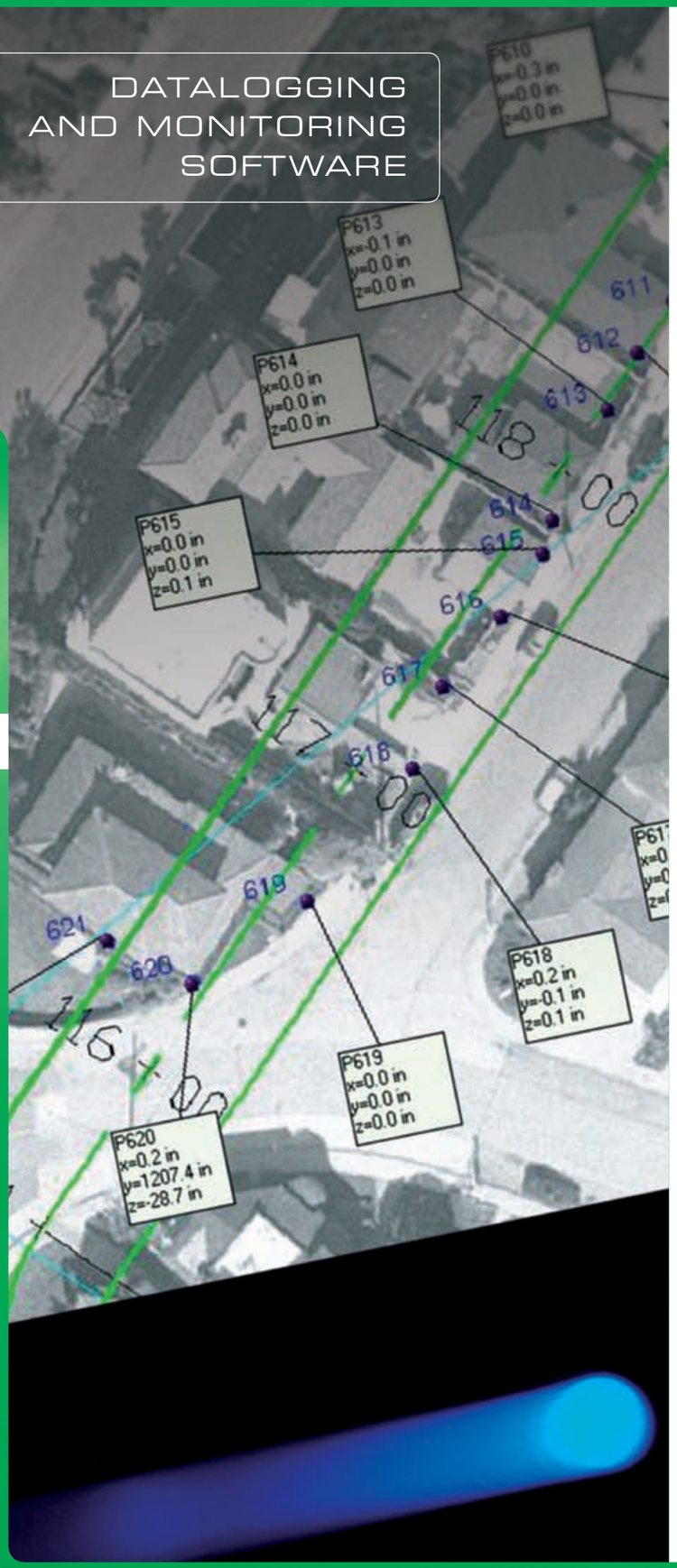
Range	±75mm in X and Y
Accuracy	±0.1mm
Resolution	0.1mm
Repeatability[1]	±0.1mm
Weight	4kg

[1] Dependent on operator experience

SPECIFICATIONS — Automatic System

Range	±50mm in X and Y or ±50mm in X and ±100mm in Y
Repeatability	±0.1mm
Resolution	±0.01mm
Operating temperature	-15 to +60°C
Output	RS-485 or 4-20mA signal

DATALOGGING AND MONITORING SOFTWARE



DATALOGGERS

APPLICATIONS

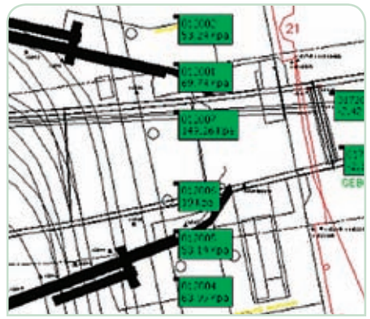
Instrumentation systems for geotechnical and structural monitoring often entail monitoring large numbers of sensors of different types, with dataloggers often being installed in remote, inaccessible and hostile locations.

INTERFELS have configured numerous loggers for a diverse range of Structural and Geotechnical Engineering applications worldwide. The loggers are built around the Campbell Scientific CR800 and CR1000 modules and can be used with monitoring software such as ARGUS giving a complete solution for remote monitoring of projects independent of the user's location.

Typical applications include monitoring dams, bridges, steel or concrete structures, tunnels, mines, railway tracks, embankments, slopes, pile testing, flood control, etc.

FEATURES

- Rugged with low power consumption
- Powered by mains, battery or solar panels
- Up to 4Mb internal memory in CR1000 and further capacity through the addition of a Compact Flash Module (CR1000 only)
- Various options for data retrieval e.g. GSM, MD485, TCP/IP, 2.4GHz radio
- Output data in simple ASCII format enables easy importing to monitoring software or spreadsheets
- Real time datalogging and analysis
- Reads most sensors common to geotechnical and structural engineering instrumentation
- Alarm triggering facilities
- Networking of multiple loggers possible



ARGUS MONITORING SOFTWARE

APPLICATIONS

ARGUS Monitoring Software is a web-based data management, calculation and presentation tool. It provides a reliable and cost efficient method for processing and monitoring ASCII files with numerical data.

ARGUS will handle all data processing requirements, starting with storage of data into a MySQL database, then performing the required calculations on the data, presenting the results in graphical and numerical format, generate alarm messages, creating automated PDF reports and much more.

ARGUS Monitoring Software is server based. Users interact with the software using their web-browser. Working with ARGUS is therefore platform-independent and can be accomplished from the local network or, when connected to the Internet, from any location in the world.

Instead of purchasing the software to run on your own server, INTERFELS also provides hosting services for your projects (i.e. for a monthly rental fee you will have access to your own 'website' running ARGUS Monitoring Software).

ARGUS FEATURES

- Multiple users per project, no licences to pay for additional users, no software to install on PCs
- 5 different plot types being timebased, coordinate based, sensor vs sensor, a 2-plot combination and a 3-plot combination
- Unlimited amount of plots (pre-defined) per project – dynamic updating of plots with latest data
- Zoom in on an area of the plot to obtain more detail
- Download data from the plot in zipped tab-separated format for import in spreadsheet applications

MAIN ADVANTAGES OF ARGUS

CROSS-PLATFORM: ARGUS is web-server based software. With a standard web-browser users can interact with ARGUS. There is no need to install any software or plugins on the PC's of the users.

MULTI-PROJECT: A single server with ARGUS monitoring software is able to host many different projects simultaneously. Each project can be equipped with company logos and start-up logos.

DYNAMIC PRESENTATION: All plots and results are re-calculated on the fly for every presentation. Hence changes in for example sensor calculations or data are directly available.

MORE ARGUS FEATURES

- Multiple views of the project (user specified images for example CAD drawings or project photos) with measurement value and sensor status displayed on top
- Automated & manual import of ASCII files with measurement data, manual input of single measurements
- Watchdog function to generate an email alarm in case of "no data received since x minutes"
- Build complex formulas with references to any sensor in the project
- Create 'virtual sensors' to calculate specific values like averages, absolute or relative measurements, corrected and uncorrected data, etc.
- Apply filters and filter out 'bad' data, minimum and maximum values and mean values
- Configure up to 8 alarm levels per sensor – alarm level changes and confirmations are issued via E-Mail and can also be received on mobile phones by using the email2SMS service of your mobile phone operator.
- Detailed alarm & alarm confirmation logging including username, remark, alarm value and confirmation time
- Automatic generation of PDF reports (daily, weekly, monthly) issued via E-Mail which may include up to 12 plots per report, sensor values, alarms and text
- Create and set privileges for users and email groups (to receive the alarms & PDF reports)
- ASCII export can be configured to automatically export calculated data in ASCII files for import in third party databases
- Create backups & archives from data and configuration settings in the database
- Add-ins/Plug-ins add project specific functionality like inclinometer, Filemanager or Logbook Addin to exchange additional project information
- Support for multiple languages currently for Dutch, German, English, French, Chinese, Spanish and Finnish, easily expanded with new languages
- Datum readings can be applied in the sensor configuration or in the plot, allowing both absolute and relative evaluations simultaneously
- Consistent further development to satisfy new upcoming requirements!
- And much more...

Please refer to the ARGUS website for additional information: www.argusmonitoringsoftware.com

INSTRUMENT CABLE

APPLICATIONS

Instrumentation used to measure the performance and safety of structures requires secure connections between the sensors and the readout locations.

It is essential that adequate consideration is given to the cables.

FEATURES

INTERFELS uses the highest quality cables, manufactured to German and EC standards. They have excellent electrical properties, are waterproof and suitable for burial in soil or concrete over long periods of time.

Typically, the cables are armoured (especially in earth dams) with a high resistance to tensile loading; PU sheathing provides waterproofing (although other jackets are available) and shielded pairs with drain wires provide for electrical noise protection.

Cables with 2 up to 48 conductors are available.

MAGNETIC EXTENSOMETER

APPLICATIONS

The Magnetic Probe Extensometer is a simple and inexpensive method for monitoring large magnitudes of settlement and heave in excavations, fills, foundations, dams and embankments. It is also adaptable for installation behind retaining walls, sheet piles and slurry walls, and above underground openings including tunnels and shafts.

The extensometer data will show settlement/ heave profile with depths as well as the total amount of settlement/ heave.

FEATURES

- Reliable, accurate, simple to install and operate
- Multiple points can be monitored at little extra cost and without changing the borehole diameter
- Magnet targets and sections of access tubing can be excavated or added
- In conjunction with a biaxial inclinometer the system will yield a three-dimensional profile of movement
- The magnetic probe reads the relative elevations of magnet targets installed permanently against the access tube in the ground

SPECIFICATIONS

Range[1]	30m, 50m, 100m, 150m, 200m
Resolution	1mm
Repeatability[2]	±2mm
Operating temperature range	-30 to +80°C
Graduations	mm/cm/m
Indicators	audio & visual
Probe material	stainless steel
Probe Diameter	16mm
Tape type	contoured/shaped copper conductors
Tape material	steel/polypropylene coated
Reel material	steel frame/polypropylene hub
Battery life	12hrs continuous use

[1] Longer lengths available

[2] Dependent on operator experience

MULTIPOINT BOREHOLE (MPBX) ENTENSOMETER

APPLICATIONS

Multipoint borehole rod extensometers serve to measure lengths between one or more anchor points in a borehole and a reference head at the borehole collar. They ensure high precision, even at great installation depths. Typical areas of application include the monitoring of:

- Movements of rock and soil, caused by fractures, landslides and weathering
- Underground settlements and deformations of foundations and abutments
- Relaxation and deformation of rock around tunnel walls, shafts, pillars, roofs and caverns

FEATURES

- Robust and economical construction
- Suitable for short or long term monitoring
- Packer Anchors (for soil and fractured rock) or Grout Anchors (for solid rock)
- Up to 5 measuring points per extensometer (6 on special request)

SPECIFICATIONS

Mechanical & automated versions

Extensometer Rods	Fibreglass 10mmØ, PEH protective tubing 16x2mm Stainless Steel 14mm Ø, PEH protective tubing 20x2mm
Packer Anchor	Stainless Steel & Geotextile 3" Ø, 600mm length, 1-3 point extensometer, 65-90mm borehole size 4" Ø, 600mm length, 1-4 point extensometer, 90-120mm borehole size 5" Ø, 600mm length, 1-5 point extensometer, 110-145mm borehole size
Grout Anchor	Steel
Dimensions	600mm length, 20mmØ
Mechanical Readout	Dial Gauge 30+50mm Digital Calliper 130mm
Automated Readout	Potentiometric Displacement Transducers, 25mm, 50mm, 100mm range, voltage output + 4-20mA output VW Displacement Transducers, 30mm, 50mm, 100mm

MEASURING ANCHOR (TYPE MA25)

APPLICATIONS

Measuring anchors can be used in all underground cavities where the formation of a rock-supporting ring is intended by system anchoring. The measuring anchor is a combination of an anchor and an extensometer. Its task is to determine the ranges of depths, where the load is taken up due to loosening effects of the rock. It is therefore suitable for the determination of the optimal anchor lengths.

FEATURES

- Measuring anchors replace a system anchor
- No extra borehole is required
- The measuring anchors will be equipped with 4 measuring points as standard
- Simple and robust mechanical readout
- Electrical transducers and automatic data acquisition systems are available
- The required borehole size is between 43mm and 50mm.

SPECIFICATIONS

Standard lengths	2m, 3m, 4m, 4,5m, 6m, 9m (special lengths and models available on request)
Measuring lengths	0.5m to 9.0m
Diameter of Anchor	26mm
Diameter of equivalent system Anchor	22mm
Cross Section	418mm²
Material	Steel
Maximum Tensile Load	250kN
Youngs Modulus	210kN/mm²
Manual Readout	Dial Gauge, 30mm (+calliper extension, 30mm)
Resolution	0.01mm
Reading Accuracy	± 0.01mm (depending on user's experience)
Electrical/Automatic Readout	Set of 4 Mini Potentiometric Transducers
Measuring Range	10mm
Resolution	0.01mm
Output Signal	Potentiometric or 4-20mA

INCREX INCREMENTAL EXTENSOMETER

APPLICATIONS

The INCREX (Incremental Extensometer) system utilises the well proven electro-magnetic induction principle and, together with inclinometer casing, facilitates highly accurate measurements of ground movements in the direction of the borehole axis.

Typical applications include the monitoring of:

- Vertical and lateral deformations around underground openings
- Settlement in differing ground layers especially in near surface tunnelling
- Settlement during construction of dams
- Settlement due to subsurface erosion formed by the dissolution of soluble rocks
- Stability of caverns in underground mines
- Monitoring settlement and heave in the foundations of dams and power plants

FEATURES

- High accuracy and resolution
- Operable with orientation varying from vertical to horizontal
- Utilises 70mm inclinometer casing
- Dedicated software for mapping profiles of settlement/heave along the borehole axis
- When combined with inclinometer data allows determination of 3-dimensional deformation profiles

SPECIFICATIONS

Measuring range	(at each point) ± 20mm
Sensor resolution	0.001mm
Overall system accuracy	± 0.02mm
Sensor accuracy	± 0.01mm
Operating temperature	-5 to +105°C
Water ingress protection	IP68 to 1500kPa
Probe outside diameter	46mm
Probe overall length	1550mm
Probe weight	5.0kg
Gauge length	1m

DIGITAL TAPE EXTENSOMETER

APPLICATIONS

For quick and accurate measurement of relative distances between pairs of reference points on the surfaces of structures including:

- Radial movements and convergence of tunnels, shafts, linings and caverns
- Deformation of excavations in underground power houses, caverns and adits
- Displacements of retaining walls, cuttings, bridge piers, arches and abutments

FEATURES

- Lightweight and rugged design which can be easily read and operated by one person
- Precision punched stainless steel tape incorporating a repeatable tensioning system and digital readout unit
- One unit reads at many locations
- Variety of reference studs available

SPECIFICATIONS

Range	20m or 30m
Accuracy[1]	±0.01mm
Resolution	0.01mm
Repeatability[2]	0.1mm
Operating temperature	-10 to +60°C
Tape tension	11kg
Optical tension indicator	
Weight excluding tape	1kg
Power off	automatic (after 10 minutes of no use)
Power on	automatic (upon movement of the micrometer)

[1] Of the micrometer

[2] Dependent on operator experience

CONVERGENCE TAPE KM

APPLICATIONS

The convergence tape is used for measuring:

- Stress relieve in the walls of underground openings such as caverns, tunnels and shafts
- Movement of walls in foundation pits
- Distortion, tilting or displacement of structures

FEATURES

- Compact and lightweight
- Can be operated with one person
- Stainless steel measuring tape
- Easy to read digital gauge
- One unit reads at many locations
- Variety of convergence bolts available
- Repeatable Measurements: The convergence tape provides repeatable measurements over spans up to 30 metres
- Economic design: Calibrations can be performed on-site as well as the easy replacement of the various components

SPECIFICATIONS

Range	15m (KM 15) or 30m (KM 30)
Reading accuracy[1]	±0.01mm
Resolution	0.01mm
Repeatability[2]	±0.1mm
Operating temperature	-0 to +40°C
Tensioning force	120N (KM 15)/ 200N (KM 30)
Tape Material	Stainless Steel
Weight of system	4kg
Dimensions	600x100x200mm
Digital Gauge range	12mm

[1] Of the micrometer

[2] Dependent on operator experience

POTENTIOMETER CRACKMETER

APPLICATIONS

The Potentiometer Crackmeter is a robust, high resolution and accurate instrument designed to measure displacements across cracks and joints. Typical applications include:

- Rock and soil structures
- Dams, Bridges, Tunnels and pipelines
- Brick & stone buildings
- Monitoring crack propagation due to settlement, heave or foundation clay shrinkage
- Monitoring construction joints and service life cracks
- Monitoring joints and bearing/support interaction
- Monitoring lining cracks
- Earthquake susceptible structures
- Monitoring for confirmation of monolithic structural element position pre/post event
- Superficial cracks

FEATURES

- Accurate, robust and very good long term stability
- High resolution and accuracy
- Splashproof and waterproof designs available
- Simple, well proven device

SPECIFICATIONS

Ranges[1]	25mm, 50mm and 100mm
Linearity	±0.05% full scale
Repeatability	0.01mm
Temperature range	-30 to +100°C
Signal Output	0-5V/4-20mA
Ingress protection	IP66

[1]. Other ranges available (Up to 350mm)

VIBRATING WIRE CRACKMETER

APPLICATIONS

The Vibrating Wire Crackmeter is designed for measuring movements across the surface cracks and joints in soil, rock, concrete, asphalt, etc. This is particularly useful for the early warning of performance problems or the effects of nearby excavation or construction activities on existing structures. Typical applications include:

- Tunnel and shaft linings
- Masonry structures
- Bridge construction
- Superficial cracks
- Dam construction

FEATURES

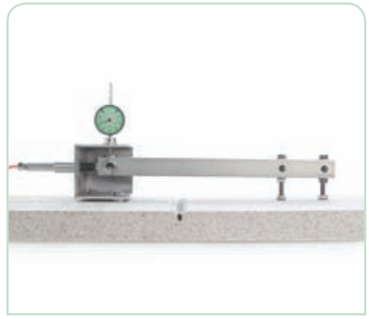
- Highly accurate and robust design
- Easy installation and excellent long term stability
- Fully waterproof to IP68
- Option for fitting a thermistor enables examination of temperature effects
- Options for manual or remote monitoring
- Good accuracy achievable with cable length in excess of 1km

SPECIFICATIONS

Ranges	30mm, 50mm and 100mm
Resolution[1]	0.025% full scale
Accuracy	±0.2% full scale
Temperature range	-20 to +80°C
Dimensions[2]	290 x 19mmØ, 340 x 19mmØ, 450 x 19mmØ
Material	316 grade stainless steel
Ingress protection	IP68 to 1700 kPa

[1]. Dependent on readout

[2]. In the closed position



1D-3D MECHANICAL & ELECTRICAL JOINTMETER

APPLICATIONS

Displacement monitoring of discrete structures, in particular opening of discontinuities, such as:

- Movement along joints and geologic faults
- Widening of fissures in concrete structures
- Monitoring of cracks in masonry brick walls
- Monitoring construction joints and service life cracks

FEATURES

The Jointmeter is designed to measure movement in three axes across any joint, if it is a construction joint in concrete or a tension crack in rock.

- The INTERFELS Jointmeter consists of a transducer mount and a target
- Simple, robust, well proven device
- Measurement in 1-3 axes/planes
- Manual and Electrical Versions available
- Suitable for manual measurement, remote reading or data-logging

Displacements are measured by a dial gauge or by permanently installed distance transducers.

SPECIFICATIONS

Maximum Joint Size	350mm (other available on request)
Measuring Range (mechanical)	12.5mm (in each direction), 50mm dial gauge/130mm digital gauge
Measuring Range (electrical)	12.5mm (in each direction), Transducers 8mm and 25mm
Resolution[1]	0.01mm (mechanical)/ <0.01mm (electrical)
Accuracy[1]	±0.05mm (mechanical)/ <0.05mm (electrical)
Material	Stainless Steel
Dimensions	380x100x100mm (mechanical)/ 420x150x150mm (electrical)

[1]. Other ranges available

VIBRATING WIRE EMBEDMENT JOINTMETER

APPLICATIONS

The Vibrating Wire Embedment Jointmeter is ideal for monitoring movement of joints in mass-concrete structures.

Typical applications include:

- Abutments, slabs, foundations and retaining walls
- Tunnels or shaft linings, arch, gravity and buttress dams

FEATURES

- Highly accurate and robust design
- Easy installation and excellent long term stability
- Versatile to accommodate any lateral movement up to 11mm
- Option for fitting a thermistor enables examination of temperature effects
- Options for manual or remote monitoring of the output
- Good accuracy achievable with cable length in excess of 1km
- Strong, flexible armoured cable

SPECIFICATIONS

Ranges	50mm and 100mm
Resolution[1]	0.025% full scale
Accuracy	±0.2% full scale
Temperature range	-20 to +80°C
Material	PVC/316 grade stainless steel case, stainless steel sensor
Ingress protection	IP68 to 1700 kPa

[1]. Dependent on readout

VIBRATING WIRE TRIAXIAL/PERIMETRIC JOINTMETERS

APPLICATIONS

Vibrating Wire Jointmeters are specially designed for measuring the relative displacement of two adjacent surfaces in three orthogonal directions. Typical applications include monitoring of movement at construction joints in concrete dams, tunnels and tanks or masonry structures.

The Vibrating Wire Perimetric Jointmeter has been designed specifically for use on concrete-faced dams to measure movement across the perimetric joint between the concrete face and plinth, either perpendicular or parallel to the perimetric joint, in the plane of the concrete face or normal to it.

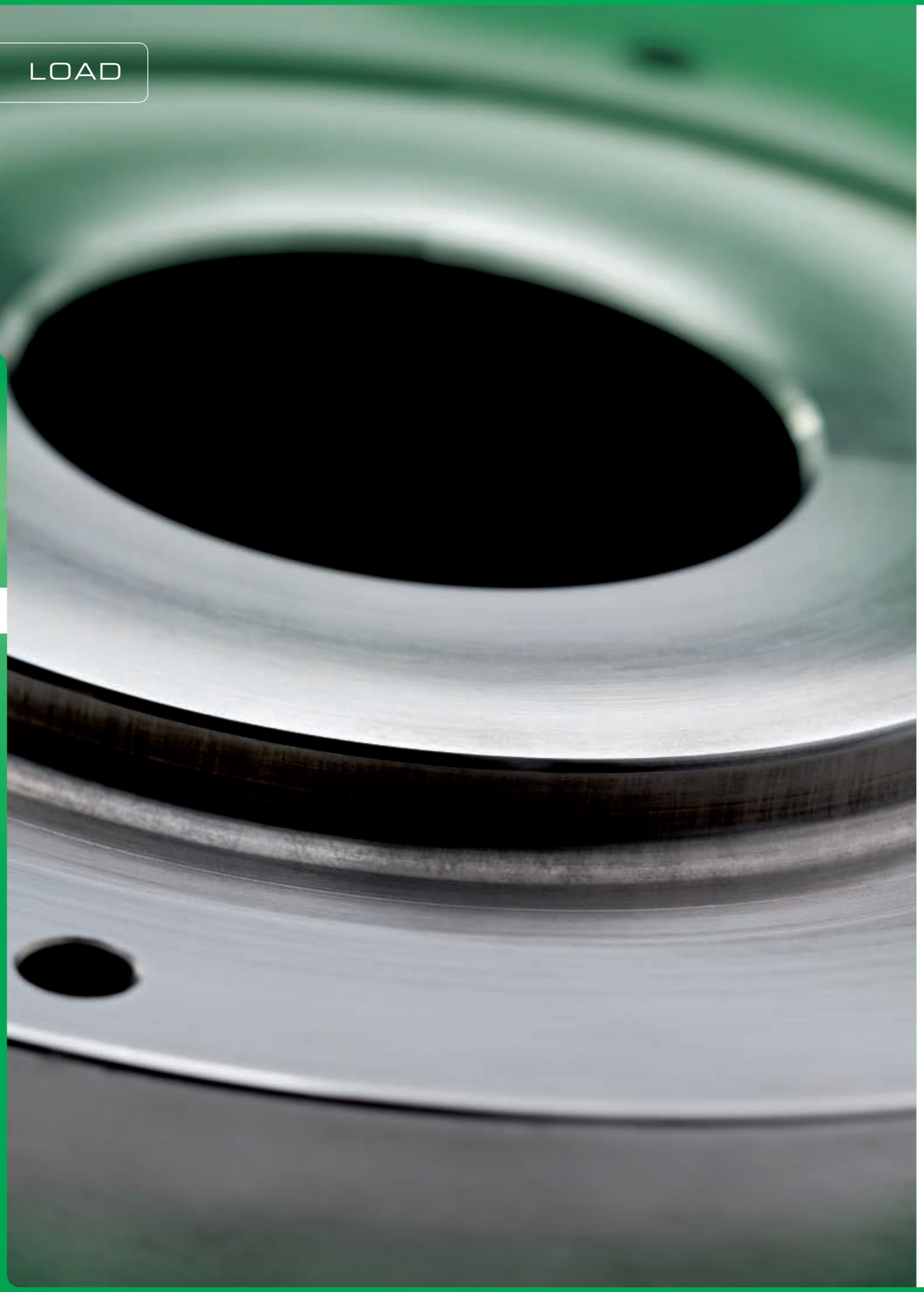
FEATURES

- Accurate, robust and very good long term stability
- Corrosion resistant frames and stainless steel measuring/reference points
- Cable lengths in excess of 1km possible
- Remote and automated monitoring

SPECIFICATIONS

Ranges	30mm, 50mm and 100mm
Resolution[1]	0.025% full scale
Accuracy	±0.2% full scale
Temperature range	-20 to +80°C
Transducer material	316 grade stainless steel
Ingress protection	IP68 to 1700 kPa standard (30mm) 2500 kPa perimetric (50mm & 100mm)

[1]. Dependent on readout



STRAIN GAUGE LOAD CELL

APPLICATIONS

Strain Gauge Load Cells are ideally suited for measuring compressive and tensile loads in rock bolts, cable anchors and tendons. They can also be used with:

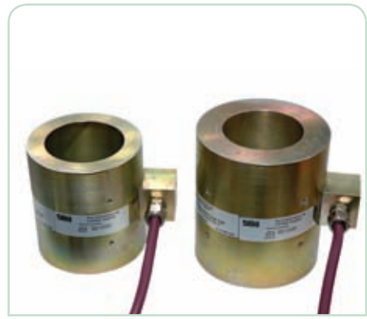
- Structural beams and piles
- Loads between tunnel lining segments and arch tunnel supports
- Internal bracing and tie-backs in deep excavations
- Loads in pull-out tests on trial anchors

FEATURES

- Up to 16 resistance strain gauges in a Wheatstone Bridge configuration equally spaced in a stainless steel low profile cylindrical housing
- Effects of uneven and eccentric loads are minimised
- Accurate, robust with good long term stability
- Negligible temperature effects compared with oil-filled load cells
- Fast response time
- Suitable for remote reading and data-logging
- Connecting cable is strong, screened and flexible
- Not susceptible to partial collapse which can be experienced with leakage from hydraulic load cells

SPECIFICATIONS

Standard ranges	from 300kN to 2500kN (30 to 250 tonnes)
Accuracy	on all ranges ±0.5% full scale
Repeatability	0.02% full scale
Sensitivity	2mV/V ±0.1%
Excitation	2-15VDC
Output Signal	voltage or 4-20mA
Temperature range	-10 to +70°C
Over-range capacity	150% full scale
Ingress protection	IP67



VIBRATING WIRE LOAD CELL

APPLICATIONS

The Vibrating Wire Load Cell is designed for the measurement of compressive and tensile loads in rock bolts. All cells are manufactured with a centre hole to accommodate rock bolts, tendons or anchor cables. For use as a solid centre load cell the instrument can be supplied with top and bottom load plates. Applications include:

- Structural beams and piles
- Tunnel lining segments and arch tunnel supports
- Internal bracing and tie-backs in deep excavations

FEATURES

- Accurate, robust with long term stability
- 3 to 6 gauges utilised depending upon the cell capacity
- High quality alloy steel, precisely machined and heat treated to provide a stable load bearing ring
- Effects from uneven and eccentric loads can be minimised
- Cables are strong, screened, flexible and can exceed 1km in length
- Fitted with thermistor to account for effect of temperature variations on the cell

SPECIFICATIONS

Standard ranges	from 100kN to 5000kN (10 to 500 tonnes)
Accuracy[1]	±0.25% full scale
Resolution[2]	0.025% full scale minimum
Temperature range	-20 to +80°C
Over-range capacity	150% full scale
Excitation method	pluck or sweep
Frequency range	2200Hz to 2800Hz
Ingress protection[3]	IP66
Thermistor	Type NTC 3k
Accuracy[1]	±0.5°C
Resolution[2]	0.1°C

[1] System accuracy is dependent on load bearing conditions

[2] Dependent on readout

[3] Waterproof versions available to 500kPa or 1000kPa

HYDRAULIC LOAD CELL

APPLICATIONS

Anchor forces are distributed onto a tightly filled hydraulic cushion (pressure pad). The pressure in this cushion is directly proportional to the anchor force. The pressure is measured by a manometer or a pressure transducer.

Typical applications for Hydraulic Anchor Load Cells are:

- Continuing Surveillance of compressive and tensile loads in rock bolts, cable anchors and tendons
- Performance Monitoring in underground construction
- Structural beams and piles
- Loads between tunnel lining segments and arch tunnel supports
- Internal bracing and tie-backs in deep excavations
- Loads in pull-out tests on trial anchors

FEATURES

- Highly accurate, robust with good long term stability
- Vacuum filled
- No bearing plates/load distribution plates are required
- Effects of uneven and eccentric loads are minimised
- Fast response time
- Suitable for direct mechanical readout or remote reading and data-logging

SPECIFICATIONS

Standard ranges	from 0…50kN to 0…3800kN
Mechanical Version	Manometer
Accuracy	±1.0% full scale (at 23°C)
Electrical Version	Transducer with 4-20mA output signal
Accuracy	±0.5% full scale (at 23°C)
Supply Voltage	10…30 VDC
Filling medium	Glycerine/Water
Cylinder stroke	0.5mm (maximum)
Material	galvanised steel
Temperature range	-30° to +60°C

VIBRATING WIRE PRESSURE CELL

APPLICATIONS

The Vibrating Wire Earth Pressure Cells provide useful information on the direction, distribution and magnitude of total stresses within a soil mass. The cell is equally applicable for measuring stresses at the contact surface between soil and structure.

Typical applications include measurement of:

- Total stress distribution within embankments and dams
- Contact pressures on diaphragm and retaining walls, piers and abutments
- Foundation bearing pressures
- Pressures on and within linings of underground excavations
- Stresses in rock walls in unlined caverns and tunnels

FEATURES

- Accurate, reliable and robust with long term stability
- Rugged stainless steel construction
- Single and double active faces available
- Various ranges in terms of size and pressure available
- Good signal transfer with cable length in excess 1km
- Manual or automated monitoring

SPECIFICATIONS

Standard ranges	(kPa): 300; 500; 700; 1000; 1500; 2000; 3000; 4000; 6000; 10,000; 15,000
Resolution[1]	0.025% full scale (minimum)
Accuracy[2]	±0.1% full scale
Linearity[2]	±0.1% full scale
Temperature range	-20 to +80°C
Over-range capacity	150% full scale
Material	stainless steel or powder coated steel

1. Dependent on readout
2. Of the pressure transducer

VIBRATING WIRE CONCRETE STRESS CELL

APPLICATIONS

For the measurement of tangential and radial stresses in concrete and shotcrete tunnel linings:

- Pressures on and within linings of underground excavations
- Monitoring of the stress distribution within the rock

FEATURES

- A compensation tube is incorporated to expand the cell to offset effects of concrete hydration shrinkage
- Accurate, reliable and robust with long term stability
- Vibrating Wire technology allows for long cable lengths of over 1km
- Low, medium and high pressure ranges available
- Stainless steel cell construction
- Internal thermistor to monitor temperature variations
- Oil filled
- Readings can be taken with Vibrating Wire readouts, recorders or dataloggers

SPECIFICATIONS

Standard ranges	(kPa): 300; 500; 700; 1000; 1500; 2000; 3000; 4000; 6000; 10,000; 15,000
Resolution[1]	0.025% full scale (minimum)
Accuracy[2]	±0.1% full scale
Linearity[2]	±0.1% full scale
Temperature range	-20 to +80°C
Over-range capacity	150% full scale
Material	stainless steel

1. Dependent on readout
2. Of the pressure transducer

PUSH-IN VIBRATING WIRE PRESSURE CELL

APPLICATIONS

The Vibrating Wire Push-In Pressure Cell is suitable for measuring total earth pressures in clay soils. The incorporation of a Vibrating Wire Piezometer enables pore water pressure to be measured and therefore the effective stress can be determined. Used to monitor changes in earth pressure associated with the construction of excavations, embankments and dams.

Other applications include:

- Radial, horizontal and vertical stresses around tunnels
- Total pressure within tailings dams
- Foundation bearing pressures
- The measurement of in-situ stresses in the ground prior to any construction

FEATURES

- Accurate, reliable and robust with long term stability
- Various ranges available
- Strong, screened and flexible connecting cable can be in excess of 1km in length
- Full datalogging capability allows rapid data storage on site or remotely
- Oil filled

SPECIFICATIONS

Standard ranges	(kPa)300; 500; 700; 1000; 1500; 2000; 4000
Resolution[1]	0.025% full scale
Accuracy[2]	±0.1% full scale
Linearity[2]	±0.5% full scale
Temperature range	-20 to +80°C
Over-range capacity	150% full scale
Material	powder coated steel cell

1. Dependent on readout
2. Of the pressure transducer

STRESS MONITORING STATIONS

APPLICATIONS

Stress Monitoring Stations comprise Total Pressure Cells (TPC) which are permanently installed in boreholes for measuring absolute stresses and stress changes in the ground. Typical applications are:

- Dimensional measurements of stress and stress changes during tunnel advance in TBM tunneling
- Deep Injection/Grouting of Shafts, etc
- Monitoring of the stress distribution within rock or soil

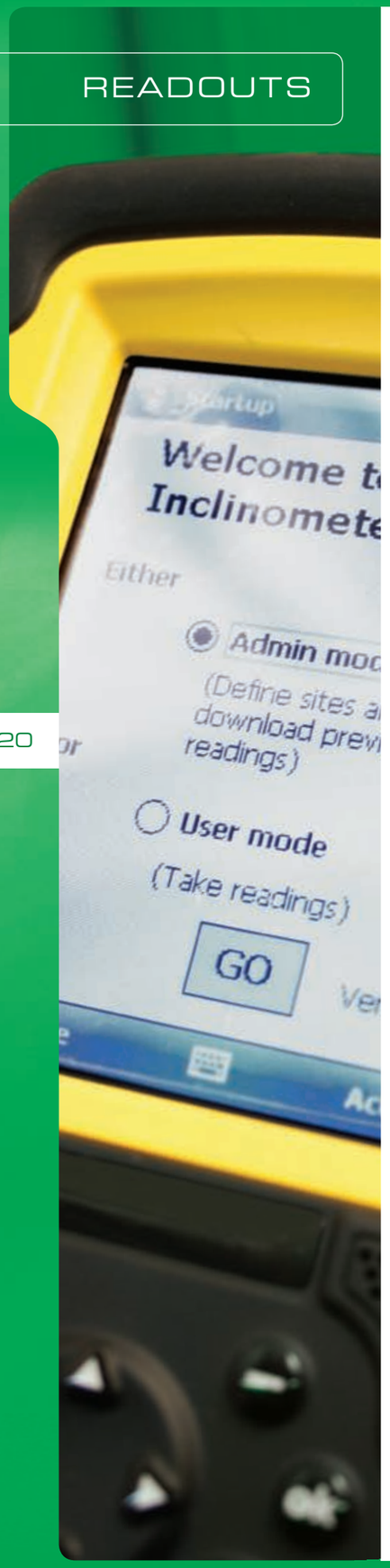
FEATURES

- Accurate, reliable and robust with long term stability
- Different layouts/ versions available (use of circular, tangential and/ or radial TPC)
- Measurement parallel to borehole axis and/or perpendicular to borehole axis in different directions possible
- Low, medium and high pressure ranges available
- Frequency (VW) or 4-20mA Sensors available
- Readings can be taken with Portable readouts, recorders or dataloggers
- Stress Monitoring Stations can be equipped with additional Piezometer

SPECIFICATIONS
Stations with VW Sensors

Standard ranges	(bar): 3,5; 5; 7; 15; 40; 210
Accuracy	±0.1% full scale
Linearity	±0.5% full scale
Resolution[1]	0.025% full scale (minimum)
Over range	2x range
Temperature range	-10 to +60°C
Output Signal	Frequency (VW → see above) 4-20mA Sensors available on request

1. Dependent on readout



VIBRATING WIRE DATA RECORDER

APPLICATIONS

The Vibrating Wire Data Recorder is designed to measure most types of commercially available Vibrating Wire instruments requiring a sweep excitation signal.

The recorder is robust and designed for use in harsh environments. A backlight is incorporated into the display for use in low light conditions.

It is capable of storing and displaying the frequency signal from the instruments in either Hz or F^2/1000.

The data recorder will also simultaneously measure the thermistor which is commonly incorporated into Vibrating Wire instruments and display the reading in °C.

FEATURES

- User selectable excitation ranges
- Date and time stamped data recording
- Storage capacity for 1920 reading sets
- Rechargeable battery
- Auto switch off after 15 minutes of non use
- The data recorder and associated electronics are housed in a shock-resistant and water-resistant case so it is well suited for harsh

SPECIFICATIONS

Excitation range	400Hz-6kHz 5 volt square wave
Excitation type	6 user selectable frequency sweep ranges
Accuracy	±50ppm
Battery capacity	24 hour continuous use
Resolution	0.1 in Hz and F^2/1000
Data recording units	Hz, F^2/1000
Operating temperature	-10 to +50°C
Reading storage capacity	1920 data sets
Communication port	RS232
Thermistor type	3kΩ
Thermistor range	-50 to +150°C
Thermistor accuracy	±0.5°C
Thermistor resolution	0.1°C

VIBRATING WIRE BLUETOOTH DATA RECORDER

APPLICATIONS

The handheld Bluetooth Vibrating Wire Data Recorder is capable of reading most commercially available Vibrating Wire instruments. Portable and able to read, record and display in engineering units.

FEATURES

- Adaptive sweep range
- Data recording and display in Hz, Period, F^2/1000 and engineering units
- Temperature correction of Vibrating Wire sensors
- Date and time stamped data recording
- Storage capacity for over 1,000,000 readings
- AA replaceable batteries
- Auto switch off
- Advanced user interface using a PDA
- Site, location and sensor indent management
- Open circuit detection
- Audio output
- Well suited for harsh environments

SPECIFICATIONS

Excitation range	400Hz-6kHz, 5 volt square wave
Excitation type	adaptive sweep range
Accuracy	±50ppm
Resolution	0.1 in any frequency units and 0.01 in any of the selectable engineering units
Data recording units	Hz, period, F^2/1000 and engineering units
Operating temperature	-10 to +50°C
Programmable instrument channels	>1000
Reading data sets storage capacity	>1,000,000
Communication ports	USB or sync port
Thermistor type	3kΩ
Thermistor range	-50 to +150°C
Thermistor accuracy	±0.5°C
Thermistor resolution	0.1°C

VIBRATING WIRE HANDHELD READOUT

APPLICATIONS

The Vibrating Wire Readout is a highly portable, lightweight and robust unit capable of reading most commercially available Vibrating Wire instruments. It is designed for one-handed operation for ease of use. Four independent sweep ranges are selected via the front panel and the readings can be displayed in Hz, F^2/1000 or period units.

FEATURES

- Readout in frequency, frequency squared and period units
- Four sweep ranges
- Reads temperature thermistors (3kΩ type)
- Auto switch off after 15 minutes of non use
- Powered by rechargeable/replaceable AA batteries
- Backlit display for night operation
- IP67 rated enclosure, encased in a protective rubber jacket ensuring the unit can survive the harshest of conditions

SPECIFICATIONS

Excitation range	450Hz-6kHz, 5 volt square wave
Excitation type	frequency sweep via 4 user selectable ranges
Accuracy	±1Hz
Resolution	0.1 of selected display units
Display units	Hz, period, F^2/1000
Operating temperature	-10 to + 50°C
Thermistor type	3kΩ
Thermistor range	0 to +60°C
Thermistor accuracy	±0.5°C
Thermistor resolution	0.1°C

4-20MA SENSOR HANDHELD READOUT

APPLICATIONS

The 4-20mA sensor handheld readout is a portable, lightweight and robust unit capable of reading all commercially available two-wire 4-20mA instruments. It is designed for one-handed operation for ease of use.

FEATURES

- Readout in mA
- Cost effective
- Compact case with protective holster
- Robust (1m drop test)
- Powered by rechargeable/ replaceable 9V AA batteries
- Removable battery door for quick battery replacement
- Simultaneous mA and % of span display

SPECIFICATIONS

Range	0mA to 24mA
Resolution	0.001mA
Accuracy	0.02% of reading + 2 counts
Loop Power while measuring mA	24V
Battery Life	18 hours typical, at 12 mA
Operating temperature	-10 to + 55°C
Operating altitude	3.000mtrs maximum

TERMINAL BOXES

APPLICATIONS

INTERFELS produces various types of terminal boxes according to project requirements. These are able to be used with almost any type of sensor.

SMALL TERMINAL BOX – NON-SWITCHING

- These boxes are inexpensive units for terminating Vibrating Wire, thermistors and 2 wire type instruments
- Manufactured to cater for 1 to 6 instruments

SWITCHED TERMINAL UNIT

- For Vibrating Wire, thermistors and other 2 wire type instruments.
- Composed from epoxy fibreglass with lockable-hinged door, sealed with a Neoprene gasket
- Equipped with a rotary switch to select the correct transducer. Standard units cater for 12, 24 or 48 instruments

JUNCTION BOX

- For projects that require cables from multiple instruments to be integrated into a multicore cable. Standard units cater for 12, 24 or 48 instruments

TERMINAL/JUNCTION BOX-SWITCHING

- For projects that require multiple instrument cables to be integrated into a single multicore cable but also have the ability to take manual readings at this point
- Surge protection units are available on request
- Non standard terminal units and junction boxes can be produced to suit customers' special requirements

HYDROSTATIC PROFILE GAUGE

APPLICATIONS

The Hydrostatic Profile Gauge (HPG) comprises of a portable probe which is drawn through an access tube buried beneath an embankment or structure in order to monitor settlement or heave. This is particularly useful where large movements might be expected during or after construction such as on dams, roads, railways and storage tanks.

FEATURES

- Wireless Bluetooth communication between the sensor and the PDA (Personal Digital Assistant) offering fast and simple data gathering
- For determination of settlement or heave profiles
- Enhanced PDA software offers ease of use and full data security
- The PDA will easily interface with most office systems and applications
- Surface mount electronics ensure long and trouble-free use in a site environment
- Special borehole lining (e.g. inclinometer casing) is not required

SPECIFICATIONS

Range	+1m to -3.5m
Resolution	1mm
Accuracy	±10mm
Repeatability[1]	±10mm
Operating temperature	-10 to +50°C

[1] Dependent on operator experience

MECHANICAL SETTLEMENT SYSTEM

APPLICATIONS

Mechanical Settlement Systems are simple instruments used to monitor:

- Settlement in the ground beneath surcharges or embankments
- Measurement and monitoring the settlement of individual soil layers
- Heave (uplift) resulting from excavation or grouting
- Settlement associated with dewatering
- Subsidence in marine fills/land reclamation

FEATURES

- Low costs
- Reliable, simple to install and read
- Readout by optical survey of the top of the inner pipe or bymeasuring the length of added tube
- Monitoring of settlement parallel to construction progress
- Various sizes of settlement plates available
- Different lengths of stainless steel measuring rods available
- Measuring rods can simply be added to extend the measuring point
- Adapter for optical targets available

SPECIFICATIONS

Settlement Plate-Dimensions	300x300m, reinforced
Settlement Plate-Material	stainless steel
Measuring rods-Dimensions	Diameter 14mm, M12 thread, 0.5m; 1.0m; 1.5m lengths
Measuring rods-Material	stainless steel
Protective Tubing	PEH, 20x2mm
Measuring head-Material	stainless steel
Adapter	M12 to 3/8"

VIBRATING WIRE SETTLEMENT CELL

APPLICATIONS

Vibrating Wire Settlement Cells are particularly useful where high levels of settlement or heave of soil might be expected; be it in a borehole or in a fill material. Typical applications include:

- Controlling the construction progress of road embankments and earth dams
- Measurement and monitoring the settlement of individual soil layers
- Settlements under storage tanks, buildings, land bridge piers
- Deformations of soil due to tunnelling and mining
- Settlement associated with dewatering
- Subsidence in marine fills

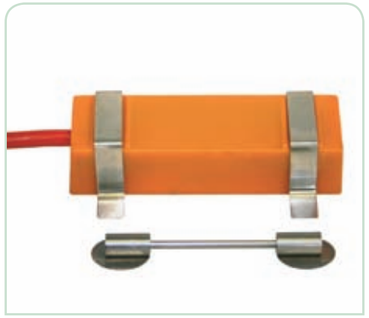
FEATURES

- Reliable, simple to install and read
- No vertical rods or tubes to interfere with construction
- Manual or automated monitoring
- Measurements can be made beneath concrete and earth structures at locations, which are inaccessible to other types of instruments
- Available in borehole and trench type with ranges of 15m and 30m

SPECIFICATIONS

Ranges	(kPa): 150; 300
Materials	PVC case, 316 grade stainless steel sensor
Accuracy	±0.1% full scale
Linearity	±0.1% full scale
Resolution[1]	0.025% full scale (minimum)
Over range	200% full scale
Diaphragm displacement	< 0.001 cm^3
Temperature range	-20 to +80°C

[1] Dependent on readout



VIBRATING WIRE SPOT WELDABLE STRAIN GAUGE

APPLICATIONS

Used for measuring strain in steel members, the strain gauge can be spot welded to load bearing beams, struts, sheet pile walling and tendons. The gauge is adjustable to suit compression or tension.

For the measurement of strain in steel structures including:

- Piles
- Beams
- Bridges
- Reinforcement bars
- Tunnel linings
- Suspension bars

FEATURES

- Removable coil unit
- Small, low profile design
- Accurate, easy to use with excellent long term stability
- Can be used with long cable lengths with no degradation of signal
- Thermistor incorporated in coil housing
- Suitable for remote reading and datalogging
- Over-voltage surge arrestor fitted to protect against electrical damage

SPECIFICATIONS

Range	3000 microstrain
Resolution[1]	0.4 microstrain
Accuracy	±0.5% full scale
Temperature range	-20 to +80°C
Active gauge length	50.4mm
Sensor material	stainless steel
Waterproof	to 700kPa

[1] Dependent on readout

VIBRATING WIRE ARC WELDABLE STRAIN GAUGE

APPLICATIONS

Used for measuring strain in steel members, load bearing beams, tunnel segments, struts, sheet pile walling and tendons.

The gauge is adjustable to suit compression or tension.

For the measurement of strain in steel structures such as:

- Piles
- Beams
- Bridges
- Reinforcement bars
- Tunnel linings
- Suspension bars

FEATURES

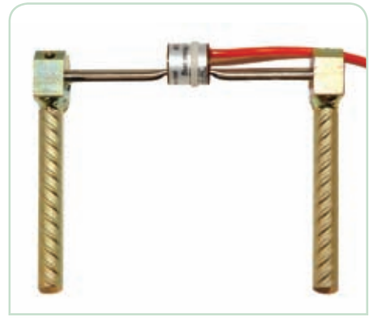
- Robust, reliable and easy to use
- Can be used with long cable lengths with no degradation of signal
- The gauge is low profile for installation on rebar and areas where clearance is limited
- Strain gauge can be adjusted to allow for the most effective use of its range
- Thermistor incorporated in coil housing
- Suitable for remote reading and datalogging

SPECIFICATIONS

Range	3000 microstrain
Resolution[1]	1 microstrain
Accuracy[2]	±0.1% full scale
Temperature range	-20 to +80°C
Active gauge length	141.4mm
Sensor material	stainless steel

[1] Dependent on readout

[2] ±0.1% full scale with individual calibration, ±0.5% full scale with standard batch calibration



VIBRATING WIRE CONCRETE SURFACE MOUNT STRAIN GAUGE

APPLICATIONS

For the measurement of strain in reinforced or mass concrete structures, including:

- Concrete members and struts
- Bridges & dams
- Piles and mass concrete
- Monitoring of strain due to load
- Monitoring strain and load during construction and service life

FEATURES

- Robust, reliable and easy to use
- Strain gauge held with groutable mounting blocks
- Can be used with long cable lengths with no degradation of signal
- Strain gauge can be adjusted to allow for the most effective use of the range
- Thermistor incorporated in coil housing
- Suitable for remote reading and datalogging

SPECIFICATIONS

Range	3000 microstrain
Resolution[1]	1 microstrain
Accuracy[2]	±0.1% full scale
Temperature range	-20 to +80°C
Active gauge length	141.4mm
Sensor material	stainless steel

[1] Dependent on readout

[2] ±0.1% full scale with individual calibration, ±0.5% full scale with standard batch calibration

VIBRATING WIRE REBAR/SISTERBAR STRAIN GAUGE

APPLICATIONS

The Vibrating Wire Rebar and Sisterbar Strain Gauges are designed to measure the strain in concrete. Both consist of a coil assembly and Vibrating Wire element with rebar extensions at both ends. Rebar Strain Gauges are welded into the re-inforcing cage while Sisterbars can be installed alongside existing lengths of rebar within the cage.

Primarily designed to be directly embedded in structures including:

- Mass concrete structures
- Caissons and cast in place concrete piles
- Diaphragm and slurry walls
- Concrete beams
- Bridges
- Foundation slabs

FEATURES

- Robust, reliable, waterproof and easy to use
- Can be used with long cable lengths with no degradation of signal
- Suitable for remote reading and datalogging
- Thermistor incorporated in coil housing

SPECIFICATIONS

Range	1000/1500 microstrain
Resolution[1]	0.4 microstrain
Accuracy	±0.3% full scale
Temperature range	-20 to +80°C
Length	900mm
Rebar diameters	16mm to 40mm
Sisterbar diameter	12mm
Material	steel

[1] Dependent on readout

VIBRATING WIRE EMBEDMENT STRAIN GAUGE

APPLICATIONS

The Vibrating Wire Embedment Strain Gauge is used for measuring strain in concrete structures and is suitable for direct burial. Also used in:

- Piles
- Concrete beams and columns
- Bridges
- Tunnel segments
- Concrete foundation slabs

FEATURES

- Robust, reliable and easy to use
- Can be used with long cable lengths with no degradation of signal
- The gauge is low profile for installation to reduce the “inclusion effect”
- Suitable for remote reading and datalogging
- Thermistor incorporated in coil housing

SPECIFICATIONS

Range	3000 microstrain
Resolution[1]	1 microstrain
Accuracy[2]	±0.1% full scale
Temperature range	-20 to +80°C
Active gauge Length	150mm
Sensor material	stainless steel

[1] Dependent on readout

[2] ±0.1% full scale with individual calibration, ±0.5% full scale with standard batch calibration

VIBRATING WIRE TEMPERATURE SENSOR

APPLICATIONS

Highly accurate instrument for measuring temperature in concrete, soil and rock including:

- Monitoring the temperature during the curing of concrete
- Soil and rock temperature adjacent to ground freezing operations and liquid gas storage tanks
- Interpretation of temperature effects on other installed instruments
- Measurements of water temperatures in reservoirs and boreholes
- Air temperature measurements on structure surfaces
- Interpretation of temperature related stress and volume changes in dams

FEATURES

- Accurate, robust, high resolution and good long-term stability
- Manual or remote readings
- Suitable for remote reading, scanning and datalogging
- Strong, screened and flexible connecting cable can exceed 1km

SPECIFICATIONS

Range	-20 to +80°C
Accuracy	±0.5% full scale
Resolution[1]	0.03°C
Material	stainless steel

[1] Dependent on readout

RESISTANCE TEMPERATURE SENSORS (PT100; AD592)

APPLICATIONS

Resistance Temperature Sensors are used for the measurement of temperature in air, water, concrete, rock and soil including:

- Monitoring temperature evolution during concrete curing
- Soil and rock temperatures adjacent to ground freezing operations and liquid gas storage tanks
- Measurement of water temperatures in reservoirs and in boreholes
- Monitoring seasonal variations of temperature within the ground and structures
- Air temperature measurements on structure surfaces
- Interpretation of temperature related stress and volume changes in mass concrete structures (dams, etc.)
- Determination of critical moment for injecting of joints within mass concrete structures, such as concrete dams and storage tank bases

FEATURES

- Accurate, robust, high resolution and good long-term stability
- Different designs for various measuring purposes available
- Robust housings
- Cost effective (AD592)
- Suitable for either manual or data-logged reading (Pt100)

SPECIFICATIONS

Pt100

Range	-50 to +150°C
Accuracy	±0.1°C
Resolution[1]	0.05°C
	4-wire resistance or
	4-20mA measurement available

AD592 (only for data-logging)

Range	-25 to +105°C
Accuracy	±0.5°C (@ 25°C)
Resolution[1]	0.15°

[1] Dependent on readout

PT100 PORTABLE READOUT

APPLICATIONS

Used for reading manually all Pt100 Temperature Sensors (Thermocouples- and Thermistor- Readout on request) for different applications such as:

- Monitoring temperature evolution during concrete curing
- Soil and rock temperatures adjacent to ground freezing operations and liquid gas storage tanks
- Interpretation of temperature effects on other installed instruments
- Measurement of water temperatures in reservoirs and in boreholes
- Monitoring seasonal variations of temperature within the ground and structures
- Air temperature measurements on structure surfaces
- Interpretation of temperature related stress and volume changes in mass concrete structures (dams, etc.)
- Determination of critical moment for injecting of joints within mass concrete structures, such as concrete dams and storage tank bases

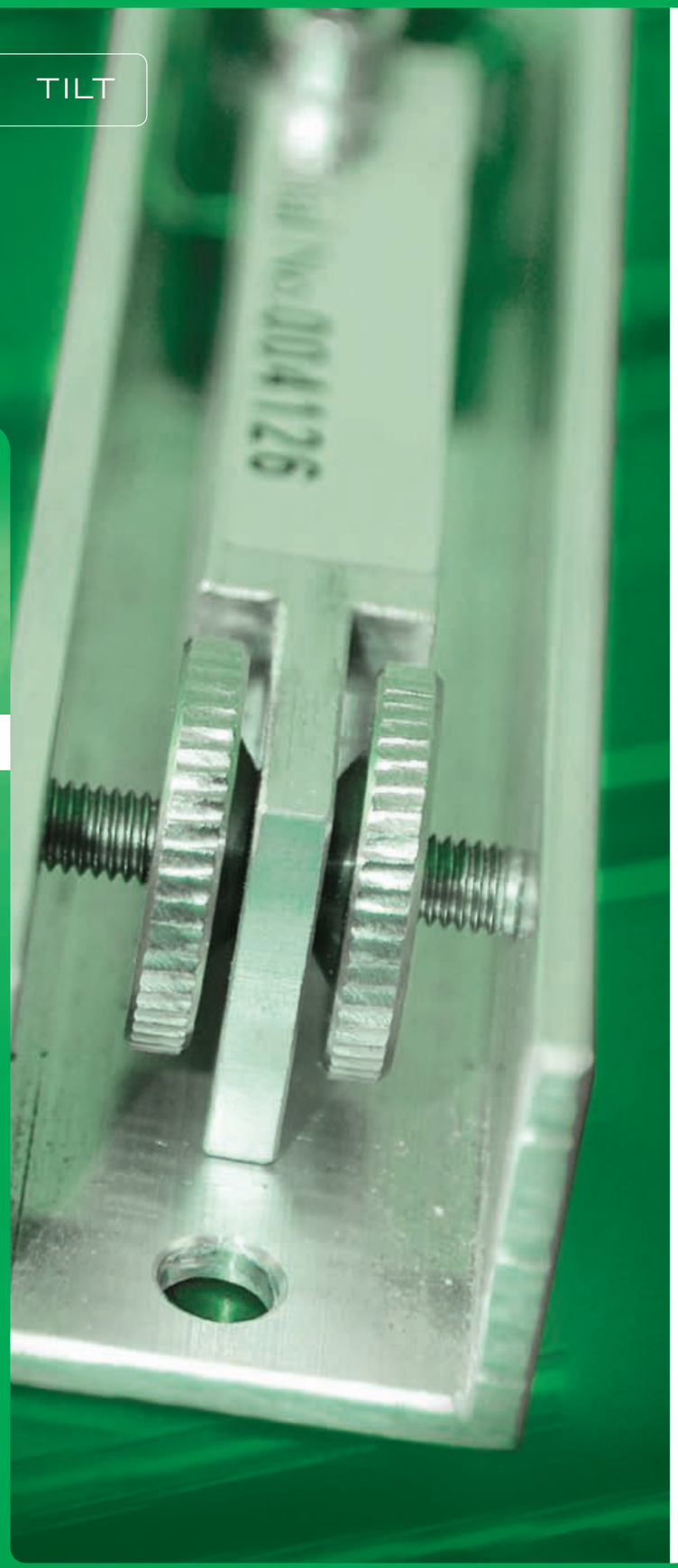
FEATURES

- Provides precise, stable readings, even in demanding environments
- Robust case, LCD Display, Auto switch-off
- °C/°F Function; wide temperature ranges
- Accurate performance: 0.2% of reading
- SpeedRead – for quicker indicative readings
- Automatic zero calibration for added accuracy
- Last settings memorised
- Long battery life (500 hours typical)

SPECIFICATIONS

Range	-150 to +800°C // -238°F to +1472°F
Accuracy	±0.2% of reading (±0.1°C/ ±0.2°F over range -150 to +800°C // -238°F to +1472°F)
Resolution[1]	0.1°C

[1] Dependent on readout



ELECTROLEVEL (EL) TILTMETER

APPLICATIONS

The EL Tiltmeter is a narrow angle, high resolution device for monitoring changes in the inclination of a structure. Applications for the Tiltmeter include:

- For example: towers and bridges
- Effects of deep excavations and diaphragm wall construction on adjacent existing structures
- Monitoring the movement and rotation of concrete dams, slope faces and crests
- Ensure stability of structures affected by tunnelling and mining activities
- Evaluating the performance of bridges and beams under load

FEATURES

- Robust, simple and reliable
- High Resolution
- Uniaxial and biaxial versions available
- Easy to Install: The compact, low profile EL Tiltmeter fits nearly anywhere.
- Remote Readout: In construction-control applications, EL Tiltmeters are connected to a data acquisition system that continuously monitors movements and can trigger an alarm when threatening movements are detected
- Cost Effective

SPECIFICATIONS

Range	±3 arc degrees/±10 arc degrees
Sensor Resolution[1]	<0.0003 arc degrees/ <0.0005 arc degrees
Sensor Symmetry@ ½ linear scale	2%
Sensor Null Repeatability	<0.0008 arc degrees/<0.001 arc degrees
Output Signal	±2.5VAC/4-20mA
Input Current (max.)	10mA/30mA
Sensor material	Ceramic
Housing material	Polyglass
Housing dimensions	110x70x70mm
Operating temperature	-20 to +70°C
Ingress protection	IP66

[1] Dependant on signal conditioner, sensor set-up and readout

ELECTROLEVEL BEAM SENSOR

APPLICATIONS

Electrolevel Beam Sensors offer an inexpensive and simple method for monitoring rotation in structures. A number of beams installed horizontally will provide a profile of vertical movements (heave or settlement) of the structure and any important differential movement can be identified. Typical applications include:

- Effects of deep excavations and diaphragm wall construction on adjacent existing structures
- Ensure stability of structures affected by tunnelling and mining activities
- Monitor deformation within tunnels including convergence
- Monitor structures undergoing foundation treatment, compensation, grouting and underpinning
- Monitor structural stability in landslide areas

FEATURES

- Robust, accurate, simple and reliable
- Can be used vertically or horizontally
- Very cost effective as compared to other settlement profiling systems
- Versatile and suitable for many applications
- Options for manual reading or fully remote datalogging

SPECIFICATIONS

Range	±45 arc minutes (±13mm/m)
Accuracy[1]	±0.1mm/m
Resolution[2]	0.02% full scale
Repeatability	±0.05% full scale
Excitation voltage	2.5VAC
Current consumption	<1mA
Output signal	ratiometric AC
Operating temperature	-20 to +50°C
Zero adjustment range	±5° fine
Adjustment	±25° coarse
Ingress Protection	IP66

[1] Accuracy within precision range (±14 arc minutes)

[2] Resolution dependent on readout (CR1000)

DIGITAL PORTABLE TILTMETER

APPLICATIONS

The Digital Portable Tiltmeter offers a versatile means for measuring tilt in almost any structure revealing potential hazards associated with structural instability. It also serves to assess any rotation caused by construction activities such as mining, tunnelling, excavation and soil compaction.

Other typical applications include:

- Monitoring rotation in buildings, dams, embankments and open pits, retaining walls, landslides, rock masses and pipelines

FEATURES

- Compact, lightweight, rugged and reliable using proven solid state electronics
- Utilisation of Bluetooth technology offers a totally cable-free solution for taking readings
- Enhanced PDA software allows defining a site with the relevant tilt-plates, taking readings, downloading data and transferring the results to a PC
- Unlimited number of monitoring points using as many inexpensive tilt-plates and only one Tiltmeter
- Heavy duty tilt-plates are dimensionally stable and weather resistant
- Easily installed with rapid data gathering by one person

SPECIFICATIONS

Range	±10°
Accuracy	±0.004°
Resolution	0.001°
Repeatability	±0.0012°
Operating temperature	-10 to +50°C
Weight	2.0kg
Dimensions	160mm x 135mm x 150mm
Battery life	>12hrs continuous use

BASSETT CONVERGENCE SYSTEM

APPLICATIONS

The Bassett Convergence System (BCS) is an effective tool in monitoring the performance of tunnels and underground openings.

The system was developed by Dr. Richard Bassett. Specific applications include:

- Ensuring safety during construction and controlling the rate of construction
- Verifying that actual performance conforms to predictions
- Monitoring the effects of nearby construction activities and any other ground movements

FEATURES

- Rapid determination of deformation profile ensures continuous safety of tunnel users
- The System is installed close to tunnel walls and can be shaped to bypass obstructions or allow extra clearance for normal traffic flow
- The BCS can complete a survey of a tunnel section, process the readingsand generate displacement data
- Data reduction, processing and presentation software is available. The software applies sensor calibration factors, performs necessary calculations and generates screen displays for up to 99 BCS rings
- Customised software displays deformation profile in near real time
- Fully automated logging system
- Insensitive to variations in the refractive index of air in the tunnel
- Tolerant to vibrations, temperature fluctuations and electromagnetic emissions
- Near real-time data

SPECIFICATIONS

Short arm Sensor

Range	±173.65mm/metre (±10 arc degrees)
Resolution	0.008% full scale
Accuracy	±0.05% full scale

Long Arm Sensor

Range	±34.9mm/metre (±2 arc degrees)
Resolution	0.008% full scale
Accuracy	±0.05% full scale

VIBRATING WIRE PIEZOMETER

APPLICATIONS

The Vibrating Wire Piezometer is used for the long term, accurate measurement of pore water pressures in partially or fully saturated soils or rock. Typical applications include:

- Monitoring pore water pressures to determine slope stability
- Monitoring pore water pressures to determine safe rates of fill or excavation
- Monitoring the effects of dewatering systems used for excavations
- Monitoring pore pressures to check the performance of earth fill dams and embankments
- Map subsurface water flow and to predict both the volume of water in an aquifer and its recharge rate

FEATURES

- Application specific versions are available for installation in soil, boreholes and open wells or for placement in fill material
- Accurate, reliable and robust with long term stability
- Rapid Response
- All VW Piezometers are equipped with a Thermistor
- Good signal transfer with cable length in excess 1km
- Manual or automated monitoring

SPECIFICATIONS

Standard ranges	(bar) 3.5; 5; 7; 10; 15; 20; 40
Material	316 grade stainless steel
Accuracy	±0.1% full scale
Linearity	±0.5% full scale
Resolution	0.025% full scale (minimum)
Over range	2x range
Filter Types	Sintered stainless steel 50μ (borehole/push in P.)/ Ceramic 1μ (embankment P.)
Diameter	27mm (borehole); 35mm (push in), 38mm (embankment)
Lengths	200mm (borehole); 270mm (push in); 210mm (embankment)
Temperature range	-10 to +60°C

4-20MA BOREHOLE PIEZOMETER

APPLICATIONS

The INTERFELS 4-20mA Piezometers are designed for accurate measurement of pore water pressures in fully or partially saturated soil and rock. The borehole version is a general purpose Piezometer. Typical applications include:

- Monitoring pore water pressures to determine safe rates of fill or excavation
- Monitoring the effects of dewatering systems used for excavations
- Monitoring pore water pressures to determine slope stability
- Map subsurface water flow and to predict both the volume of water in an aquifer and its recharge rate
- Monitor streams for forestry, agriculture, power companies and metropolitan water districts
- Monitor tidal effects on coastal soils

FEATURES

- Piezometer comprises a porous/ sintered stainless steel filter tip element integral with a diaphragm type piezoresistive pressure transducer
- Sensor and electronics are stored in proof stainless steel housing
- 4-20mA borehole Piezometer is available for absolute and for relative (no barometric reference measurements required) measurement
- Piezometer for absolute measurements is equipped with a Thermistor

SPECIFICATIONS

Standard ranges	(bar) 1; 2; 5; 10; 20 (PR + PAA)
Material	316 grade stainless steel
Accuracy	±0.25% full scale
Supply voltage	12-30VDC
Output Signal	4-20mA
Filter Type	sintered stainless steel
Filter Size	50μ
Dimensions	22mm diameter, 160mm length
Weight (without cable)	300g
Temperature range	-10 to +80°C

PNEUMATIC PIEZOMETER

APPLICATIONS

Placed in boreholes or embedded infill materials, the Pneumatic Piezometer is a low cost instrument used for the measurement and control of water pressures in soil and rock, including:

- Stability investigations of natural and cut slopes
- Control of permeability testing, de-watering and drainage
- Monitoring water table elevation
- Construction control and stability monitoring of tunnels and other underground works
- Stability monitoring of foundations, embankments and dams

FEATURES

- Short response time even in low permeability soils such as clay
- Excellent stability
- High and low air entry filters available
- Simple, accurate and reliable design with over 50 years of use worldwide

SPECIFICATIONS

Range	from -5m to +100m head of water
Accuracy	±2% full scale
Filters	ceramic, 60 micron and 1 micron

Total system accuracy is limited by the type of readout used

STANDPIPE PIEZOMETER

APPLICATIONS

Standpipe Piezometers offer a simple and economic method for measuring water pressures in soil and rock.

Typical applications include monitoring of water pressures for the control or assessment of:

- Stability of natural or cut slopes
- Performance of vertical drains, sand drains, and dynamic compaction
- Dewatering and drainage schemes
- Performance of earthfill dams and embankments
- Containment systems at landfills and tailings dams
- Seepage and ground water movements in embankments, landfill dykes and dams
- Uplift pressures in dams or other foundations when fitted with a Bourdon Gauge

FEATURES

- Simple and reliable long term measurement of pore water pressures
- Manual reading using water level meters or automated reading by installing a pressure transducer down the standpipe
- Maintenance possible using downhole video cameras
- In conjunction with Bourdon type gauges allows measurement of uplift or artesian pressures

SPECIFICATIONS

Porous plastic tip	
	300/1000mm x 32mm diameter
	60 micron filter
Drive-in tip	300mm x 43mm diameter
	60 micron filter

WATER LEVEL INDICATOR

APPLICATIONS

For the measurement of water levels in wells, open standpipes and boreholes in soils and rock, including:

- Site investigations
- Water levels in open boreholes
- Control of dewatering and drainage operations
- Hydrological and hydro-geological investigation of water resources
- Stability investigations of natural and cut slopes
- Pollution and environmental studies
- Pumping tests

FEATURES

- Shrouded probe available in 12mm and 16mm diameters
- Reliable, simple to operate and read
- Visual or audio indication when probe makes contact with the water
- Battery operated, lightweight, portable and robust
- Design of tape prevents sticking to borehole sides
- Components are protected against corrosion and mechanical damage
- One instrument reads at many locations
- Replacement tape available

SPECIFICATIONS

Probe type	shrouded
Probe diameters	12mm and 16mm
Probe length	230mm
Material	stainless steel
Tape material	steel/polypropylene coated
Width	9.4mm
Graduations	mm/cm/m
Indicators	audio & visual
Sensitivity control	internal
Battery life	12 hours continuous use
Reel material	steel frame/polypropylene hub

WATER LEVEL LOGGER

APPLICATIONS

The water level logger is an autonomous battery powered instrument designed to record pressure/ water depth and temperature over long periods of time. Typical applications for the water level logger are:

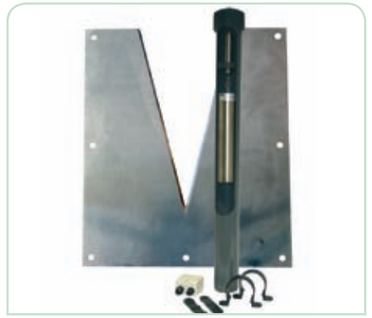
- Environmental projects
- Mining and open-pit mining
- Construction sites, Tunnelling projects
- Monitoring of aquifers, Pumping tests
- Water reservoirs, Lakes and rivers

FEATURES

- Small diameter: The Ø22mm diameter allows installation in 1" monitoring wells
- Compensated version available
- Battery Life: The lithium battery allows 10-year operation based on one reading per hour
- Reading capacity: The Water level logger allows 28000 readings (up to 57000 under certain conditions) to be stored in its memory
- Intelligent: The intelligent memory management software allows readings to be recorded only when it is required (at pre-set events or changing water levels).
- Easy of use: The lithium battery is field replaceable and the software is easy to understand

SPECIFICATIONS

Standard ranges	0.8-2bar, 0.8-3bar, 0.8-6bar, 0.8-11bar (compensated 0.8-1.8bar, 0.8-2.3bar)
Material	316 grade stainless steel
Error band	0.05% full scale typical to 0.1% full scale max.
Linearity	0.02% full scale typical
Resolution	0.0025% full scale maximum
Accuracy of Temperature Sensor	±0.5
Output	RS485, digital
Diameter	22mm
Weight (without cable)	360g
Temperature range	-10 to +40°C



V-NOTCH WEIR MONITOR

APPLICATIONS

V-Notch (triangular) Weirs are typically installed in open channels such as streams to determine discharge (flow rate). They are ideally suited to the long term monitoring of drainage systems in dams & tunnels.

The main component beneath the weir plate itself is on the one hand a cylindrical weight suspended from a Vibrating Wire force transducer. With a change in water level the changing buoyancy force on the cylinder acts directly on a Vibrating Wire transducer. Alternatively an Ultrasonic Water Level Sensor (distance transducer) can be used.

FEATURES

- Simple low cost and robust instrument
- Manual Readout possible
- Ultrasonic Water Level Transducer (4-20mA output)
- Vibrating Wire precision water level sensor (frequency output)
- Accurate and sensitive water level monitoring
- Low maintenance system
- Easy to automate via data acquisition and ARGUS monitoring software

SPECIFICATIONS

Ultrasonic Water Level Sensor

Range	can be calibrated between 100mm and 800mm
Resolution[1]	0.25mm
Repeatability	0.2/1mm
Linearity	<0.5% full scale
Operating temperature	-20 to +70°C
Output Signal	4-20mA
Beam Angle	8°

VW Buoyancy Water Level Sensor

Range	300mm
Resolution[1]	0.025% full scale (minimum)
Accuracy[1]	±0.5% full scale
Linearity	±0.5% full scale
Operating temperature	+5 to +60°C
Dimensions	(sensor only) 150 x 32mmØ
Weight	(sensor only) 600g

[1]. Dependent on readout

FURTHER INSTRUMENTS/ SERVICES AVAILABLE FROM INTERFELS

- Weather Stations
- Wireless Sensors
- Liquid Leveling Systems
- Seismic Measurement
- Vibration Measurement
- In-Situ Instruments
- Geodetic Equipment
- Hydrometric Equipment
- Rentals
- Technical Services

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